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STUDY TO ASSESS THE EFFECTS OF DIFFERENT SLOT ALLOCATION SCHEMES

A Report for the European Commission, DG TREN

Project Team: *Ian Jones, Stuart Holder, Jan Peter van der Veer, Emily Bulman,*
Neil Chesters, Simon Maunder, Dr Philip Kalmus, Dr Soren Sorensen,
Federica Maiorano, Dr Pablo Mendes de Leon, Professor Piet-Jan Slot,
Peter Somers

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EXECUTIVE SUMMARY

Background

This report, by National Economic Research Associates (NERA) in conjunction with the Faculty of Law at the University of Leiden and Consultair Associates, examines the feasibility and likely impact of using market mechanisms to allocate slots at congested EU airports.

There is significant excess demand for slots at a number of EU airports. Among the 30 or so EU Category 1 airports:

* seven airports experience excess demand for slots throughout the day – these are Düsseldorf, Frankfurt, London Gatwick, London Heathrow, Madrid, Milan Linate and Paris Orly. In some cases, this situation is partly due to environmental restrictions or air traffic distribution rules;

* a further 14 airports experience excess demand for slots at certain times of the day.

While planned investments may ease the situation somewhat at Düsseldorf, Frankfurt and Madrid, these airports will still have excess demand at certain times of the day. For Category 1 airports as a whole, moreover, the general extent of excess demand is expected to increase over the next five years.

Despite this excess demand, the effect of the current EU slot regulation (95/93) is that existing users of these airports enjoy grandfather rights in relation to their current slot holdings. While the regulation provides for 50 per cent of any slots not subject to grandfather rights to be allocated to new entrants, and the remainder allocated according to administrative criteria, there are usually very few slots available from this "pool". It is therefore difficult for airlines to obtain slots in order to introduce new or more frequent services.

The fact that existing airport charges fail to reflect the scarcity value of slots means that they may be allocated to services that are barely profitable at the current level of airport charges. Airlines that might be able to use these slots more efficiently (for example, because their services would carry more passengers or generate more profits), and would therefore be willing to pay considerably more than the current level of charges, may nevertheless be unable to get hold of any slots.

In addition, the fact that airlines only pay charges based on their actual use of slots means that they have poor incentives to use slots efficiently. Some slots therefore remain unused, even at congested airports - either because they are returned late to airport co-ordinators (and cannot be reallocated) or because airlines simply fail to use their full allocation of slots.

The Role of Market Mechanisms

Market mechanisms have the potential to address these inefficiencies by confronting airlines with the cost of occupying scarce capacity. This occurs in one of two ways:

- under primary trading mechanisms, such as auctions or higher posted prices, airlines have to pay for their slots. Both mechanisms aim to ensure that slots are allocated to the airlines that value them most, and they seek to achieve this by setting prices sufficiently high that other airlines are no longer interested in those slots;

- under secondary trading, airlines are able to buy and sell slots. Though existing slot holders do not have to pay for their slots, they nevertheless face an "opportunity cost" in the form of the revenues they forego if they carry on using a slot that could be sold instead to another airline.

If market mechanisms were introduced at congested EU airports, we believe that higher passenger volumes would use existing airport facilities for the following reasons:

- a shift in the mix of services using congested airports, notably an increase in the proportion of long haul services, which, compared to short haul services, generally use larger aircraft, carrying a higher number of passengers, and often at higher load factors;

- within each category of service, a general shift to services with higher load factors. Within short haul services, for example, some regional services and services operated by full service carriers other than the hub carrier will be withdrawn, and more services will be operated by low cost carriers. Some of the least profitable long haul services will also be withdrawn;

- where possible, airlines will shift services to off-peak times or to uncongested airports. This is most likely to affect charter services and perhaps some long haul services, and will free up peak capacity for other services. For many services, however, shifting to off-peak times or uncongested airports will not be a realistic option;

- slot utilisation will also improve, as the increased fixed costs (including opportunity costs) of holding slots will encourage a more intensive use of slots by reducing the incidence of late slot returns and cancellations. In addition, the increased cost of slots at congested airports is likely to discourage airlines from holding onto more slots than they need (which they can do at present, provided they do not breach the 80-20 rule).

Taking account of both the shift in traffic patterns and the improved utilisation of slots, our illustrative calculations suggest that these factors could increase passenger numbers

at Category 1 airports by approximately 7 per cent. But for the reasons set out below, it is unlikely that any specific market mechanism will deliver all of this increase.

While service levels on some routes will be cut, other routes may gain both from increased service levels and also from stronger and more effective competition (either from entrants on long haul routes or from low cost carriers on short haul routes). The cases where service levels are increased will more than offset those where services are reduced, and consumers will benefit from the increased volume of flights and from higher levels of service.

This increase in services, combined with stronger competition on some routes, is likely to put downward pressure on airfares. These impacts are unlikely to be offset by the effect of higher slot costs, as these are mainly fixed costs and will not therefore affect the long run profit maximising fares structure for airlines. We therefore expect market mechanisms to lead to lower fares on average.

Potential Mechanisms

We have examined the potential ability of specific market mechanisms to deliver these improvements, and also the implementation costs and other effects of each mechanism.

Secondary trading

Under secondary trading, airlines have the ability to buy and sell slots from each other. As a secondary mechanism, it operates only after an initial (or "primary") allocation has been established. It can also be applied, therefore, alongside the primary allocation mechanisms discussed below. But in the absence of a primary mechanism, any new slots will continue to be allocated on the basis of administrative criteria.

We envisage that trading would take place as a result of bilateral negotiations between potential buyers and sellers. There might be a risk that deals would not take place, either because buyers and sellers could not identify each other or because airlines were reluctant to sell slots to their competitors. The first of these problems might be reduced in several ways, including the potential for independent agents to act as facilitators and to remain aware of each airline's willingness to buy or sell slots. And the second is less likely to occur in practice, as we would expect most of the potential slot sellers to be airlines that do not have such concerns.

Secondary trading is likely to have low implementation costs and is unlikely to interfere with existing slot allocation and scheduling procedures. But because airlines are confronted only with an opportunity cost, rather than a cash outflow, the response in some cases might be delayed, or might not occur at all. Secondary trading might also be slightly less successful than primary trading mechanisms in promoting a more efficient use of slots.

Higher posted prices

Slot prices could be increased in order to reduce the extent of excess demand and ensure that sought-after slots are not allocated to low value services. The main difficulty, however, is that airport operators would have to forecast demand one year in advance, and might have little or no information about the way that airlines would be likely to respond to higher prices, at least during the early stages of adjusting from current charges towards market clearing levels. Higher posted prices would be set as a rate per slot per season (or shorter period for seasonal services), to provide incentives for airlines to use slots efficiently.

To reduce the risk of setting prices too high and slots remaining unsold, we would expect prices to be set deliberately on the low side. But this means that prices might still fail to clear the market and therefore there would still be excess demand for some slots. The benefits of this approach might also be delayed, as we assume that prices would be raised only gradually.

This mechanism would be relatively straightforward to implement, and would also provide incentives for airlines to use slots efficiently. But there is a risk that higher prices could lead to disputes, challenges and possible retaliation by non-EU states.

Higher posted prices and secondary trading

There could be additional benefits from applying secondary trading alongside higher posted prices. The ability to buy and sell slots might help to address remaining inefficiencies that result if higher posted prices fail to clear the market. But secondary trading is most effective when there are large differences between the buyer's and the seller's valuation of a slot, and it may therefore only be partially successful in "fine tuning" the allocation of slots among those airlines willing to pay high posted prices.

Both mechanisms would be easy to implement, but the risk of disputes, challenges and possible retaliation associated with higher posted prices would remain.

Auction of pool slots and secondary trading

While auctions have been used to allocate telecommunications and other licences in recent years, the fact that airport slots at different times may not be good substitutes for each other, and the existence of significant demand interdependencies, means that auctions might be difficult to implement in practice. A simultaneous ascending auction, where all lots are sold (either individually or in combination) in a single auction with repeated rounds, is the type of auction most suitable for the allocation of airport slots.

We assume that secondary trading would be allowed whenever auctions were implemented, as this would provide an important safeguard against the risk of airlines ending up with slots they could not use. And in the case where auctions were applied

only to pool slots, secondary trading would also play an important role in improving the allocation of existing slots.

An auction of pool slots would address the problem that secondary trading alone cannot be used to achieve an efficient initial allocation of new slots. Even some of these auctions, however, might be quite costly to organise and participate in, especially where significant blocks of new capacity were created.

Auction of 10 per cent of slots and secondary trading

A more radical approach would be to auction 10 per cent of existing slots each year, in a rolling programme such that each slot came up for auction every 10 years. In theory, this approach could achieve the most efficient allocation of slots possible, and would have a relatively early impact. In practice, however, some of the auctions might be so complex, both for auction organisers and for airlines bidding in them, that it is difficult to tell whether an efficient allocation of slots would emerge.

These auctions, moreover, would be expensive to implement, with high costs for both organisers and participants. They might have a disruptive impact on airline schedules, and co-ordination problems might occur because of the need to hold several auctions (for slots at different airports) at the same time. They might also provoke challenges and retaliation by non-EU states, and would be strongly opposed by many EU airlines because they could involve the suppression of grandfather rights.

Summary of Impacts

Table 1 below summarises the main features of each mechanism. In addition to the factors discussed above, all of the options (but especially auctions of existing slots) would be likely to lead to an increased concentration of slot holdings by hub carriers at their main airports. More generally, however, we believe that market mechanisms will have positive impacts on the degree of competition in the industry, as they will remove important entry barriers for low-cost and competing long haul services, which will increase competition on key routes.

Since market mechanisms will increase the overall volume of flights, especially long-haul flights, to and from EU airports and increase aircraft size, they will have negative impacts on the environment (though there may be offsetting factors, such as delaying the need for new airport capacity, and we note that the predicted change in the traffic mix and increase in load factors will lead to lower environmental costs *per passenger km*). And in the absence of other measures, market mechanisms may also have a negative impact on the accessibility of regional airports.

But the main impact of introducing market mechanisms will be to achieve a more efficient use of scarce airport capacity. We have carried out some high level calculations to illustrate the potential scale of the impact of each mechanism under low, central and high

case assumptions. The results are summarised in the first few rows of Table 1. Inevitably, these calculations rely on a large number of assumptions and estimates, as there is very little evidence available about the likely impact of either specific market mechanisms or the use of market mechanisms in general. This uncertainty is reflected in the low and high estimates. The ranges between these reflect the varying degrees of uncertainty about the impact of individual mechanisms. Nevertheless, we believe these illustrative calculations provide an appropriate (though very approximate) indication of the likely medium to long term effectiveness of each mechanism.

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Table 1
Summary of Main Properties of Market Mechanisms

	Secondary trading	Higher posted prices	Higher posted prices & secondary trading	Auction of pool slots & secondary trading	Auction of 10% of slots & secondary trading
Approximate estimate of impact on passenger numbers					
Low case	2.2%	3.8%	4.1%	2.4%	0.4%
Central case	**4.0%**	**4.3%**	**5.0%**	**4.2%**	**4.1%**
High case	4.8%	5.2%	5.8%	5.0%	4.6%
Implementation costs	very low	low	moderate	moderate	very high
Other factors					
- potential for instability in airline schedules	very low	low	low	low	high
- likelihood of increased concentration at hub airports	moderately high	moderately high	moderately high	high	very high
- consistency with existing scheduling procedures	good	moderately good	moderately good	moderately good	poor
- risk of international disputes, challenges & retaliation	low	high	high	low	very high

1.   INTRODUCTION

This report, by National Economic Research Associates (NERA), in conjunction with the Faculty of Law at the University of Leiden, and Consultair Associates, sets out our findings on the feasibility and likely effects of using market mechanisms to allocate capacity at congested EU airports. These findings are based, inter alia, on a combination of desk research, and on evidence collected in an extensive programme of interviews with industry participants, with whom we discussed the operation of the existing arrangements for allocating capacity, and the possible effects of a number of different candidate market mechanisms.

The background to the project, as described in the Commission's terms of reference, is the awareness that whilst the working of the existing Council Regulation 95/93 might be improved, [1] such measures may be insufficient to ensure the efficient use of scarce capacity when demand for slots exceeds supply. More radical measures would then be required to ensure that there was enough slot mobility to enable incumbent carriers to optimise their use of slots, and to provide realistic opportunities for new entrant carriers.

Against this background, the terms of reference for the study require the consultant to conduct an in-depth analysis of options for increasing the flexibility of the slot allocation process through the use of market mechanisms. Whilst the assessment of options was to have regard above all to the effects of candidate measures on the mobility of slots and the efficient transport by air of passengers and cargo, it was also to have regard to the need, first, to maintain effective competition at EU airports, second, for consistency with overall EU air transport policy, and third, to ensure compatibility between intra-EU arrangements and world-wide procedures for allocating slots.

At the kick-off meeting for this study, held in Brussels and attended by aviation industry representatives, the Commission made several clarificatory remarks concerning the scope of the study:

- first, the work to be carried out by the consultants was to be purely *positive* in nature. The final report would therefore contain an assessment of the viability and effects of candidate market mechanisms, but the consultants would not be required to develop recommendations for a *preferred* option;

- second, the consultants would not be required, as part of the exercise, to reach any views on the highly contentious subject of slot ownership. They would only be required to consider which different allocations of ownership rights would have implications for the feasibility or effectiveness of alternative market mechanisms;

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[1]   The terms of reference speak of measures involving "clearer definitions, streamlined procedures, more efficient monitoring tools and strict sanctions against abuse or non-compliance with the slot allocation rules."

- finally, the consultants would not be required to consider how revenues raised through the application of market mechanisms should be used, although they would, as part of their assessment, identify the legal and regulatory implications.

The remainder of the report is organized as follows:

- Chapter 2 describes the existing framework for allocating airport capacity in the EU, and the wider regulatory and policy context, and arrangements for slot allocation at a worldwide level;

- Chapter 3 presents evidence on the current use of Category 1 airports under Regulation 95/93, and the likely evolution of demand for and supply of slots at these airports;

- Chapter 4 discusses the nature of the inefficiencies that may result from the existing Regulation;

- Chapter 5 describes the potential market mechanisms that could be used to allocate airport capacity;

- Chapter 6 gives an assessment of the potential impact of market mechanisms on the use of airport capacity, on airline competition, on fares and service levels, on the environment and on the regions;

- Chapters 7 to 11 discuss respectively the feasibility and likely impact of secondary trading (Chapter 7), higher posted prices (Chapter 8), auctions in general (Chapter 9), and auctions applied either to pool slots (Chapter 10) or to pool slots and to 10 per cent of all slots (Chapter 11).

- the concluding Chapter 12 summarises the main properties of the candidate market mechanisms.

The report contains the following Appendices:

- Appendix A describes the approach to information gathering used by the project team;

- Appendix B contains a fuller discussion of the legal issues arising in the implementation of market mechanisms;

- Appendix C discusses experience of slot trading in the US;

- Appendix D contains a fuller discussion of issues in the application of auction mechanisms to allocate airport slots; and

- Appendix E provides a detailed description of the methodology used in our assessment of the impacts of market mechanisms.

In undertaking the study, we have been assisted by a large number of people in the industry, including coordinators, airports, airlines, industry associations and others. We would like to thank all the officials involved for their help.

2. THE EXISTING FRAMEWORK

2.1. Introduction

In this chapter, we discuss how airport slots are allocated under existing EU legislation, the wider regulatory and policy context, and slot allocation at a worldwide level.

In Section 2.2, we discuss the existing Slots Regulation and two earlier studies that have been carried out for the European Commission into its effectiveness. The proposed amendments to the Slots Regulation, and some of their potential implications are outlined in Section 2.3. Section 2.4 sets out the wider regulatory and policy context, including bilateral agreements, the market access regulation, and environmental policy. The way in which slots are currently allocated at a global level is the subject of Section 2.5.

Throughout this chapter, we refer to a more detailed legal analysis which may be found in Appendix B. This Appendix also discusses the relationship between slot allocation and the competition rules.

2.2. The Existing Slots Regulation

2.2.1. Introduction

Regulation 95/93 on slot allocation, as amended by Regulation 894/2002, forms the legal basis of the present slot allocation process. In this section we will first provide a summary of the Regulation and then discuss two studies that have previously been commissioned by the Commission into the functioning of the Regulation. In Section 2.3, we summarise the proposed amendments to the Regulation that were made by the Commission in November 2002.

2.2.2. Summary of Regulation 95/93

Definitions

Article 2 of the Regulation contains the following key definitions:

- The term *slot* refers to the scheduled time of arrival or departure available or allocated to an aircraft movement on a specific date at an airport coordinated under the terms of the Regulation.

- A *new entrant* is defined as an air carrier:

    - holding or having been allocated fewer than four slots at an airport on the day for which slots are requested; or

- an air carrier requesting slots for a non-stop service between two Community airports where at most two other air carriers operate a direct service between these airports and having been allocated less than four slots for that service. However, a carrier holding more than 3 per cent of the total of slots available for the day in question at a particular airport[2] will not be regarded as a new entrant at that airport.

- A *co-ordinated airport* is an airport where a slot co-ordinator has been appointed to facilitate operations from and to that airport.

- A *fully co-ordinated airport* is defined as an airport "where, in order to land or take off, during the periods for which it is fully co-ordinated, it is necessary for an air carrier to have a slot allocated by a co-ordinator".

Hence, pursuant to Regulation 95/93, slots are allocated at fully co-ordinated Community airports. Designation as a fully co-ordinated airport takes place upon a thorough capacity analysis with respect to the airport in question. If a Member State designates an airport as co-ordinated or as fully co-ordinated, it must take into account the principles of transparency, neutrality and non-discrimination.

Process of slot allocation

The process of slot allocation is dealt with in Article 8 of the Regulation. The key provision is laid down in Article 8(1) which specifies that subject to the conditions of Article 10 (see below), an air carrier is entitled to claim the same slot in the next scheduling period that it had been operating in the previous equivalent period. If not all requests can be satisfactorily accommodated, preference shall be given to commercial air services, in particular for scheduled and programmed non-scheduled services. Any additional industry-agreed priority rules or guidelines recommended by the coordination committee should also be taken into consideration unless they constitute a breach of Community law.

Article 8(4) specifies that slots may be freely exchanged between air carriers by mutual agreement or as a result of a takeover. Any slot transfers of this type must be transparent and be agreed by the coordinator.

An exchange will however not be agreed in the following situations:

- The coordinator believes it will prejudice airport operations.

- The slot exchange will breach any limitations placed on the slot by a Member State under Article 9, regarding regional services.

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[2] Or more than 2 per cent of the total slots available on the day in question in an airport system of which the airport forms part.

- An air carrier uses the exchange to introduce additional frequencies on a route between a fully coordinated Community airport and another Community airport, if another air carrier from a Member State has made serious and consistent efforts to obtain slots but has failed (Art 11). These slots must have been such that they could reasonably be used to provide additional frequencies on the route within two hours of those requested from the coordinator.

- The exchange involves slots allocated to new entrants operating a route between two Community airports. This prohibition applies for a period of two seasons after the allocation of the slots.

Article 9 specifies that certain slots for domestic scheduled services may be reserved by a Member State at fully coordinated airports in the following situations:

- On routes that are viewed as vital for the economic development of the peripheral or development region. This is however conditional upon:

  - the service having been established prior to the introduction of the Regulation;

  - only one carrier is operating on the route; and

  - no other mode of transport can provide an adequate substitute.

- On routes where public service obligations have been imposed.

Operation of the slot pool

In Article 10, a requirement is laid down that at those airports where slots are allocated, a pool for each coordinated period shall be set up which contains all newly created slots, unused slots and those slots that carriers give up or otherwise become free. Any allocated slots that are not used without justification for the non-use should be withdrawn from the carrier and made available in the appropriate pool. Non-utilisation can only be justified by reason of airspace or airport closures, grounding of a type of aircraft or any other exceptional situation of a similar type.

Operators of scheduled or programmed non-scheduled services are only entitled to the same series of slots in the next equivalent period if they can satisfactorily demonstrate to the coordinator that they have utilised those slots at least 80 per cent of the time for which the slots had been allocated in that period, a rule known as the use-it-or-lose-it rule or the 80/20 rule. If the air carrier fails to adequately demonstrate that it has achieved this required level of usage, or cannot justify it, all the slots that constitute that series will be placed into the slot pool. Again, justification can only be granted for a small number of specific reasons, which are generally based on factors beyond the air carriers' control.

Pursuant to Article 10(7), a total of 50 per cent of pool slots shall be allocated to new entrants, unless applications from new applicants are insufficient to reach this level.

Amendment by Regulation 894/2002

Regulation 894/2002 amended Regulation 95/93 in order to maintain grandfather rights for air carriers which have not been able to use slots as a consequence of the terrorist attacks of 11 September 2001 on the US.

2.2.3. Previous studies into the Slots Regulation

2.2.3.1.   The 1995 Coopers & Lybrand study

Regulation 95/93 provided that the Commission should submit a report on the operation of the Regulation three years after its entry into force. To this end, a study was commissioned in 1995 from Coopers&Lybrand into the application and possible modification of the Regulation.[3]

The study assessed the extent to which the Regulation had been implemented across the Community; assessed the effectiveness of the Regulation and identified problems that had arisen in its application; and proposed possible modifications to the Regulation to improve its effectiveness.

Since the study is now rather dated, we do not report in this study in detail. We note however that while the focus of the study was on the application of the Regulation in the context of the existing administered process of slot allocation, the study did include a broad overview of more radical options for change, without providing a full assessment.

2.2.3.2.   The 2000 PricewaterhouseCoopers study

In 2000, a new report by PricewaterhouseCoopers into the operation of the Slot Regulation was presented to the Commission.[4]

Unlike the 1995 study, the focus of the 2000 study was on the implementation of the Regulation only. It follows that the relevance of the 2000 study for the present study is limited, since slot allocation is the focus of the present study but was excluded from the 2000 study.

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[3]   Coopers&Lybrand (1995) *The Application and Possible Modification of Council Regulation 95/93 on Common Rules for the Allocation of Slots at Community Airports.*

[4]   PricewaterhouseCoopers (2000) *Study of Certain Aspects of Council Regulation 95/93 on Common Rules for the Allocation of Slots at Community Airports.*

An important element of the PricewaterhouseCoopers report in the context of the present study is however the discussion of the definition of a slot in the report. The PricewaterhouseCoopers analysis highlighted that a slot is not necessarily linked only to runway capacity but other types of capacity. This includes stand and terminal capacities, as well as terminal airspace capacity, surface access capacity and environmental capacity at a number of airports.

In view of this, PricewaterhouseCoopers recommend that the definition of a slot should recognise that it contains all resources necessary to operate at the airport, except traffic rights. This would include all binding constraints, as well as other resources which were not binding at the time of first allocation of the slots. In PricewaterhouseCoopers' view, a slot would typically be described by:

- a time period relating to the planned landing or take-off time;

- stand capacity, probably including a specified aircraft type and intended parking time and possibly area of apron (ie terminal, adjacent or remote);

- terminal capacity in terms of the average peak number of passengers carried and probably the type of operation; and

- in some airports, share of environmental capacity.

2.3. Proposed Amendments to Regulation 95/93

2.3.1. Introduction

In this section, we outline the proposals for amending Regulation 95/93 as made by the Commission in November 2002.[5] We first summarise the proposed amendments, focusing on those that are most relevant for the present study, and then discuss some of their implications.

2.3.2. Summary of amendments

The amendments include changes to several of the definitions in Article 2.

One of these changes relates to the definition of a "slot", in part following the recommendation of the 2000 PricewaterhouseCoopers study. Under the proposed text, the definition of a slot becomes "the entitlement established under this Regulation, of an air carrier to use the full range of airport infrastructure necessary to operate an air service at a coordinated airport on a specific data and time for the purpose of landing and take-off as allocated by a coordinator in accordance with this Regulation".

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[5]   COM(2002) 623 final of 7 November 2002. The initial proposal is contained in COM(2001) 335 final of 20 June 2001.

The proposed amendments also alter the definition of "new entrant". The following key changes are made:

- additional conditions are introduced to ensure that only genuine new entrants can benefit from the Regulation;

- the maximum percentage of slots that air carriers can hold at a particular airport on the day for which slots are requested is increased to 7 per cent, as this better reflects an average slot portfolio in the industry; and

- an additional provision has been introduced to facilitate entry into routes to regional airports.

Article 8 of the Regulation is also amended in several important ways. Article 8(1) provides that "series of slots are allocated from the slot pool to applicant carriers as entitlements to use the airport infrastructure for the purpose of landing and take-off for the scheduling period for which they are requested, at the expiry of which they have to be returned to the slot pool". However, Article 8(2) also contains the grandfathering rule, according to which carriers can continue to use series of slots if they have used them for at least 80 per cent of the time in the previous equivalent scheduling period.

Article 8bis contains the following provision:

> *"The entitlement to series of slots referred to in Article 8(2), shall not give rise to any claims for compensation in respect of any limitation, restriction or elimination thereof imposed under Community law, in particular in application of the rules of the Treaty relating to air transport."*

One anomaly that exists in the current Regulation is that, while international convention[6] is to allow the practice of retiming historic slots, it is not explicitly allowed in the Regulation. In the Explanatory Memorandum to the original amendments, it is argued that this procedure is an important feature of scheduling that ensures flexibility in the system and allows air carriers to improve their timings and slot portfolios without having to hoard slots that they would otherwise not use. The international experience at the IATA level is said to support this view. As a response to this the amendment changes the regulations to explicitly allow for this practice. It is stated that the retiming of historic slots should occur before the allocation of the pool and should only be accepted for "operational reasons".

In order to provide Member States with increased powers to make the use of airport capacity more efficient, the amendment explicitly enables Member States to impose restrictions on the minimum size of aircraft that can be used for a slot. Further powers to dictate other slot use criteria, such as short/long haul, were not adopted. However, with the

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[6]   Through the IATA Scheduling Guidelines

aim of improving the efficiency of capacity use further, and to bring the regulations into line with EU policy on revitalising railways, the amendment proposes that an additional criteria should be introduced whereby applications for intra-Community route slots will be given a low priority where other satisfactory modes of transport exist.

The amendments also provide for environmental constraints to be taken into account when determining airport capacity. This is in response to growing concerns about the use and expansion of the major Community airports, and the need to bring the regulations in line with the Commission's position on improvements in the environmental performance of the industry.

Article 8a of the proposed amended Regulation deals with slot mobility. Slot transfers are allowed within air carriers; between parent and subsidiaries; in the context of mergers and acquisitions; and in the context of decisions taken by competition authorities. Furthermore, paragraph 1(d) specifies that "slots may be exchanged, one for one, between two carriers where both air carriers involved undertake to use the slots received in exchange". Paragraph 2 provides that paragraph 1 forms the exclusive basis for the transfer of slots.

In the proposal, new entrants will now be allowed to exchange their slots provided they improve their timings taking into account their initial requests. Otherwise, new entrants cannot exchange their slots for a period of three consecutive scheduling seasons (as opposed to two seasons in the current Regulation).

2.4. Regulatory and Policy Context

2.4.1. Introduction

The basic framework under which global civil aviation is regulated was established in 1944 by the Chicago Convention. Article 1 of this Convention provides that every State has "complete and exclusive sovereignty over the airspace above its territory". Article 6 does not allow any scheduled international air service to be operated over or into the territory of a contracting State, except with the special permission or other authorisation of that State. Whereas Article 6 of the Chicago Convention regulates the operation of international scheduled services, international access to airports is governed, inter alia, by Article 15 of this convention.[7]

The Chicago Convention did not deal with economic regulation of civil aviation in detail and separate regulatory elements emerged as a result of this. Of these, bilateral air service agreements are of particular relevance for the present study and these are discussed in Section 2.4.2 below. The potential implications of the recent Open Skies ruling by the

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[7] On Article 15 of the Chicago Convention, see Section B.2.1.3.

European Court of Justice, which related to certain bilateral agreements, are outlined in Section 2.4.3.

Within the Community, access for Community carriers to the intra-EC market was liberalised on 1 January 1993 on the basis of Regulation 2408/92. This Regulation is discussed in Section 2.4.4. Section 2.4.5 deals with the implications of the EU's policy on air transport and the environment. Section 2.4.6 contains the key elements of the overall EU transport policy.

2.4.2. Bilateral air service agreements

2.4.2.1. Traffic rights

The prime purpose of bilateral air service agreements has been the control of market access and market entry, regulating such issues as the points to be served in each country, traffic rights, and the designation of airlines. In many cases, capacity and frequencies were controlled as well.

Traffic rights can only be exercised if the airline granted the traffic rights has access to the airport or airports located in the territory of the grantor state. Hence, there is an operational link between of traffic rights - grant of access to the airspace of the other country - and access to airports.

An important question is whether the grant of traffic rights by one party to another includes access to the airport located in the territory of the grantor state. Generally speaking, the answer to this is negative: the grant of traffic rights does not imply free access to congested and slot co-ordinated airports. However, the question must be examined on a case by case basis.

For instance, a bilateral "Open Skies" air agreement provides unrestricted operation of international air services by the designated airlines between the two countries. If that agreement does not provide for slot restrictions at airports of one of the two countries, and the concerned country did not mention such restrictions before the conclusion of that agreement, the country whose airlines face these unforeseen restrictions could claim that the bilateral air agreement proceeds from free and unrestricted trade. Hence, the imposition of unforeseen (at the time of the conclusion of the agreement) slot restrictions infringes free trade of international air services agreed upon by the two countries. In particular, the country whose airlines are affected by such restrictions may appeal for the clause on "fair and equal opportunity to compete" in bilateral air agreements to be invoked.[8]

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[8] On the requirement in bilateral agreements to grant carriers a fair and equal opportunity to compete, see Section B.2.2.5.

2.4.2.2.   Slot allocation

Since the 1990s, certain bilateral air agreements contain provisions on slot allocation in order to create more transparency in the relationship between slots and traffic rights.

An example with particular relevance for the present study is the US-Germany agreement that was concluded in 2000. This agreement is discussed in Section B.2.2.3. Key points to note are the following:

- US carriers receive free access to German airspace and are granted economic rights without restrictions, but the exercise of these rights is subject to:

  - operational restrictions at German airports, including slot allocation;

  - national treatment of US carriers at German airports when being subject to such (and other) restrictions.

  The same conditions apply to the operations of German carriers in US airspace and at US airports.

- Germany and the US must allow the carriers designated by them under the agreement *a fair and equal opportunity to compete* when operating the agreed services. The provision is a standard provision in Open Skies agreements as well as in many other bilateral air agreements.

2.4.2.3.   Airport charges

In some but not all bilateral air agreements, a provision similar to the following may be found:[9]

> "*User charges imposed on the airlines of the other Parties may reflect, but shall not exceed, the full cost to the competent charging authorities or bodies of providing the appropriate airport, airport environmental, air navigation, and aviation security facilities and services at the airport or within the airport system. Such charges may include a reasonable return on assets, after depreciation. Facilities and services for which charges are made shall be provided on an efficient and economic basis.*"

This provision may impact on the ability to increase charges at congested airports towards market clearing levels. We will return to this issue in Section 8.3.2.

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[9]   A similar provision is also contained in ICAO's Policies on Charges for Airports and Air Navigation Services.

2.4.3. The Court ruling on Open Skies

On 5 November 2002, the European Court of Justice (ECJ) handed down its judgments regarding "Open Skies" agreements concluded between seven Member States and the United States, and the Bermuda II agreement in place between the US and the UK. The cases were brought by the European Commission, which challenged the authority of Member States to negotiate bilateral air services agreements. The Commission argued that such authority in fact rests exclusively with the Commission.

While the ECJ held that the Commission does not have exclusive authority to negotiate bilateral air service agreements with third countries, the Court did rule that the nationality clauses in bilateral agreements violate the freedom of establishment principle contained in Article 43 of the Treaty. In addition, the Court held that in three areas the Community did have exclusive external competence: airport slots, computer reservation systems and intra-Community fares and rates.

It will now be necessary to rectify the violations of the freedom of establishment that the Court has found in the existing Open Skies agreements, as well as in other agreements with the United States and third countries that also contain the nationality clause or have infringed Community exclusive external competence.

If the removal of this barrier does indeed lead to consolidation among the Community's flag carriers, the implications of this for the aviation market in the Community could be profound. It would probably lead to substantial changes in airline networks, although it must be kept in mind that some of these changes have already taken place as airlines within alliances have to an extent been able to coordinate their schedules.

Multi-hub airlines could emerge and this could have implications for the demand for capacity at the airports concerned. To some extent, moves towards hub-and-spoke networks could also happen, although the short geographic distances between many key Community airports would suggest that the scope for hub-and-spoke networks within Europe is smaller than within the United States, where such networks were a key result of airline deregulation.

The Commission published a Communication on the implications of the judgement on 19 November 2002,[10] in which it asked Member States to ensure at the earliest possible date compliance of their agreements with the United States with the ECJ judgments; to refrain from taking international commitments in the field of aviation before having clarified their compatibility with Community law, and as a first step to agree a mandate for negotiations to replace the current bilaterals with the United States with an agreement at Community level.

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[10]   COM(2002) 649 final

On 26 February 2003, the Commission published another Communication on relations between the Community and third countries in the field of air transport,[11] in which it explains how it intends to proceed with the conduct of external relations in this field. However, the Commission did not address the matter of slot allocation, although the ECJ confirmed that the Community has exclusive external competence in this area.

On 5 June 2003, the Council gave a mandate to the Commission to open negotiations with the US on an Open Aviation Area, and to open negotiations with third countries on the replacement of the nationality clauses. As stated above, the Community has exclusive external competence to negotiate slot allocation with third countries.

2.4.4. The market access regulation (2408/92)

Council Regulation 2408/92 provides for free access to the intra-EC market for Community air carriers and was a central part of the "third package" that entered into force on 1 January 1993.

The freedom of market access is subject to a number of restrictions. These include:

- the right of Member States to impose Public Service Obligations (Art 4);

- the right to introduce operational restrictions relating to safety and the environment (Art 8(2), see also the discussion of Council Directive 2002/30 in Section 2.4.5 below);

- the right of Member States to distribute the traffic between the airports of an airport system (Art 8(1)); and

- the right to refuse the exercise of traffic rights in cases where serious congestion or environmental problems exist, in particular when other modes of transport can provide satisfactory levels of service (Art 9).

Because Member States are entitled to subject market access to slot allocation, there exists an operational link between the two measures. This link is analysed in detail in Section B.3.4. One of the key conclusions from this analysis is that the relationship between the two measures is not always clear, and that it could be made more explicit by, for example, the introduction of cross-references between the measures in question.

Appendix B also notes that the draft regulation on slot allocation applies to *all* carriers, whereas Regulation 2408/92 only applies to *Community* air carriers. Depending on the relationship between Community law and international law, Community air carriers may be subject to a regime which is different from that applied to non-Community air carriers.

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[11] COM(2003) 94 final

2.4.5. Air transport and the environment

In the previous section, it was noted that under Art 8(2) of Regulation 2408/92, market access can be restricted for environmental reasons. Examples of important airports where environmental restrictions are currently applied are Amsterdam Schiphol in the Netherlands and Düsseldorf in Germany.

In so far as those environmental restrictions are noise-related, such restrictions must comply with Council Directive 2002/30 on the establishment of rules and procedures with regard to the introduction of noise related restrictions at Community airports. This Directive specifies that as a general principle, Member States should adopt a balanced approach in dealing with noise problems at airports in their territory. A provision with potential relevance for the present study is that Member States may also consider economic incentives as a noise management measure.

The general Community approach in regard to reducing the environmental impact of air travel was published in December 2000.[12] The approach includes limiting the use of noisy aircraft (for which procedures were laid down in Directive 2002/30 described above), more stringent standards for gaseous emissions, and strengthened economic incentives for improved environmental performance. Examples of economic incentives given are a revenue-neutral aircraft efficiency charge; an en-route emissions charge with the revenues used to mitigate the environmental impact from emissions; and emissions trading.

In 1999, the Commission suggested the possibility of introducing environmental criteria into the slot allocation rules.[13] This could not only be attractive from the point of view of environmental performance but might also improve the overall capacity of airports. The reason for this is that when combined with a system of overall noise quotas for airports, there may no longer be a need for overall caps on movements as "proxy" for environmental capacity.

In addition, the Commission raised the concept of emission rights trading. This would imply the establishment of overall emission quotas for the airport and of rules for the trading mechanisms which would have to be compatible with existing slot allocation rules. The Commission regarded the idea as attractive in terms of its underlying economic rationale.

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[12]   COM(2000) 821 final

[13]   COM(1999) 640 final

2.4.6. Overall EU transport policy

The policy issue of airport slot allocation forms part of the overall EU transport policy. The overall policy framework was published in September 2001 in the White Paper "European Transport Policy for 2010: Time to Decide".

The White Paper distinguishes between the following four major policy areas:

- **Shifting the balance between modes of transport.** This includes completing the internal market in the transport sector, particularly as far as railways are concerned. As far as air transport is concerned, priorities are the creation of a single European sky; making optimal use of existing airport capacity, *inter alia* through slot allocation (though it is mentioned that Europe will not be able to cope without new airport infrastructure); striking a balance between air transport and the environment;[14] and maintaining safety standards. Improving the links between the various transport systems, including maritime transport, also falls under this heading.

- **Eliminating bottlenecks** by developing the trans-European network and applying innovative funding methods. The White Paper indicates that in 2004 new trans-European network guidelines will be published which will include the issue of airport capacity.

- **Placing users at the heart of transport policy**. This area includes improving road safety, establishing an infrastructure charging framework that reflects the external costs of transport, rights and obligations of users (especially in air transport), and a rationalisation of urban transport. The White Paper refers to the proposal to regulate airport charges and the fact that this has not been taken up.[15]

- **Managing the globalisation of transport**, including meeting the challenges of enlargement; and improving the assertiveness of Europe on the world stage. This area includes the need for an external dimension to air transport, ie competence for the Commission to negotiate air transport agreements on behalf of the Member States. It is against that background that the Commission has contested the "open skies" agreements in the European Court of Justice.[16]

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[14]   On the relationship between air transport and the environment, see Section 2.4.5

[15]   COM(1998) 509 final; withdrawn by the Commission in December 2001.

[16]   On the ECJ Open Skies ruling, see Section 2.4.3

2.5.   The Current Scheduling Process

2.5.1. Introduction

In this section, we present an overview of the current worldwide scheduling process and of the IATA Schedules Conferences.

The scheduling process is discussed in Section 2.5.2; Section 2.5.3 describes the IATA Scheduling Conference

2.5.2. The worldwide scheduling process

The IATA *Worldwide Scheduling Guidelines* describe the scheduling process for non coordinated, schedules facilitated and fully coordinated airports. We focus in this section on fully coordinated airports since slots are allocated at such airports only.

By way of illustration, the scheduling process for the Winter 2003/04 scheduling season is shown in Figure 2.1.

Figure 2.1
Scheduling Timetable for Winter 2003/04 Timetable Season
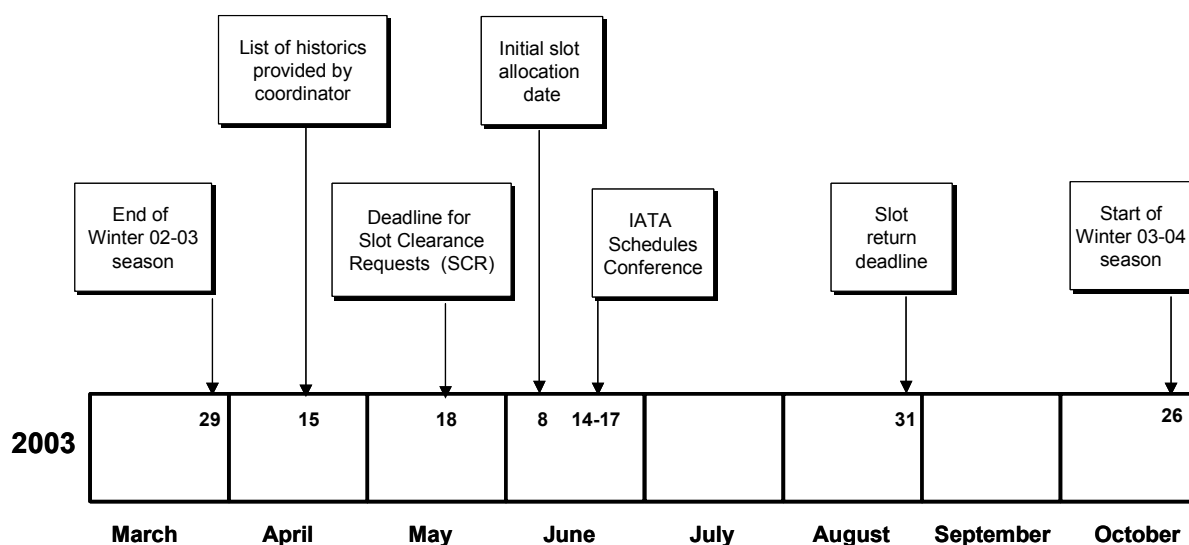
Key dates in the timetable are:

•   In mid-April, the coordinators provide airlines with information on their entitlement to historical slots, which is dependent on the extent to which airlines have actually operated the slots that were allocated to them for the previous Winter season ending

29 March 2003.[17] The slots held on file by the coordinators at the slot return deadline dates (31 August 2002 for the 2002/03 Winter season) will be used as the basis for the determination of historics.

- Airlines have to provide details of their planned schedules for the Winter 2003/04 season to the coordinator, using a Slot Clearance Request, by 18 May 2003. The request should include historic slots, changes to historic slots and new slots.

- By 8 June 2003, coordinators should inform the airlines of the status of their requested slots. This information should include the changes required to meet capacity limitations. If a requested slot is not available, coordinators should offer the nearest time available.

  The *Worldwide Scheduling Guidelines* specify that coordinators should not enter into a dialogue with airlines prior to the start of the Schedules Conference. However, airlines that are willing to accept initial slot offers should confirm this to the coordinator.

- The Schedules Conference will be held from 14 to 17 June 2003. The process of a Schedules Conference is described in Section 2.5.3 below.

- After the Schedules Conference, schedules are finalised. Schedules are normally loaded into the reservations systems within a month to six weeks after the Conference.

- Unwanted slots for the Winter 2003/04 season should be returned by 31 August 2003.

2.5.3. The IATA Schedules Conferences

The IATA Schedules Conference, organised twice a year in June and November, is a forum for, *inter alia*, the allocation of slots at fully coordinated airports. Representatives of up to 300 airlines come to meet with representatives from more than 200 schedules facilitated or fully coordinated airports. At the 111th Schedules Conference in Vancouver in November 2002, over 920 delegates were present, of which about 720 from airlines and 160 from coordinators.

During the Conference, schedules are adjusted mainly through bilateral discussions between airlines and Coordinators regarding alternatives offered, or between airlines to exchange slots offered or accepted. A schedule change at one airport will affect one or more other

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[17] For Summer seasons, coordinators have to inform airlines of historics by mid-September. However, the Summer seasons do not actually end until the end of October. This means that coordinators have to supply the airlines with information on historics based on the current Summer season up to that time. This information has to be regarded as provisional until the season is completed.

airports. Because all Coordinators attend the Conference, it provides a forum in which all such repercussive changes can be processed.

Although the work of coordinators continues after the conferences (for example to reallocate returned slots and to accommodate schedule change requests), the conferences are the main forum for the allocation of slots. Allocating slots after the Conference can be problematic since it is considerably more difficult to obtain compatible slots at other constrained airports without the opportunities provided by the Conference.

2.5.4. After the conference

After the conference, airlines continue their scheduling process right through to the start of the timetable (and beyond to deal with changes in the timetable).

Fine tuning the schedules to match the available slot holdings can be done in various ways. If there are small mismatches between the slot holdings and the timetable (eg 5 or 10 minutes), then it may be possible to reschedule the flights concerned to the slots actually held. If the mismatches become larger, eg 15 or 20 minutes, then it may in some cases still be possible to reschedule the flights to slots held. This can however be difficult and there will be instances where such rescheduling is not possible without impacting on the overall schedule. In the case of larger mismatches, rescheduling will often be impossible and slot exchanges are likely to be required. In the few cases where rescheduling is possible in such circumstances, there will be a commercial impact arising from a suboptimal schedule (eg flights not evenly spaced throughout the day).

Airlines view the adjustment process after the slot conferences as very important and in fact, under the current system, the majority of slot scheduling problems are resolved through slot exchanges after the conferences (as opposed to exchanges during the conferences themselves). These exchanges are of varying complexity.

In some cases, the proportion of slots held by a carrier after a conference that is subsequently exchanged (ie after the conference) can be substantial. For charter airlines that are not vertically integrated with tour operators, as many as 30 per cent of slots may be exchanged with other airlines in the period after the conference.

3. IMPACT OF THE EXISTING FRAMEWORK

3.1. Introduction

This chapter presents a basic factual background to the report. We first examine the current use of EU Category 1 airports under regulation 95/93. The analysis is based on information gathered from airports, coordinators and public sources through questionnaire responses and interviews. In sections 3.2 through to section 3.8 we describe

- Category 1 airports and their current level of use

- The structure of charges at Category 1 airports

- The extent of excess demand for slots at Category 1 airports

- The traffic mix and variations in the mix of traffic at Category 1 airports

- Variations in aircraft loadings and size between Category 1 airports

- The operational patterns of network carriers and how this affects peak times

- Variations in the slot holding of the major carriers at airports

In Section 3.9 we then present projections of the degree of congestion at Category 1 airports in 2007. These are based upon passenger and ATM forecasts provided by the airports and expected increases of capacity, either through capital projects, improved air traffic control or the lifting of legal restrictions.

3.2. Current Levels of Use of EU Category 1 Airports

Table 3.1 lists the 32 EU Category 1 airports considered in our study and shows for each airport annual traffic volumes, in terms both of passengers and air traffic movements (ATMs), along with the hourly runway capacity. In 2002 this group of airports handled more than 560 million passengers and around five million air traffic movements (ATMs). There is great variation in the levels of activity at the airports. London Heathrow handled more than 63 million passengers whereas Berlin Tempelhof handled only 613,000. The airports identified with an asterisk are those from which a carrier operates a hub and spoke network. As we shall demonstrate, the traffic pattern and the demand for facilities at such airports tends to be different from that observed at other airports.

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Table 3.1
EU Category 1 Airports

Airport	IATA Code	Passengers per year (000's)	Air Transport Movements per year (000's)	Capacity per hour
Amsterdam Schiphol*	AMS	40,732	401	106
Athens	ATH	11,666	144	52
Berlin Schonefeld	SXF	1,688	26	40
Berlin Tegel	TXL	9,880	122	35
Berlin Tempelhof	THF	613	38	30
Brussels	BRU	14,446	237	74
Copenhagen Kastrup*	CPH	18,136	275	83
Dublin	DUB	14,692	164	44
Dusseldorf	DUS	14,600	178	38
Faro	FAO	4,655	31	20
Frankfurt*	FRA	47,660	425	80
Gran Canaria	LPA	9,330	49	34
Helsinki Vantaa	HEL	9,605	153	50
Lisbon	LIS	9,217	110	30
London Gatwick	LGW	29,519	235	45.5†
London Heathrow*	LHR	63,012	460	86.25†
London Luton	LTN	6,418	58	32
London Stansted	STN	16,044	155	41.5†
Madrid Barajas*	MAD	34,047	197	78
Malaga	AGP	9,928	31	35
Mallorca	PMI	19,203	76	60
Milan Bergamo	BGY	1,044	18	18
Milan Linate	LIN	7,714	86	18
Milan Malpensa	MXP	15,401	196	70
Munich*	MUC	23,200	320	87
Paris Charles de Gaulle*	CDG	46,693	486	97
Paris Orly	ORY	24,606	225	250,000 per year
Rome Ciampino	CIA	960	29	22
Rome Fiumicino	FCO	25,340	283	90
Stockholm Arlanda	ARN	16,456	247	76
Thessaloniki	SKG	3,399	41	13
Vienna*	VIE	11,974	187	66

Source: Airport operators; ACI Europe data; NERA estimates

†Average capacity per hour

*Acts as the hub airport of a network carrier

3.3.   The Structure of Airport Charging

All Category 1 airports levy airport charges that distinguish between:-

- a take-off or landing charge, expressed as a rate per aircraft or per unit of aircraft weight;

- an aircraft parking charge, typically based on the weight of the aircraft and the time spent parked; and

- a passenger charge, typically expressed as a rate per arriving or departing passenger.

The structure of charges for each element varies between different airports, so that, for example, some operators apply landing charges that vary directly with aircraft weight, whereas others set two-part charges incorporating a fixed minimum fee plus a variable, weight-related element. Aircraft parking charges tend to be weight related though many operators appear to use pricing policy to encourage quick turnaround traffic (eg low cost and charter operators) by offering limited periods of free parking and lower charges for using remote stands.

Significantly, only a minority of the airports set charges that differentiate between peak and off-peak periods. Six airports (AMS, DUB, HEL, LGW, LHR and STN) set differentiated (higher) peak landing charges. Peak parking charges are set at LGW, LHR and STN, and a seasonal peak passenger charge is levied at LTN.[18] The very limited extent of peak pricing structures for airport charges contrasts strongly with the highly peaked nature of airline fares.

3.4.   The Extent of Excess Demand for Slots

Table 3.2 categorises the airports by the level of excess demand observed in 2002 at each in the form of slot requests beyond those that can be accommodated within runway capacity. We have also considered data describing the level of runway utilisation, information provided during our interview programme with stakeholders and publicly available information.

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[18]   Per passenger charges at LHR used to be heavily peaked. This structure was withdrawn following the arbitration proceedings with the US Government in the early 1990s.

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Table 3.2
Categorisation of Airports

Airports with little or no excess demand	Airports with excess demand at peak times of the day	Airports with excess demand throughout the day
ARN	AGP	DUS
ATH	AMS	FRA
BGY	BRU	LHR
CIA	CDG	LGW
FAO	CPH	LIN
HEL	DUB	ORY
LPA	FCO	MAD
LTN	LIS	
SKG	MUC	
SXF	MXP	
THF	PMI	
	STN	
	TXL	
	VIE	

Source: NERA estimates

Within the category of airports with excess demand throughout the day there are two distinct groups. First, at FRA, LHR, LGW and MAD, the declared capacity of the airport reflects physical constraints, in all cases relating to runway capacity. Second, at DUS, LIN and ORY, the declared capacity is less than the physical capacity of the airport , but the number of permitted ATMs is restricted either on environmental grounds, as at DUS and ORY, or, as at LIN, because of the application of air traffic distribution rules between LIN and MXP, by the Italian authorities under EC Regulation 2408/92. Additionally at LIN, the entire declared capacity is dedicated to short haul services.

The extent of excess demand for slots at the legally constrained airports was demonstrated recently at ORY. After the insolvency of Air Lib, 35,658 slots became available. More than 251,000 slot requests were made to the coordinator (COHOR) by 43 airlines.

The levels of excess supply of or demand for slots at one airport from each of the above groups are shown below in Figure 3.1, Figure 3.2 and Figure 3.3. These show the greatest number of slot requests made above or below capacity available for each clock hour from 0400 to 2300 in a typical week in the summer 2002 season. Where the bar is above the axis we observe revealed excess demand for slots. Where the bar is below the axis we see an excess supply of slots.

Figure 3.1
Slot Requests at an Airport with Little or No Excess Demand
(ATH Typical Week Summer 2002)
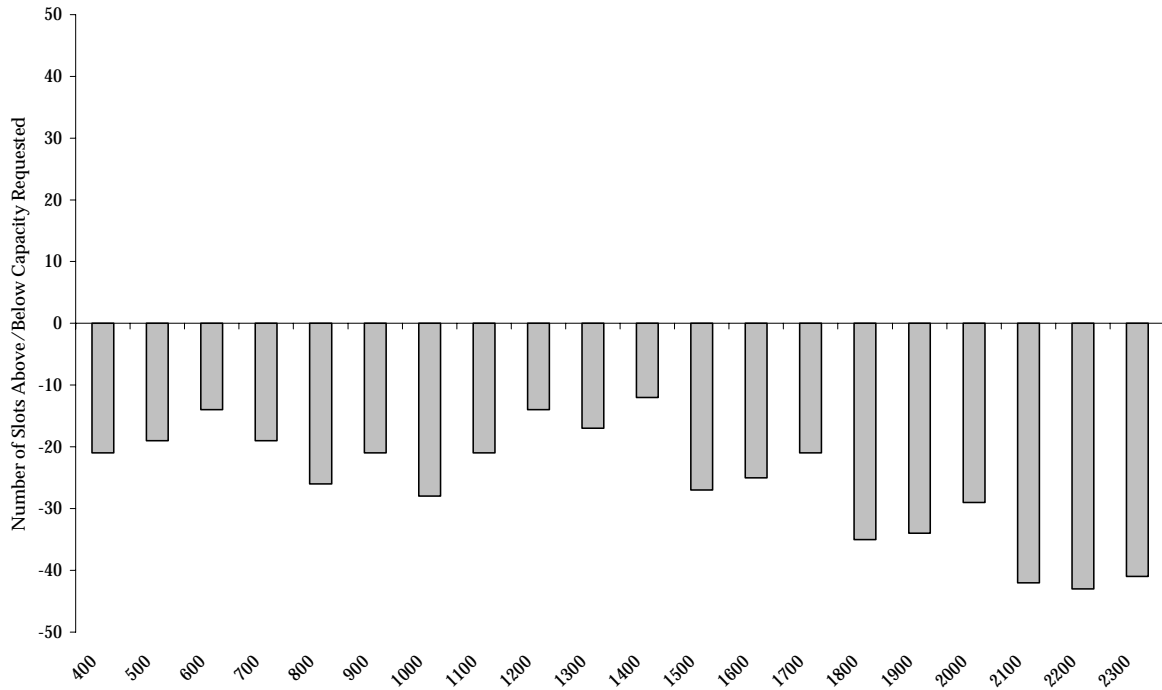
Source: Greek Airports Coordination

Figure 3.2
Slot Requests at an Airport with Excess Demand at Peak Times of the Day
(AGP Typical Week Summer 2002)
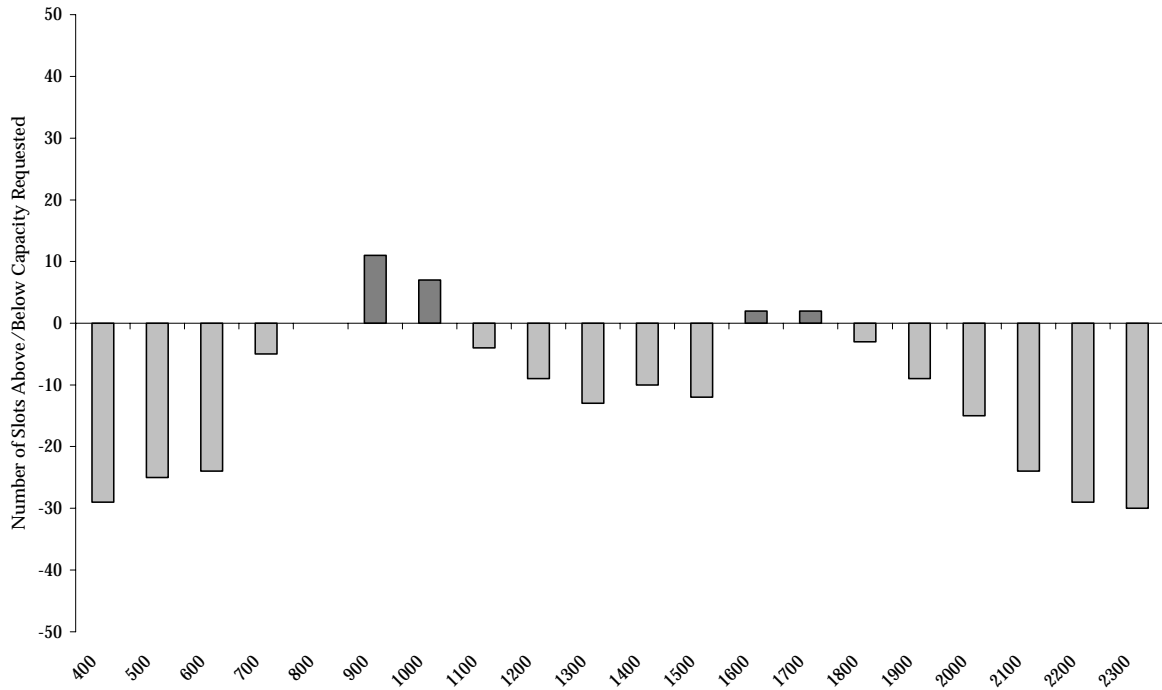
Source: Aena

Figure 3.3
Slot Requests at an Airport with Excess Demand throughout the Day
(LHR Typical Week Summer 2002)
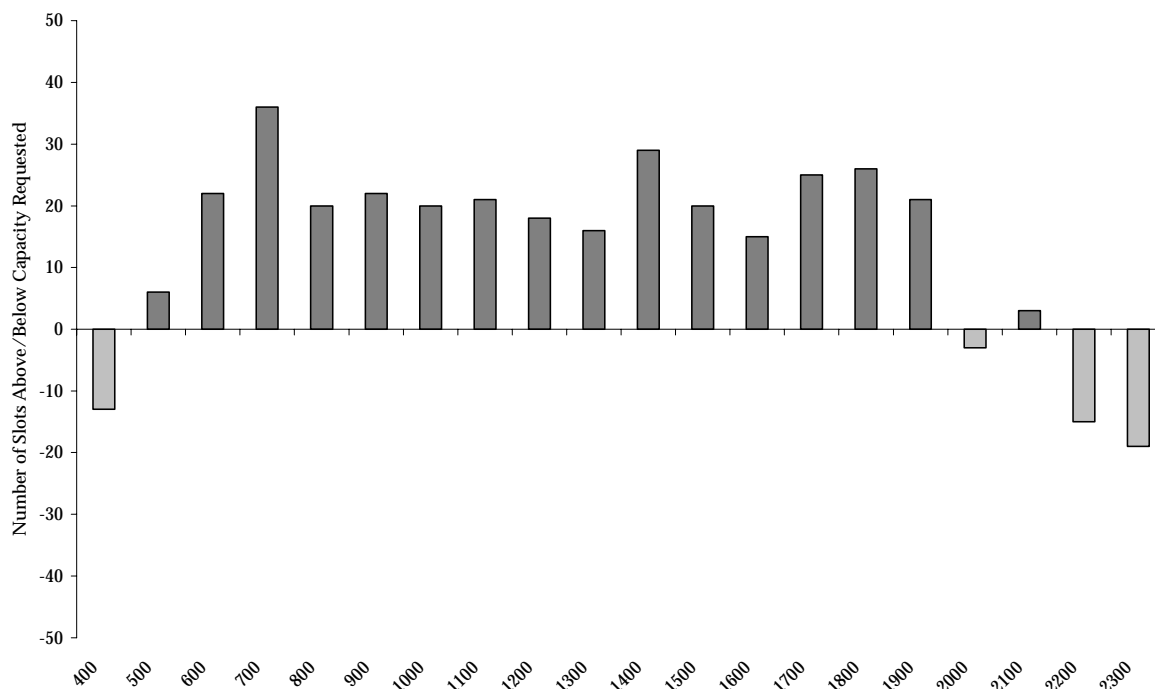
Source: Airport Coordination Limited

Demand at the unconstrained airport described in Figure 3.1 truly represents demand for slots there because there is no prospect of carriers not requesting slots that they would like to operate. Conversely, at the constrained airport with excess demand throughout the day carriers may request more slots than they require for strategic reasons. Such action would make it more difficult for competitors to add services at the airport. However, the experience at ORY (where a large slot holding was recently released by Air Lib) suggests that there is significant pent up demand for slots at the most severely constrained group of airports. Knowing that they will not be allocated sufficient holdings to operate additional viable services carriers do not reveal the extent of their demand when making requests to the coordinators.

At the most severely constrained airports slot utilisation is high. This can be seen for the examples of LHR and FRA in Figure 3.4 and Figure 3.5 below.

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Figure 3.4
Slot Utilisation at an Airport with Excess Demand throughout the Day
(LHR Typical Week, Summer 2002)
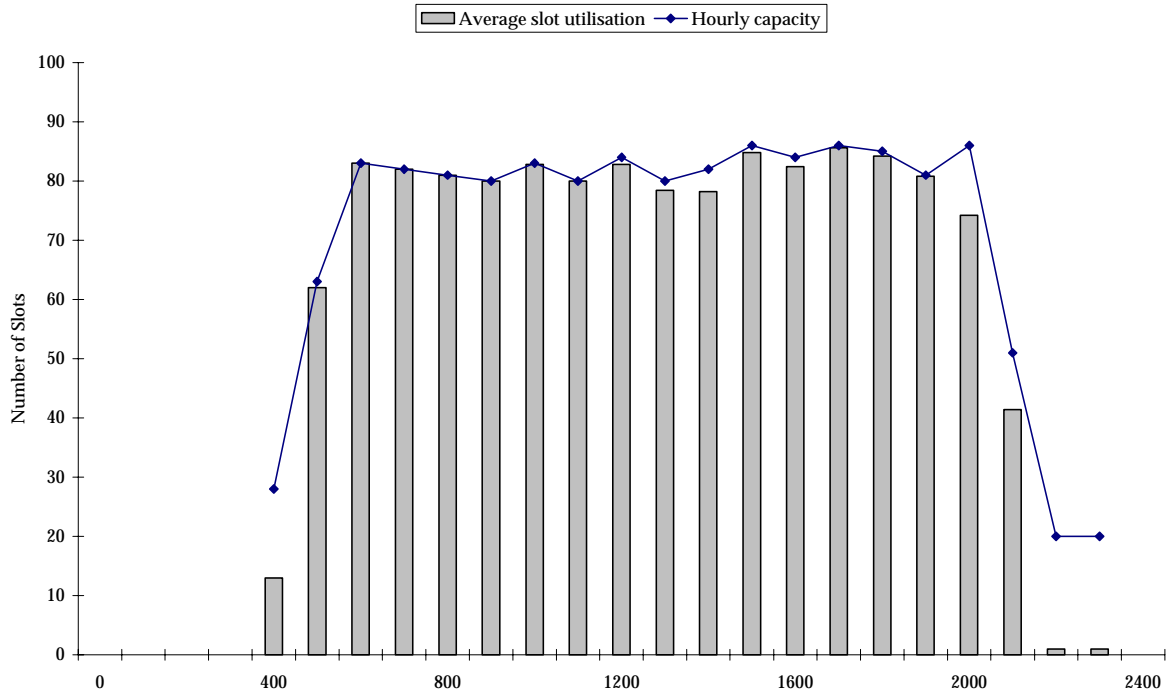
Source: Airport Coordination Limited

Figure 3.5
Slot Utilisation at an Airport with Excess Demand throughout the Day
(FRA Typical Week, Summer 2002)
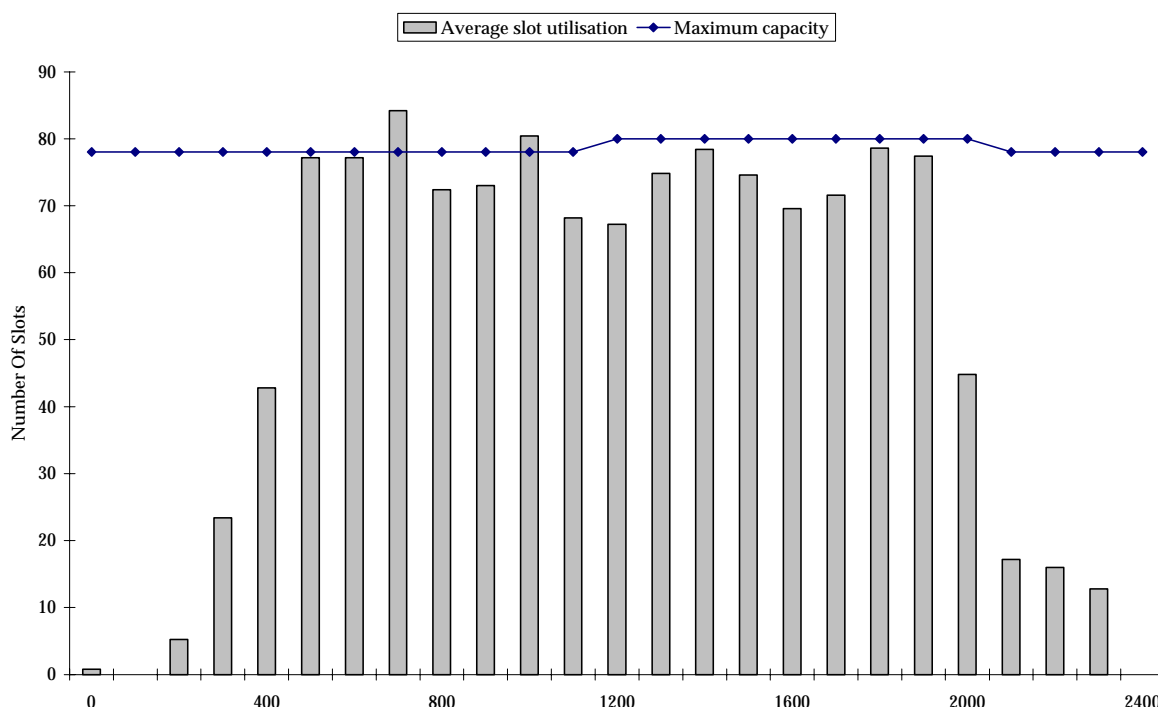
Source: Airport Coordination Germany

Where slots are not filled it may be that no airline requested the slot or that airlines have not used the slot for operational reasons. Alternatively, the observed excess demand at times when slots are available is for, say, departure slots but the directional limit at the airport is reached. We would then expect to see unused arrival slots, for example.

The directional demand for and initial allocation of slots at an airport with excess demand at peak times of the day (STN) is shown in Figure 3.6. We see demand in excess of directional capacity twice. First, for departure slots in the morning from 0600 to 0700. Then for arrival slots between 2100 and 2200.[19] However, at STN requests outstrip total available capacity at four times of the day: there are additional peaks in demand for slots from 1000 to 1200 and from 1600 to 1800. The apparent availability of directional capacity does not exclude the possibility that excess demand for slots exists. Equally, the availability of slots does not exclude the possibility of there being excess directional demand.

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[19] Low cost carriers need early morning slots and late evening arrival slots at STN in order to base aircraft there. If they do not have these slots, then they will not require the corresponding intermediate slots either.

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Figure 3.6
Directional Demand for Arrival and Departure Slots at an Airport with Excess Demand at Peak Times of the Day
(STN Typical Week Summer 2002)
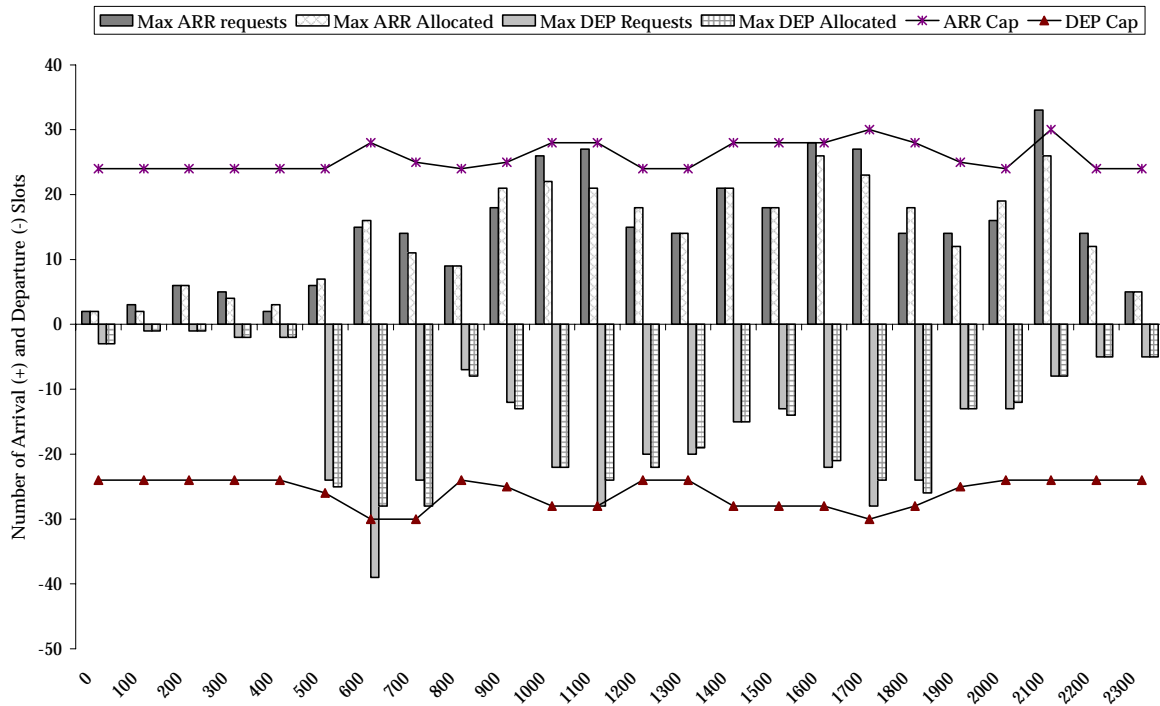
Source: Airport Coordination Limited

3.5.   Variations in Traffic Mix Between Airports

As shown in Table 3.3 and Table 3.4 the traffic mix varies between EU airports. We see that increasing scarcity of slots is correlated with increasing proportions of scheduled and long haul services and a reduced proportion of general aviation traffic.   There appears to be a strong relationship between the level of excess demand for slots and the traffic mix at airports.

We observe much greater shares of slots being operated by charter carriers at airports where there are few, if any, restrictions on obtaining slots. We also see a greater proportion of slots being used to operate long haul services the greater is the demand for slots. This suggests that airlines value slots differently between our three groups of airports and so operate services targeted at customers with greater willingness to pay at those airports where there is a shortage of slots. Long haul services typically generate greater revenues per slot than short haul services.   Similarly, scheduled services tend to cater for higher yielding passengers than charter services. Additionally, charter carriers may be placing importance on the availability of slots as it allows high levels of aircraft utilisation and flexibility, which - for their services - may be required to ensure financial viability.

Table 3.3
The Mix of Scheduled and Charter Traffic at EU Category 1 Airports

Airport category	Charter	Scheduled	General aviation
Airports with little or no excess demand	29%	47%	24%
Airports with excess demand at peak times of the day	11%	84%	5%
Airports with excess demand throughout the day	6%	88%	6%

Source: ACI Europe Data; NERA estimates

Table 3.4
The Mix of Long and Short Haul Traffic at EU Category 1 Airports

Airport category	Long haul	Short haul
Airports with little or no excess demand	16%	84%
Airports with excess demand at peak times	19%	81%
Airports with excess demand throughout the day	27%	73%

Source: ACI Europe Data; NERA estimates

Where excess demand is greatest there exists greater potential for inefficient allocation of slots under regulation 95/93. Figure 3.7 shows the traffic mix at each of the airports where excess demand exists throughout the day. We observe wide variation in the traffic mixes at these airports. For this group of airports charter traffic accounts for 4-6% of traffic at DUS, FRA, ORY and MAD and 22% at LGW. This very high proportion of charter traffic at LGW skews the group average upwards.

We also see wide variations in the share of slots used to operate long haul services within this group of airports. At MAD only 12% of slots are used to provide long haul services. Carriers at DUS utilise 24% of slots for long haul services. Both of these appear low compared to LGW, where 33% of slots are used to provide long haul services, especially considering the high level of charter traffic at LGW. The utilisation of slots for long haul services is higher still at FRA (37%) and LHR (38%) though these operate as major international hub airports. Under the air traffic distribution rules, long haul traffic cannot operate at LIN.

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Figure 3.7
The Traffic Mix at Airports with Excess Demand throughout the Day
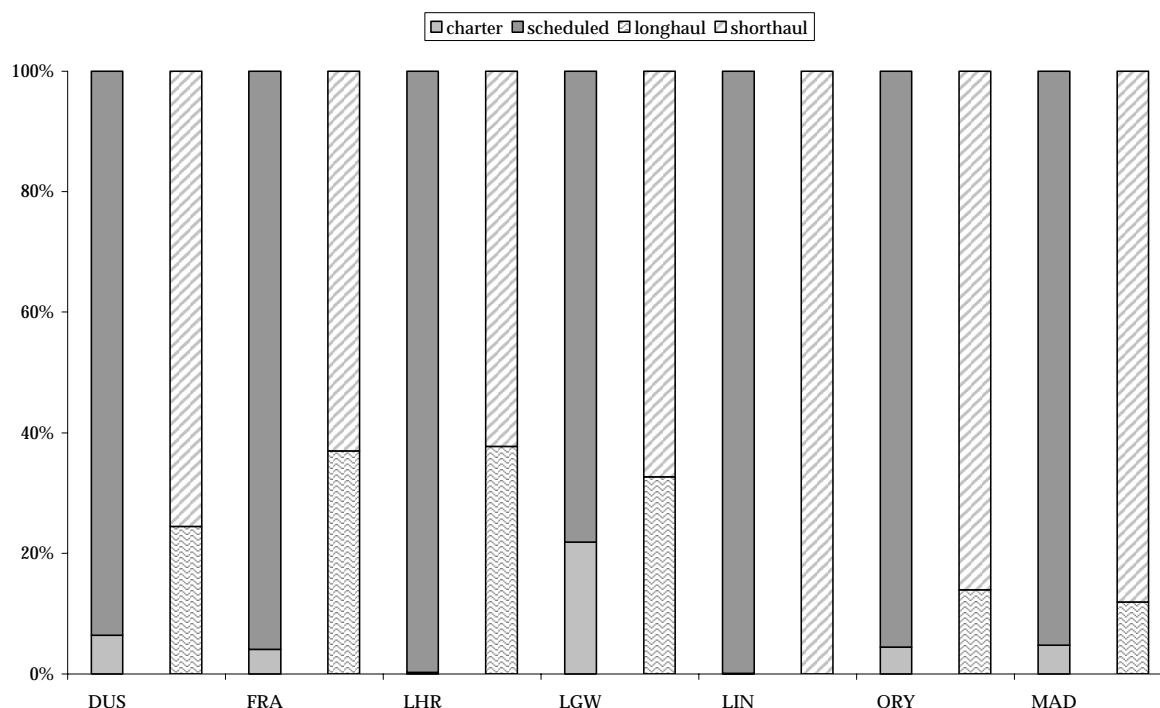
Source: ACI Europe data; Airport operators

3.6. Variations in Aircraft Size and Loadings

As shown in Table 3.5 there is considerable variation in average loads carried between EU airports. As the incidence of excess demand for slots increases we observe higher average loads. This indicates that there is greater demand from passengers for travel to and from the slot constrained airports.

Table 3.5
Average Passenger Loads

| Airport category	Average passenger load per ATM (excluding general aviation)
Airports with little or no excess demand	77
Airports with excess demand at peak times of the day	85
Airports with excess demand throughout the day	105

Source: ACI Europe data; NERA estimates

There is wide variation in average loads achieved within all demand categories of airport. In the two lower demand groups we typically observe greater loads being carried at airports

with above average levels of charter traffic, such as the Spanish airports located in tourist destinations (AGP, PMI, LPA). As shown in Figure 3.8 loadings at the airports with excess demand throughout the day varied from 84 passengers per ATM at LIN to 132 passengers per ATM at LHR. [20]

Figure 3.8
Average Passenger Loads at Airports with Excess Demand throughout the Day
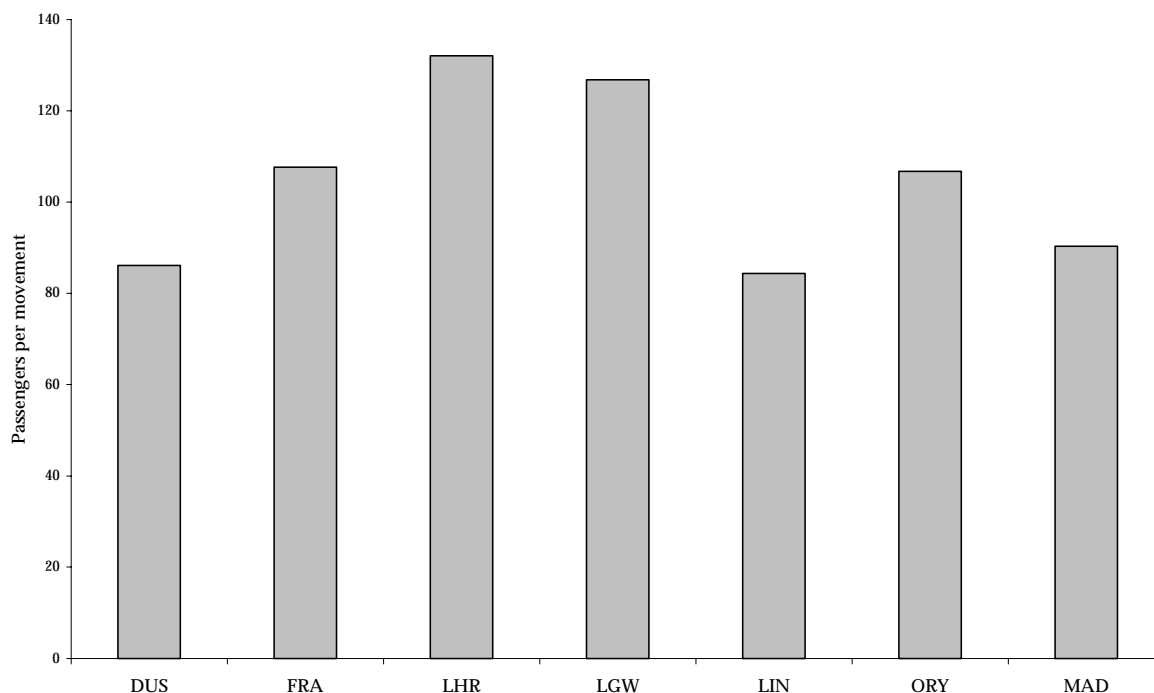
Source: ACI Europe data

As shown in Table 3.6 the greater is excess demand for slots at an airport the greater is the proportion of large aircraft utilised and the lower is the proportion of small aircraft operated. At the airports where there is excess demand throughout the day there are typically a greater proportion of long haul services operated. These services typically utilise larger aircraft, which may help to explain the greater proportion of large aircraft utilised.

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[20] The low level of passengers per ATM at LIN reflects the impact of traffic distribution rules restricting the use of the airport to short-hail traffic.

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Table 3.6
Size of Aircraft Utilised at Category 1 Airports

Average size of aircraft	Airports with little or no excess demand	Airports with excess demand at peak times	Airports with excess demand throughout the day
(1 – 49 seats)	20%	18%	7%
(50 – 124 seats)	35%	38%	34%
(125 – 179 seats)	34%	30%	32%
(180 – 249 seats)	11%	10%	16%
(250 – 349 seats)	0%	3%	5%
(more than 350 seats)	0%	1%	5%

Source: IATA Airport Capacity/Demand Profiles (2003 Edition)

As shown in Table 3.7 and Figure 3.9 there is great variation in the sizes of aircraft utilised at each of the airports where there is excess demand throughout the day.

Table 3.7
The Size of Aircraft Utilised at Airports with Excess Demand throughout the Day

Average size of aircraft	DUS	FRA	LGW	LHR	MAD	ORY
(1 – 49 seats)	12%	9%	8%	1%	11%	12%
(50 – 124 seats)	51%	33%	62%	29%	24%	28%
(125 – 179 seats)	28%	32%	13%	25%	46%	45%
(180 – 249 seats)	7%	17%	4%	25%	17%	11%
(250 – 349 seats)	3%	3%	11%	10%	1%	2%
(more than 350 seats)	0%	6%	2%	10%	2%	3%

Source:: IATA Airport Capacity/Demand Profiles (2003 Edition)

Figure 3.9
The Size of Aircraft Utilised at Airports with Excess Demand throughout the Day

Legend: ▣ (1-49 seats) ▢ (50-124 seats) ▨ (125-179 seats) ▨ (180-249 seats) ■ (250-349 seats) ▨ (more than 350 seats)
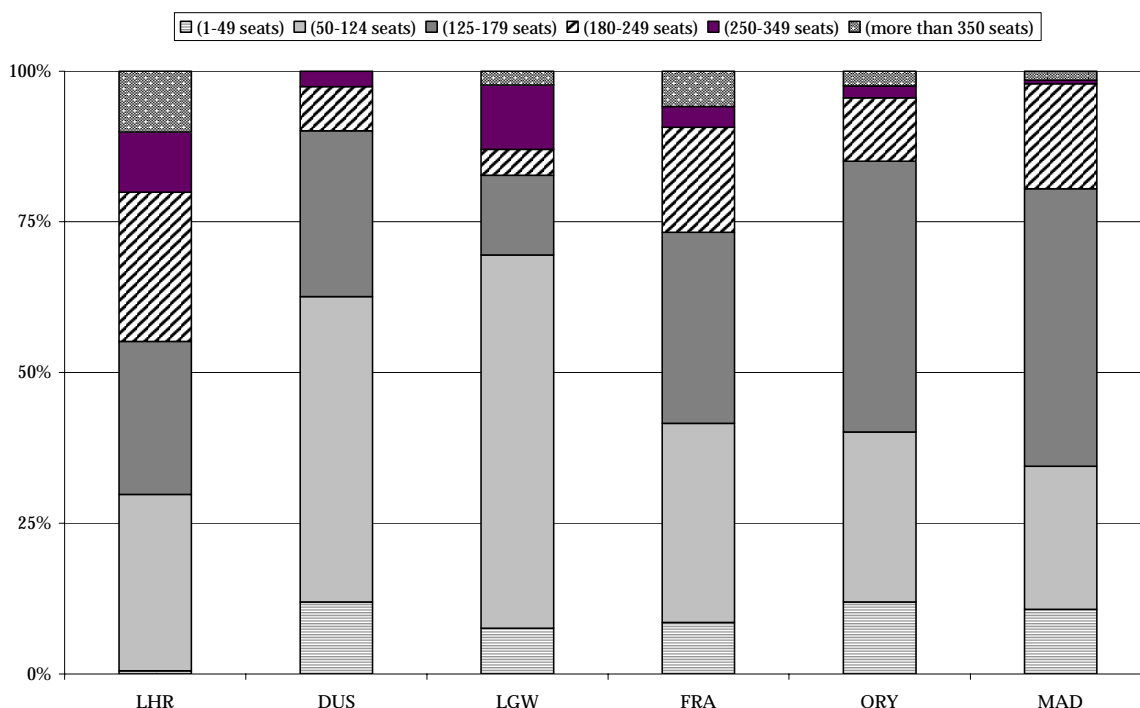
Source: IATA Airport Capacity/Demand Profiles (2003 Edition)

3.7. The Operational Patterns of Network Carriers and the Effect on Traffic Peaks

All of the airports considered in this study have times of the day during which the facilities are utilised to a greater extent than at other times, with particularly wide differences in intensity of use being observed at some, though not all, airports where hub and spoke networks are operated. This is due to the operation of arrival and departure waves at those airports by the network carrier. This traffic pattern sharply reduces the availability of slots at certain times of the day. The rationale for operating in this manner is explained in Box 3.1 below.

Box 3.1
The Economics of a Hub-and-Spoke Network

Substantial parts of the networks of most flag carriers in Europe can be characterised as hub-and-spoke networks. The essence of a hub-and-spoke network is that all destinations ("spokes") are linked to each other via services into a central hub.
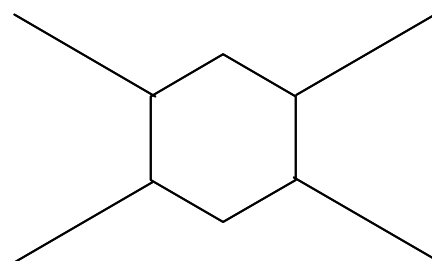
In the example above, there is one hub and four spokes, a total of five destinations. Only four routes are required to offer connections from each destination to all other destinations. If direct point-to-point services were offered from each destination to all other destinations, the total number of routes required would in this example have been 10.

The hub-and-spoke system as described above is used by many US carriers and became especially important after deregulation. In Europe, the hub-and-spoke system is generally used to feed intercontinental flights with connecting passengers from short-haul destinations. Intra-European flights are dominated by point-to-point services, in part because the distances between key European cities are much smaller than between many key US cities.

If a new route is added to the system by adding a new destination (for example a short-haul route), the entire system benefits. The reason for this is that the new destination will not just generate point-to-point passengers from the new short-haul destination to the hub, but also passengers connecting at the hub with long-haul flights. Because of the increased transfer traffic, it may become commercially viable to add a new long-haul destination. The increased number of connections benefits all cities already served by the system. Similarly, passengers travelling from the existing spokes benefit from an increase in the number of connections available at the hub.

An important feature of European hubs is the need to operate several banks per day in order to serve different long haul destinations at times desirable to passengers. The mix of destinations served in the different time windows (usually referred to as banks) are shown in Figure 3.10 below for the example of Frankfurt. This also shows the time frame in which these banks are operated.

Figure 3.10
Hub Pattern at Frankfurt Airport
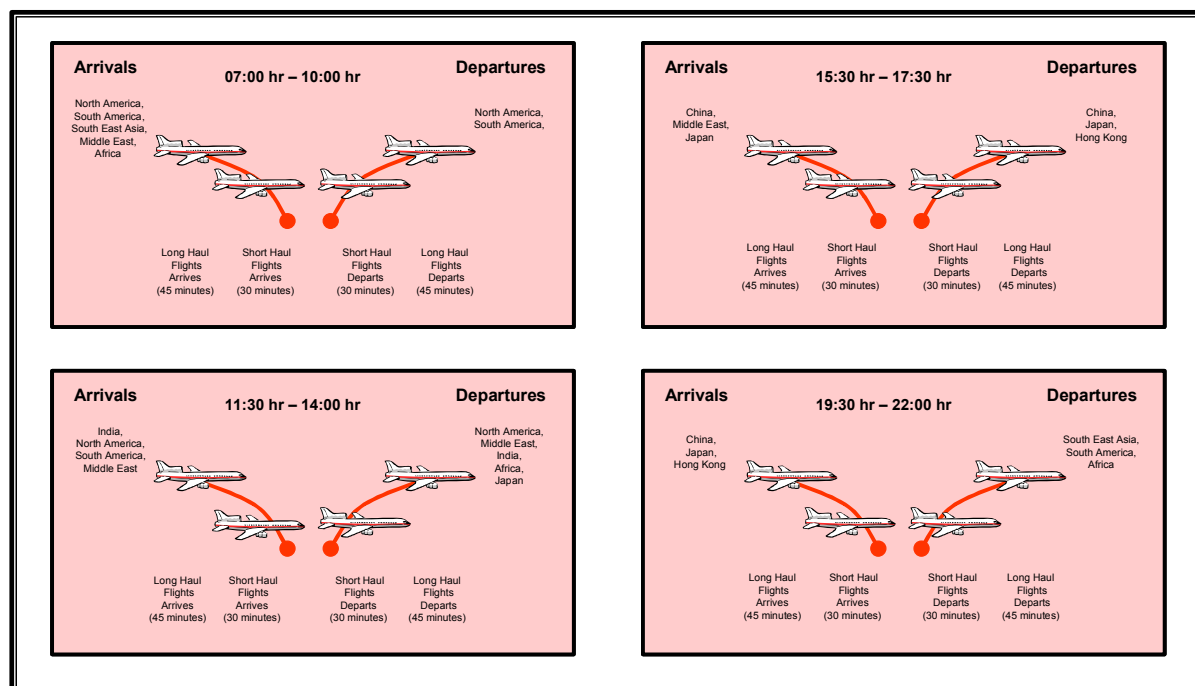
None of the airports where there is little or no excess demand are used as the hub of a major network carrier so we now focus on the two slot constrained groups of airports and the differences in peak times and network carriers operations.

The operational pattern of a network carrier at an airport with excess demand at peak times is shown in Figure 3.11. The maximum capacity at this airport (VIE) is 66 movements per hour and up to 85 per cent of this capacity is utilised by the network carrier (Austrian Airlines) at peak times. This suggests that the peak restriction here, and by implication at other similar hub airports within the group, is caused by the pattern of operation by the network carrier.

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Figure 3.11
Operation of the Network Carrier at an Airport with Excess Demand at Peak Times of the Day (Austrian Airlines at VIE)
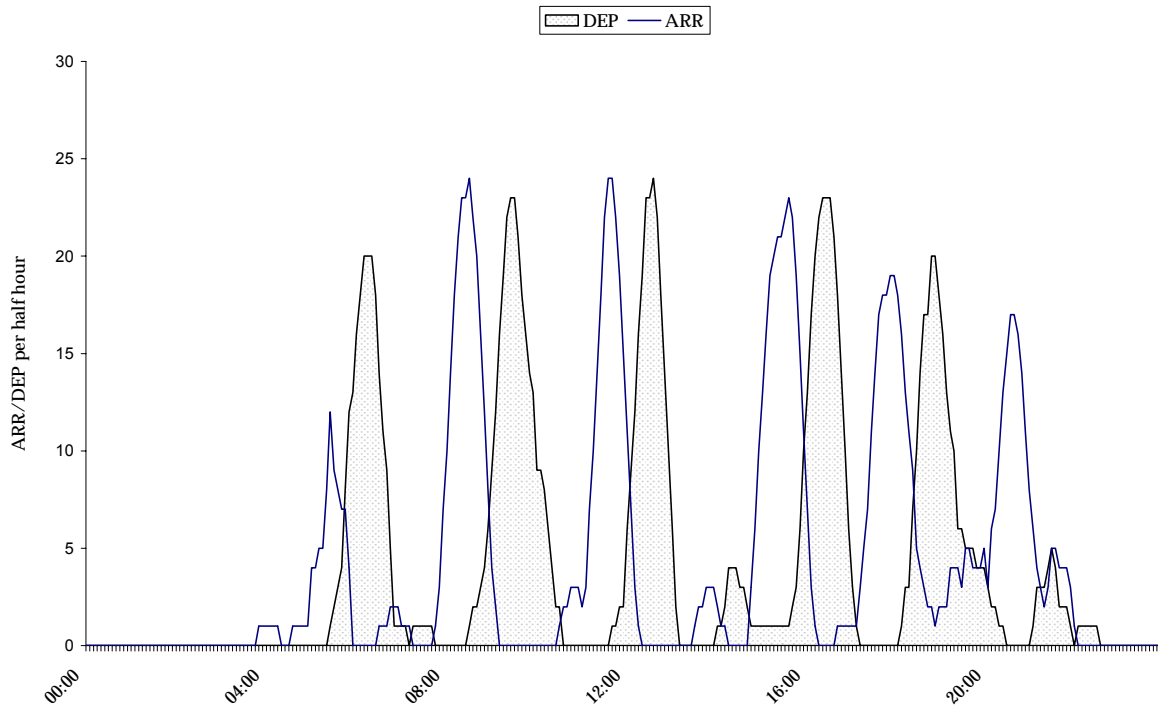
Source: Schedules data

This contrasts with the pattern of operation of Lufthansa (LH) at FRA, which is depicted in Figure 3.12 below. The banks operated by LH at FRA are broader than those of Austrian Airlines at VIE and less pronounced relative to maximum capacity (80 movements per hour). The introduction of market mechanisms might enable LH to increase its peak slot holdings, and thereby achieve an operating pattern at FRA closer to that observed for Austrian Airlines at VIE, which would allow LH to improve service by offering reduced transfer times to connecting passengers.

Figure 3.12

Operation of the Network Carrier at an Airport with Excess Demand throughout the Day (Lufthansa at FRA)
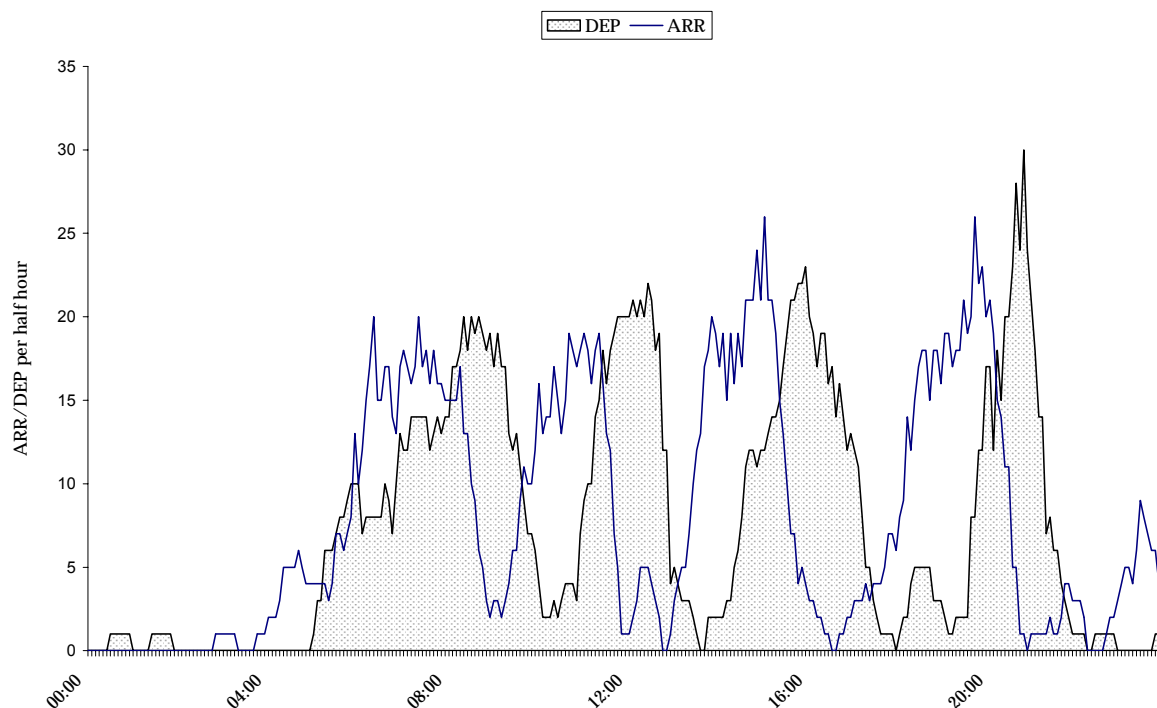
Source: Schedules data

As shown in Figure 3.13 British Airways (BA) does not have sufficiently concentrated slot holdings to operate banks at LHR. There are arrival and departure peaks but these do not appear to facilitate the short transfer times for connecting passengers that are observed at VIE and FRA. The physical layout of LHR is such that transfer between terminals takes longer than at other European hubs. This may have deterred BA from developing arrival and departure waves if establishing such a pattern of operation would not be commercially beneficial. There are also fewer troughs observed in BA's operation at LHR. This pattern may have emerged due to the high demand for slots and the binding constraint.

However, the pattern of BA's operations at LHR could also reflect underlying demand factors. The LHR catchment area population far exceeds that of other European airports and may be sufficient to sustain profitability of long haul services at LHR with fewer short haul feeder services than are necessary at other hub airports.

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Figure 3.13
Operation of the Network Carrier at an Airport with Excess Demand Throughout the Day
(British Airways at LHR)
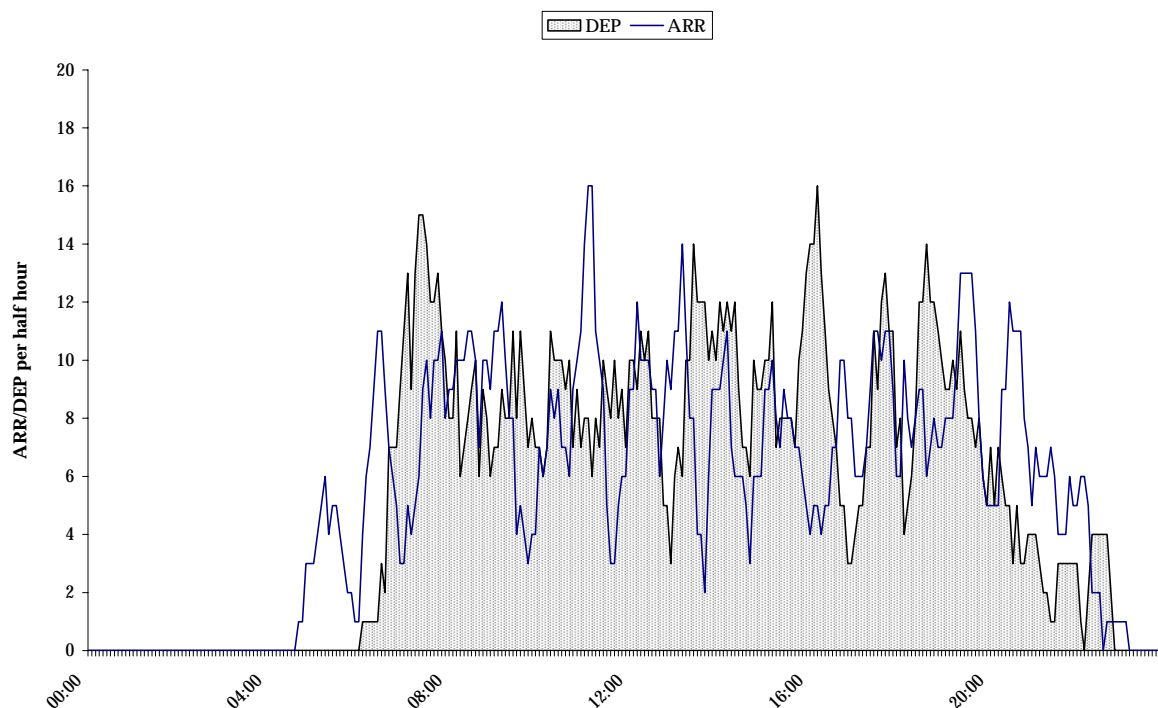
Source: Schedules data

The effect that the operational pattern of the major slot holder has on the structure of movements varies between the hub airports. Slot utilisation at LHR and FRA is shown in Figure 3.4 and Figure 3.5 on pages 28 and 29. At FRA there are hours in which average utilisation dips below capacity. These dips tend to be observed on the fringes of, or outside of banks operated by LH. This contrasts with the position at LHR where the hourly average utilisation rarely falls below the maximum hourly capacity. Figure 3.14 shows the impact of Austrian Airlines operational pattern on total slot utilisation at VIE. We observe that the structure of movements at VIE appears to be determined by the operation of clear and pronounced waves of arrivals and departures operated by Austrian Airlines, as seen in Figure 3.11. Excess directional demand from other carriers who may prefer to operate into the banks in order to benefit from Austrian Airlines network cannot always be accommodated.

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Figure 3.14
Hour by Hour Movements at an Airport with Excess Demand at Peak Times of the Day
(VIE Representative Monday Summer 2002)
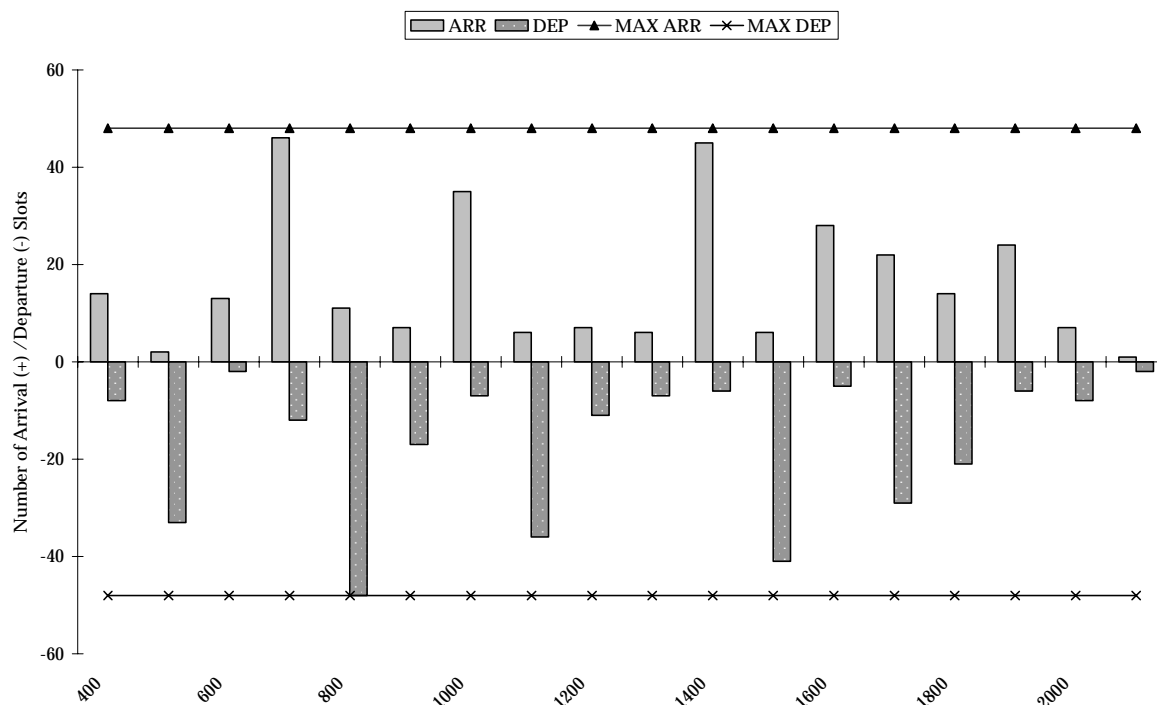
3.8.   Slot Holdings of Major Network Carriers

As shown in Table 3.8, the average proportionate slot holding of the major carrier at airports with little or no excess demand is considerably lower than those of carriers at slot constrained airports. Within each group of airports the holding of the major carrier, on average, increases during the morning peak. This increase is typically much greater at airports with little or no excess demand. This is to be expected because the carriers' applications for slots are not restricted by lack of capacity during the peak times.

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Table 3.8
Slot Holdings of Major Carriers at Airports

Airport category	Average slot holding of the major carrier (all day)	Average slot holding of the major carrier (morning peak)
Airports with little or no excess demand	28%	37%
Airports with excess demand at peak times of the day	41%	47%
Airports with excess demand throughout the day	42%	47%

Source: Schedules data; NERA estimates

The lower average proportionate slot holdings of the major carriers operating at airports with little or no excess demand represents the carriers desired holding. It follows that the holding is determined by underlying passenger demand, which is typically lower at these airports than at those in the slot constrained groups. None of the airports in the unconstrained group are operated as a hub and the carriers typically offer less developed networks.

There is greater variation in slot concentration between airports with excess demand throughout the day as shown in Figure 3.15. The greatest variation occurs between FRA, where Lufthansa holds 60% of all slots that are operated there, and LIN, where Alitalia holds only 32% of all slots operated there. Such differences may be explained by the type of services operated at these two airports. Lufthansa operates as a network carrier with FRA as its hub whereas only short haul services operate at LIN. Of this group of airports FRA, LHR and MAD are hubs. The network operators at LHR and MAD each hold 40% shares of the operated slots whereas Lufthansa's holding at FRA is much higher.

Figure 3.15
Concentration of Slot Holdings at Airports with Excess Demand throughout the Day
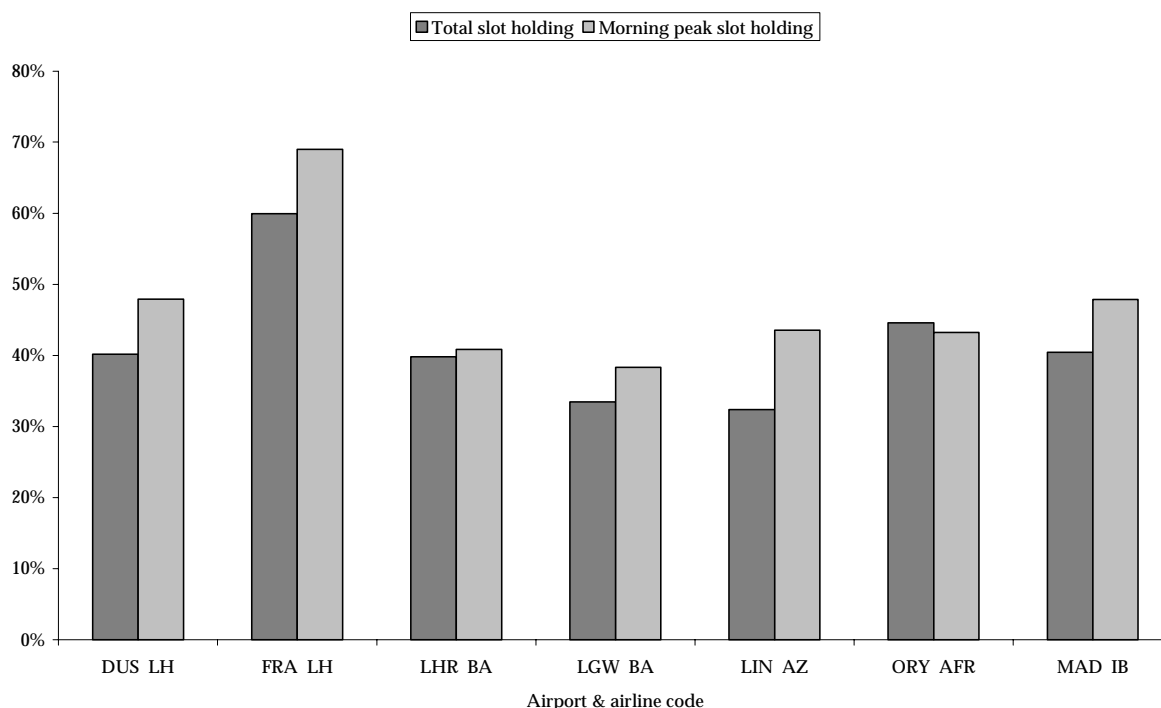
Source: Schedules data; NERA estimates

Figure 3.15 also shows the differences between the total slot holdings of major carriers and holdings during the morning peak. All of the major carriers except Air France at ORY have higher slot holdings during the morning peak than at other times. The differences then vary between 1% for British Airways at LHR and 12% for Alitalia at LIN. Of the hub airports in the group, the hub carrier has a substantially higher share of slots in the (morning) peak slot at MAD and at FRA. The differences may be due to the carriers' historic strategies or the physical layouts of the airports. Lufthansa and Iberia operate distinct, identifiable waves of arrivals followed by departures at their respective hub airports whereas British Airways does not.

3.9. Forecast of Changes in Excess Demand at Airports Between 2002 and 2007

The level of and changes to excess demand at airports in the future each depends on changes in capacity and the volume of air transport movements during the forecasting period. We have obtained information on the average forecast changes in capacity and movements in the period to 2007 from the airport operators and coordinators, and the information for each of the three groups of airports is summarised in Table 3.9. The expected growth in the volume of ATMs varies inversely with the current extent of excess demand, although there is relatively little difference in the expected growth as between airports with severe excess demand, and those where excess demand occurs mainly during peak periods only.

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Table 3.9
Changes in Capacity and the Number of Movements Between 2002 and 2007

Airport demand in 2002	Average capacity increase	Average increase in air traffic movements
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%

Source: Airport operators' forecasts; NERA estimates

Where excess demand is currently greatest, movements are forecast to increase in line with capacity whereas at airports with lesser constraints, increases in movements are forecast to outpace capacity increases. Between the groups of airports with little or no excess demand and those with excess demand at peak times, forecast growth in movements at the former outstrips that at the latter because of the greater availability of slots at peak times. The availability of slots throughout the day makes the less constrained airports more desirable to carriers who require high aircraft utilisation, such as low cost and leisure carriers.

As shown in Figure 3.16 there is wide variation in both increases in traffic and capacity during the forecast period between airports where there is excess demand throughout the day. Capacity is expected to be increased substantially at DUS, FRA and MAD but not at all at the other airports. Much of the additional capacity at FRA will be utilised by 2007 whereas spare capacity at DUS will become available. We also predict that there will be a greater number of available slots at MAD once the additional runways, terminal and satellite are available though we do not have 2007 traffic forecasts.

Figure 3.16
Forecast Increases in Capacity and the Number of Movements at Airports with Excess Demand throughout the Day
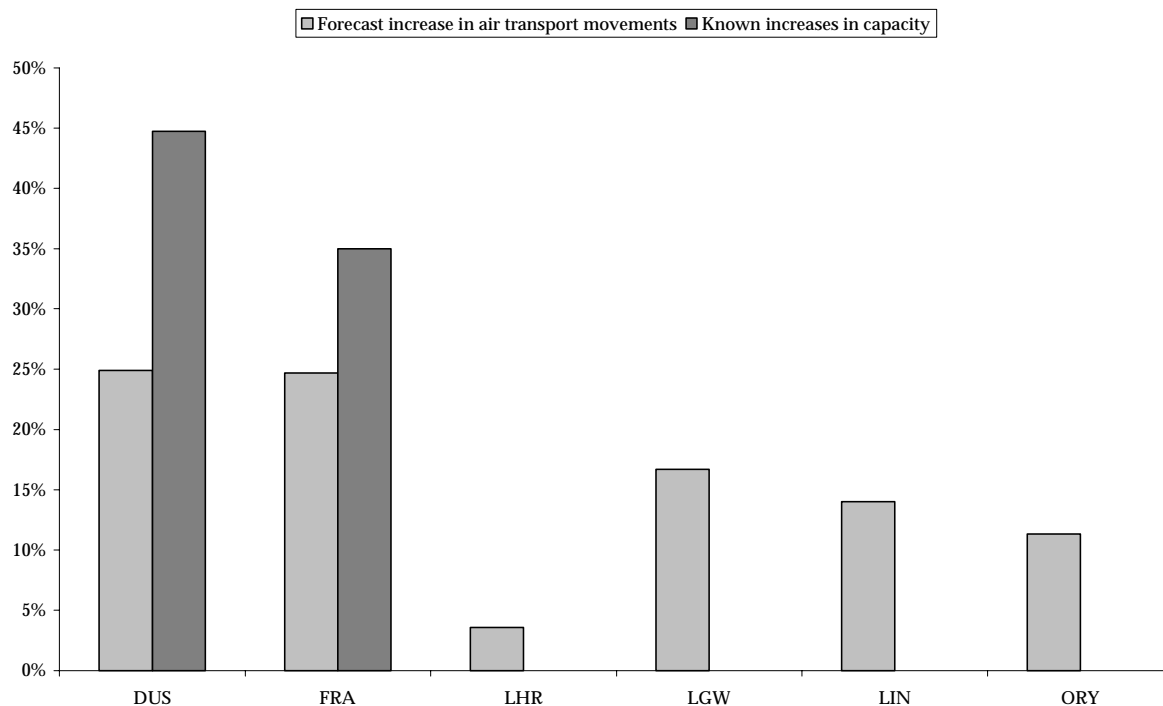
Source: *Airport operators' forecasts; NERA estimates*

The increase in the number of movements at LHR is much less than the increases predicted at the other airports in this group. The high rate of current capacity utilisation at LHR leaves little room to increase the number of movements at the airport, except by allowing the runways to be operated on a dual mode basis, as is currently the case at LGW, but which would be controversial in terms of environmental impact. Additionally, the UK government has placed an annual limit of 480,000 on the total number of movements permissible at the airport. However, this does not appear to artificially constrain LHR before 2007; the total number of movements forecast for 2007 being 474,000. We predict that passenger loads will increase by 8% at LHR in order to accommodate increasing passenger demand. This will result in greater passenger loadings and the use of more large aircraft at LHR.

At ORY there is little prospect of the 250,000 annual movement limit being raised or removed before 2007, and the 11 per cent increase in movements forecast at ORY represents no more than a pick up from the depressed utilisation of slots during 2002 after Air Lib started to reduce its operations at the airport. Expected increases in passenger demand for services to or from ORY are expected to result in 16 per cent more passengers being carried per air transport movement by 2007.

Given no additional capacity at LGW or LIN, we will see further broadening of peak times and even higher slot utilisation accommodating increased movements at these airports during the forecast period.

By 2007 the extent of excess demand for slots at airports will have changed. At DUS, FRA and MAD we predict that excess demand will have reduced considerably, with limited or no excess demand outside peak periods. This leads us to reclassify those airports as shown in Table 3.10. Of airports which experienced little or no excess demand in 2002 we predict sharp increases in traffic at BGY, CIA and SXF and significant increases at most others, but there is unlikely to be any significant excess demand at these locations.

Table 3.10
Categorisation of Airports

| Airports with little or no excess demand		Airports with excess demand at peak times of the day		Airports with excess demand throughout the day	
2002	2007	2002	2007	2002	2007
ARN	ARN	AGP	AGP	**DUS**	LHR
ATH	ATH	AMS	AMS	**FRA**	LGW
BGY	BGY	BRU	BRU	LHR	LIN
CIA	CIA	CDG	CDG	LGW	ORY
FAO	FAO	CPH	CPH	LIN	
HEL	HEL	DUB	DUB	ORY	
LPA	LPA	FCO	**DUS**	**MAD**	
LTN	LTN	LIS	FCO		
SKG	SKG	MUC	**FRA**		
SXF	SXF	MXP	LIS		
THF*		PMI	**MAD**		
		STN	MUC		
		TXL	MXP		
		VIE	PMI		
			STN		
			TXL		
			VIE		

Source: NERA estimates

* THF is due to close before 2007

Similarly, we do not expect the extent of excess demand to alter sufficiently in any of the airports categorised as having excess demand at peak times in 2002 for them to require reclassifying, although peak times at MUC and DUB are set to widen during the forecast period, since no additional runway capacity will be provided. The greatest increases in movements are expected to occur at CDG, where additional runway, apron and terminal capacity will come on stream, and AMS.

These projections therefore indicate that there will be fewer airports experiencing excess demand for slots throughout the day in 2007 than there were in 2002. We predict that there

will be significantly less excess demand at DUS, FRA and MAD. In each case this is because of airport capacity being increased before 2007. At all these airports we predict that capacity added will be greater than additional slots allocated so it follows that some excess demand will be satisfied.

At LHR, LGW, LIN and ORY we expect to see increased movements accommodated on the fringes of the day and increased slot utilisation where possible. Average passenger loading will increase at each of these airports and larger aircraft will be utilised. Excess slot demand throughout the day will continue to be an acute problem at these airports.

4. INEFFICIENCIES IN THE CURRENT FRAMEWORK

4.1. Introduction

In this chapter we consider forms of inefficiency in the current system of slot allocation at EU Category 1 airports.[21] We concentrate on forms of the inefficiency that will be affected by the introduction of market mechanisms. We do not consider features of the current system, such as public service obligations (PSO), or measures to encourage new entrants, which could equally well accompany market mechanisms; nor do we consider efficiencies that could be achieved by reforming the administrative mechanism.

We start in Section 4.2 by discussing how the allocation of slots may be inefficient. In Section 4.3 we examine data on slot utilisation. In particular, we examine the extent to which there appear to be unused slots at times when requests for slots exceed availability. In Section 4.4 we examine indications that slots for which there is excess demand are not being used efficiently. In Section 4.5 we present data on slot mobility. In Section 4.6 we look at peak and off peak use of airports.

4.2. The Causes of Inefficiency

4.2.1. The basic problem

Airports are widely perceived as generating significant negative externalities, in the form of noise and pollution, and the experience in the EU has been that airport expansion is deeply unpopular with local residents. As a result, growth in the supply of airport capacity, especially runway slots, has tended to lag behind the growth in demand for airport services, especially at airports located close to major population centres.

As with all goods and services, <u>existing</u> airport capacity can be allocated efficiently if charges to airlines are set to equal the marginal social cost of the service using the airport. Marginal social cost includes both the marginal operating cost of the airport owner, and the cost of delay to passengers and airlines. Delay etc costs tend to increase as the airport operates close to its physical capacity. Once the physical capacity is reached, marginal social cost reflects the opportunity cost, or willingness-to-pay of services that cannot be accommodated, given the capacity constraint. In practice, charges to airlines are not set according to these principles, and this divergence from marginal cost results in inefficiencies.

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[21] We are concerned with the allocation of capacity, rather than the overall level of capacity. Insufficient capacity can, of course, be a major source of inefficiency (as can too much capacity, for example if this leads to excessive congestion and delays).

Three types of inefficiency may occur from prices which diverge from marginal social cost, and these are shown in Figure 4.1.

In the first case, the price (airport charges including taxes) <u>exceeds</u> the marginal cost. This is shown in the Figure as Demand Case 1: the number of slots used, Q_1, is less than the efficient number, E_1. This is often the case at airports where there is excess capacity. Airport charges tend to exceed marginal cost in such cases, because the additional cost for an airport of an extra aircraft landing is low. At such times, some marginal flights may not be willing to pay the specified airport charges, though would be willing to pay the marginal cost they impose on the airport, and so the charges are inefficient because the potential benefits of such flights are forgone.

Figure 4.1
Excess Demand When Prices are Below Market-Clearing Levels.
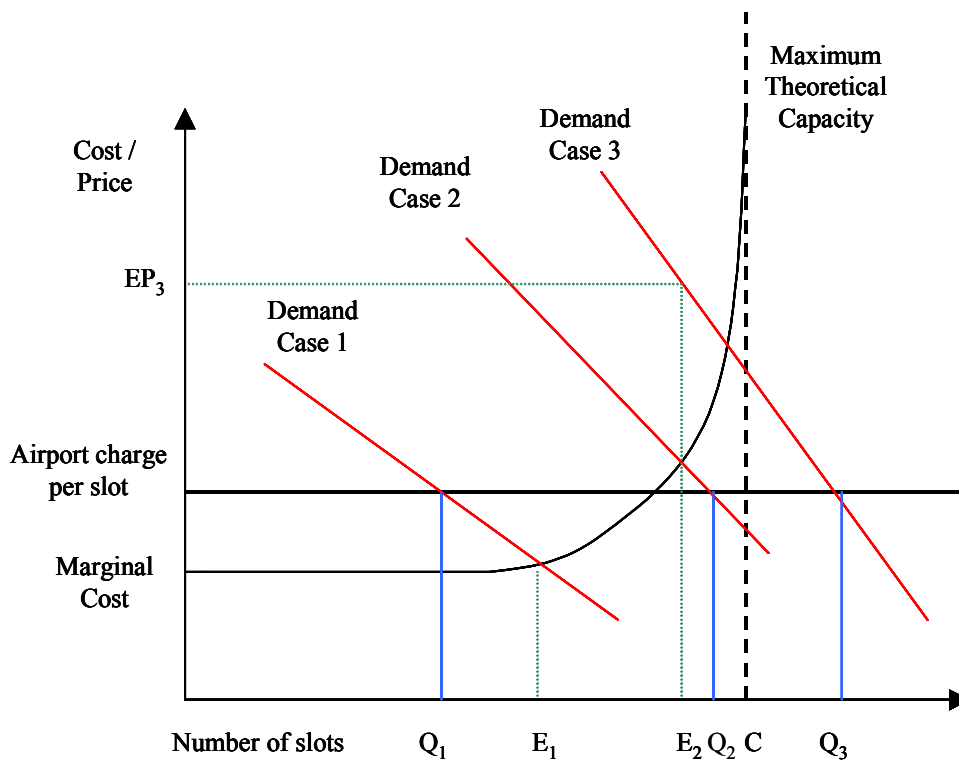
The second type of inefficiency occurs when prices are <u>less than</u> marginal cost, but all demand for slots is satisfied. This is shown in Figure 4.1 as Demand Case 2. In such cases, the number of slots used Q_2 exceeds efficient levels, E_2. This second situation is less common in the context of airports. However, it may occur, for example, if there is no capacity declaration or slot coordination at an airport which occasionally experiences congestion, so that too many aircraft queue to use the runway, resulting in excessive delays. Normally it is the responsibility of the competent authorities to declare airport capacity, and our report is concerned with airports where capacity declarations have been made.

Finally, inefficiency occurs when demand exceeds the declared capacity (also shown as E_2) given the prevailing level of airport charges, so that there is excess demand to use the airport. This is shown in Demand Case 3, where demand for slots Q_3 exceeds the declared capacity, E_2. This is commonly the case at many major, fully coordinated, EU airports, at least at peak times of the day. In such circumstances, the optimal price (assuming no capacity expansion) is simply the price, EP_3, at which demand for slots is equal to the declared capacity.

Presently, administrative procedures are used to manage the excess demand, in particular the grandfathering of slots, and the rules in regard to the allocation of pool slots. Administrative procedures act as alternatives to pricing mechanisms, and some procedures will be more efficient than others.

Under many systems, however, some slots will be allocated to airlines that would not be willing to pay the market clearing price, EP_3, and indeed who might be willing to pay only a little bit more than the current charge. As a result of this, some airlines that would be willing to pay EP_3 (and perhaps considerably more) will not be able to get hold of slots, even though they would be prepared to pay considerably more than some of the airlines that do have slots. This is the basic source of inefficiency associated with administrative allocation mechanisms, and the main purpose of this report is to consider the impact of market-based allocation mechanisms that may be able to reduce or even eliminate such inefficiencies.

4.2.2. Barriers to entry and expansion

The most important factor that is liable to cause inefficiency at Community airports is probably the inertia that is inherent to the present system. At congested airports, airlines will wish to continue to use slots for which they have historic rights provided that they can make a marginal profit on the service. There is limited scope to sell such slots within the current framework, even though other airlines may value them more highly.

The result of this lack of slot mobility is that it is very difficult to obtain a series of slots with which to launch or expand a service. At congested airports, pool slots tend only to be available at unattractive times, or are not available as a series. This is a barrier to competition, because new services may not be launched, and a barrier to attractive services being expanded (though clearly some new services have been launched successfully in these circumstances, sometimes obtaining the use of slots through secondary trading or leasing agreements). The barrier affects new entrants and competitors to incumbent airlines in particular, but may also prevent incumbents from improving their network of services.

As a result, incumbents are reluctant to relinquish slots. Even if they make a financial loss on some services, they may wish to continue with these services in the expectation that they will be able to use the slot profitably again within, say, one or two seasons. In the meantime, the services that operate are inefficient, and in some cases a proportion of such flights will be cancelled in order for the airlines to reduce costs, and hence scarce capacity is wasted.

While market entry has certainly occurred, some of it very successfully, the fact that low cost carriers often use less convenient airports, and offer a rather different service to most incumbents, has tended (until recently at least) to limit the competitive impact. Some low cost carriers might choose to avoid congested airports, for both financial and operational reasons, but others would welcome the opportunity to compete directly with established carriers servicing congested airports.

Of course, the current slot allocation process is not the only factor that potentially causes inefficiencies in the EU aviation market. There is a strong link with other areas of aviation regulation and in particular the bilateral air services agreements discussed in Section 2.4.2. On routes where a restrictive agreement applies, for example designating only the two flag carriers, it would not be possible for a new entrant to enter the market even if suitable slots could be obtained. However, the single European aviation market, established through the so-called "third package", and the fact that many Member States have conducted Open Skies agreements with the United States (with the United Kingdom being a notable exception) imply that in many key markets, it is now the slot availability and not the traffic rights that has the greatest potential for causing inefficiencies.

4.2.3. Incentives to minimise costs

The lack of entry opportunities reduces the competitive threats faced by incumbent airlines, and this weakens the incentives to reduce costs. While private-sector airlines can in theory be expected to achieve efficient cost levels, in practice there are substantial practical problems which mean that cost minimisation is unlikely to be achieved in the absence of sufficient competitive constraints. As pointed out by Sir John Hicks – the best of all monopoly profits is a quiet life.

It is noteworthy that both a very substantial demand shock (following the September 11 attacks on the US) and new competitive pressure <u>outside</u> the main hub airports (in the form of the low cost airlines) appear to have been necessary to enable the Community's flag carriers to undertake some radical cost cutting measures. If these competitive pressures had been present <u>at</u> the hub airports themselves, these cost savings might have been achieved at an earlier stage.

4.2.4. Air fares

We would expect airline fares to be higher on routes for which there is little or no competition. As there are currently significant barriers to competition at slot constrained airports, we expect there to be inefficiently high air fares on some routes.

However, while entry into a market with high fares may lead to lower fares in that market, such entry could (assuming a fixed level of airport capacity) lead to a reduction in competition in other markets with higher air fares there as a result.

4.2.5. Other types of inefficiency

Another type of inefficiency of the current system is that airlines that have been allocated slots from the pool have little incentive to return them in good time. The result of this may be that they are returned late, so that then the opportunities for the coordinator to reallocate the slots to scheduled services are greatly reduced. This is a particular problem for airports that experience some, but not large amounts, of congestion. This is discussed further in Section 4.3 below.

4.2.6. Factors limiting inefficiency in the current framework

We should note that there are also a number of factors in the present framework that mitigate these inefficiencies.

- **Internal market within carriers** Carriers can, subject to compliance with capacity constraints, adjust the services allocated to particular slots in order to increase their profitability, and hence efficiency. Carriers with a larger slot portfolio have more flexibility to make such improvements.

- **Internal market within alliances** Exchanges of slots within alliances to modify service patterns work in a similar way to the market within an individual carrier.

- **Administrative procedures** Certain procedures in the current system will act to reduce inefficiencies, including scope for slot swaps and, in some cases, retiming historic slots.

- "**Grey market**" Secondary trading, using "junk slots" and monetary exchange, occurs at London Heathrow and, to a limited extent, at certain other airports. These exchanges mean that the slot is transferred to an airline which values it more, and therefore the efficiency of its allocation is increased. Slot leasing agreements act in a similar manner.

4.3. Slots Utilisation

Under the current EU and international slot allocation systems, airlines are not charged for slots allocated to them which they do not use. The IATA scheduling guidelines require that airlines return unwanted slots before an allotted time in advance of the relevant season (31 January for the summer season and 31 August for the winter season) but, for most EU airports, failure to meet this deadline has no associated sanction.[22]

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[22] Under Council Regulation 95/93 this deadline is used for the purpose of calculating historic rights (the 80-20 rule); there is no other requirement that slots are returned by this time.

In some cases, it will be in airlines' interests to request more slots than they are likely to need, because airlines with a larger slot portfolio have greater flexibility to finalise their schedules. However, at times where demand exceeds capacity there is an opportunity cost associated with slots which are allocated and are not used. It may not be possible for coordinators to reallocate slots which are returned late, even if demand for the slots exceeded supply earlier in the season. As the opportunity costs are not borne by the airlines retaining unused slots, this may result in an inefficient outcome.

There is some indication that this inefficiency is substantive. It is certainly a cause for concern and has been drawn to our attention repeatedly, primarily by coordinators and airport operators.

We have only limited data on **late** returns of slots to the pool, though the figures we do have suggest that this is a significant problem. Late returns were particularly prevalent for the Summer 2002 season, where the proportion of all slots allocated at the slot return deadline (31 January 2002) which were not used was between 8 and 13 per cent for the seven EU airports for which we have data.[23] This was some months after 11 September 2001, and the associated sharp fall in air travel. There appear to be around 25 per cent fewer late returns in other seasons, ie around **6 to 9** per cent of all slots allocated at the deadline would not be used for many of the major EU airports.

Several coordinators are able to alleviate the inefficiency associated with late returns by initially allocating more slots than would be optimal under a range of weather conditions. They are able to predict that a large number of slots will not be used and therefore that delays will be contained.

This "second best" approach is not possible for a limited number of airports where the capacity constraints are specified in legislation. In these cases there is little opportunity to balance potential delays with efficient use of capacity. The outcome can be poor utilisation of airport slots. There are two main examples of this: the very congested airports of Düsseldorf and Orly. At Düsseldorf, where capacity is legally determined at 38 movements per hour (with additional night time restrictions), initial demand exceeds capacity during the summer season throughout the day, with the exception of some hours at the weekend. But for the Summer 2002 season, 12 per cent of slots allocated were not used. The binding legal restriction at Orly is 250,000 movements per year, and demand greatly exceeds supply. However, in 2002, only around 90 per cent of these movements occurred.

Figure 4.2 shows patterns of use at an example airport for a particular day. Requests exceed capacity for much of the day. Movements are allocated on the basis of these initial requests

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[23] The airports are AMS, CDG, CPH, DUS, LGW, ORY and STN. MAD is excluded and is discussed below. We do not have equivalent figures for LHR and FRA, but can calculate that around 95 per cent of all runway capacity between 7am and 7pm local time on typical weekdays is used.

so that all capacity constraints are satisfied. Actual use however is significantly below the movements allocated.

Figure 4.2
Requests, Allocation and Use of Slots at an Example EU Category 1 Airport
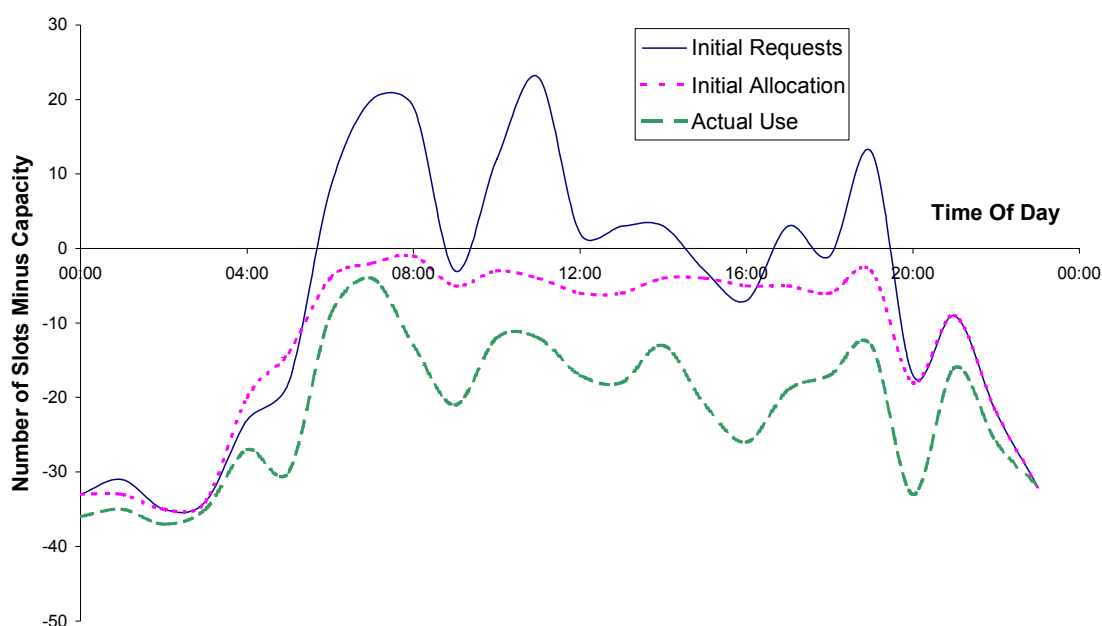
Many of the slots which are not used will have historic rights maintained. Under the 80-20 rule, airlines need only use 80 per cent of a series of slots. It is also possible to manipulate the 80-20 rule, though close monitoring may reduce such opportunities. For example, we understand that in some cases airlines are able to switch services from a highly utilised slot series to a slot series with poor utilisation to ensure that the 80 per cent threshold is reached on both series. As the monitoring of the 80-20 rule does not necessarily record the time of flight, airlines may be able to manipulate the 80-20 rule without disrupting their schedules.

The bankruptcy exemption of the 80-20 rule can last for many months, and has also resulted in slots for which there is excess demand not being used. The recent suspension of the 80-20 rule is another example where slots for which excess demand exists may not be used;[24] we understand that some of the new slots allocated at Orly in the wake of the Air Liberté bankruptcy will not be used because of this exemption, even though demand for such slots greatly exceeded supply.

Indicative evidence from Spain confirms that airlines would return more slots within the deadlines if they had financial incentives to do so, thereby permitting improved utilisation

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[24] Supervision of the 80-20 rule has been proposed by the Commission but not yet ratified.

of slots: when fines were established for the late return of slots by Royal Decree in November 2001, the proportion of slots returned within the deadline increased from around 7 per cent to around 14 per cent; only a further 2 per cent were not used.

4.4. Indicators of Inefficient Use of Slots

In this section we examine situations where excess demand for slots exists and allocation of the slots appears to be inefficient. We start by defining what we mean by inefficiency.

4.4.1. Defining inefficiency

An allocation of slots is inefficient if an alternative allocation exists which would deliver more net benefits. The net benefits of allocating a slot are:

> *Total passengers' willingness to pay for the flight – total paid in airfares + revenue to airline + revenue to airport – airline's marginal costs and charges – airport's marginal costs – net external costs.*

Some of these items cancel, for example charges levied by the airport to the airline are revenues for the airport but charges for the airline (though they may also include taxes). Hence, the above expression can be written in a variety of forms. For example, total net benefits can also be expressed as

> *Benefits to passengers (net of airfares and other costs) + marginal profit to airline + marginal profit to airport – net external costs.*[25]

The net benefits (or relative efficiency) of a particular allocation A relative to an allocation B is:

> *{Benefits to passengers of allocation A*
> *– benefits to passengers of allocation B}*
> *+ {marginal profit to the airlines and airports resulting from allocation A*
> *– marginal profit to the airlines and airports resulting from allocation B}*
> *- {net external costs caused by allocation A*
> *- net external costs caused by allocation B}*

We are not able to estimate the change in benefits, and hence the change in efficiency, directly because we do not have information on different airlines' marginal costs for different types of services and have little information on revenue. Instead, we can make the

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[25] The economics terminology is that the benefits are the sum of the "consumer surplus" (passengers' benefits) and "producer surplus" (the airlines' and airports' profits), less net external costs.

following observations, which identify how broad estimates of the size of benefits can be estimated.

- Allocating a slot to a service with **high airline revenues** will be more efficient than allocating it to a service with low revenues, provided that the benefits of higher revenues are not outweighed by higher costs.

- An allocation to an airline which has an **efficient cost base**, all other things being equal, will be more efficient than an allocation to an airline which has an inefficient cost base. This does not necessarily mean that an airline with low costs will always be more efficient. Higher costs may be justified if they are a reflection of higher service quality which in turn delivers higher revenue and / or passengers' benefits.

- We expect that a flight with more **passengers** will on average deliver more net benefits than a flight with fewer passengers. Total passengers' benefits will typically be greater if there are more passengers, and airlines and airports' profits are both strongly correlated to the number of passengers. Clearly a flight with a higher loading of passengers will usually have more net benefits than another otherwise identical flight. But an airline's decision to accommodate more passengers will be a commercial one, and so on average more passengers should imply greater benefits even if there are more associated costs.[26]

- Similarly, we expect a flight with more **seats** to deliver more net benefits than a flight with fewer seats, on the basis that a larger plane is provided because more passengers are expected and are commercially justified.

- All other things being equal, allocating a slot to a flight causing less **external costs** (for example environmental costs) will be more efficient than allocating it to a flight with more external costs.

In practice, we have not found it possible to obtain reliable data on airline revenues and costs on an airport by airport basis, or distinguishing between peak and off peak periods. Data on passenger numbers tends to be aggregate. We do have disaggregate data on numbers of seats.

4.4.2. Use of small aircraft

The use of small planes at times of excess demand may be an indicator of inefficient use of runway capacity, especially if the small number of passengers signals a relatively low total

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[26] This condition will always hold when comparing like with like. If comparing different types of service, for example a small service for mainly business passengers and a larger service for mainly economy passengers, the correlation of benefits to number of passengers may break down.

willingness to pay for the service.[27]   Some services operated by small planes may be very profitable, but on average we expect services with small planes to be less profitable than those with larger planes. This is also supported by the evidence presented in Section 3.6, which shows that services operated by small planes account for a lower proportion of slots at airports which are more congested.

Figure 4.3 shows alternative analysis, namely size of aircraft across EU Category 1 airports, but restricted to times of the day where use of slots is constrained.[28]   This analysis reveals that 8 per cent of these slots (around 3,300 slots per week in total) are used by aircraft with 50 or fewer seats; 16 per cent are used by aircraft with fewer than 100 seats. We have found that these statistics are only marginally affected by public service obligation flights (which often operate with small planes) because most of the airports in the sample have few or no PSO services. To illustrate this, the Figure shows the profile of seat sizes for Orly airport separately; Orly is unusual in that around 14 per cent of all slots are used for PSOs.[29]

Figure 4.3
Size of Passenger Aircraft During Slot Constrained Times, Summer 2002 Season

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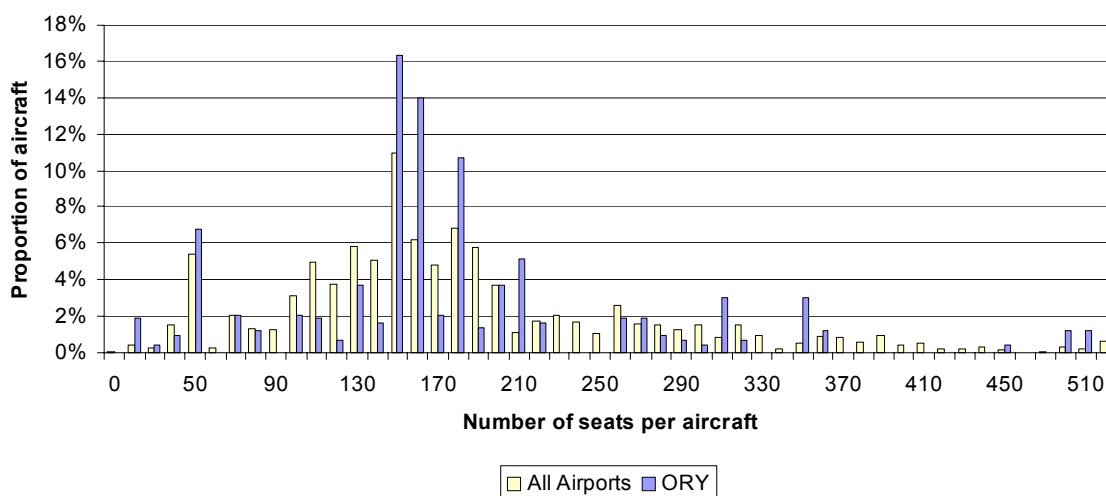
[27]   This might not be the case if, for example, a high proportion of passengers were time-sensitive business users, or were transferring to long-haul flights.

[28]   We have used a proxy for slot constraint: those hours where the number of slots scheduled exceed 90 per cent of the hourly slot capacity (and we have also included Orly airport which has a binding annual constraint). This measure is conservative because there will be other times of slot constraint, for example where a directional runway capacity threshold is met, which are not included in this measure. All EU Category 1 Airports where this threshold is met have been included, 19 airports in total, with the exception of Germany and Finland for which we do not have the necessary data. We have also excluded night flights. Only passenger aircraft are shown.

[29]   If the analysis excludes Orly, we find that 7 per cent of slots at constrained times are used by aircraft with 50 or fewer seats, 16 per cent are used by aircraft with 100 or fewer seats. The equivalent figures for Orly alone are 10 per cent and 15 per cent respectively.

The structure of airport charges influences aircraft size. Landing charges for many airports are highly differentiated by aircraft weight so that smaller aircraft pay less. BAA found that the number of small aircraft used at Heathrow fell sharply after landing charges were reformed in the mid 1980s so that they were a flat rate for all sizes of aircraft at peak times. The number of movements under 16 tonnes fell from 3.5 per cent in 1984/85 to 0.01 per cent in 1992/93.[30] Our data suggest that this effect has persisted. For example, in the Summer 2002 season there were only around 40 (0.6 per cent) scheduled movements a week at Heathrow operated by aircraft with 50 or fewer seats (7am to 7pm local time). The equivalent statistic for Madrid, another very congested airport, is 500 movements a week (12 per cent of scheduled movements). In common with many airports, Madrid's landing charges are highly differentiated by aircraft weight.

4.4.3. High frequency services

Several airport operators drew our attention to another possible indicator of inefficient use of slots, based on the relationship between service frequency and the size of aircraft used for the service.

Düsseldorf Airport and others have examined the relationship between service frequency and aircraft size with the aim of increasing aircraft size and hence airport revenue. Under OPUS (Optimisation Programme for Using Slots), they propose prohibiting use of slots for high frequency services with small aircraft. Such services are identified using the size-frequency-ratio, which is defined as follows:

SFR = {average number of seats offered by an airline X on a route Y per departure} divided by {average number of departures by airline X on a route Y per day}

The ratio would apply within a certain frequency range (for example for services with between five and eight departures a day), and may vary by airport and type of service (for example domestic, intra-European etc).

Figure 4.4 shows the average number of seats per service on high frequency services at EU Category 1 airports which are slot constrained.[31] According to the proponents of OPUS, the use of small planes to operate such services is indicative of inefficient use of slots for which there is excess demand.

The small number of services with more than 200 seats per movement operate to both long haul and short haul destinations. Services with small aircraft tend to operate over shorter distances, sometimes competing with rail services, and are a mixture of domestic and

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[30] M R Toms (1994), "Charging for Airports: The New BAA Approach", *Journal of Air Transport Management.*

[31] We define "high frequency" services as those for which there are at least five flights a day in each direction operated by a single airline. The services shown are those from or to highly congested airports, or are between pairs of moderately or highly congested airports; the classification of these categories is given in Section 3.

international flights. The very high frequency services tend to be domestic, typically competing with rail services.

The Figure also shows a SFR of 25, applied for up to 8 frequencies a day. It is interesting to note that most high frequency services from EU Category 1 airports would fail to comply with a SFR of 25 or 30, say, which are values used for illustrative purposes by Frankfurt Airport.

Figure 4.4
High Frequency Services at EU Category 1 Airports
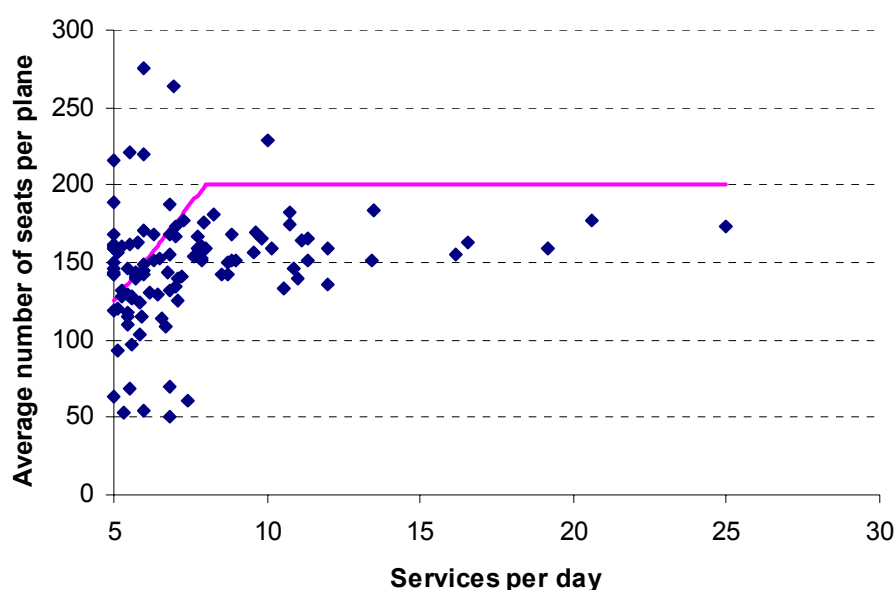
Although a market mechanism might lead to the use of larger aircraft in general, it is by no means clear that application of the OPUS approach would come near to replicating the effects of market mechanisms, and its impact would depend on the particular value of the SFR that was applied. Unlike OPUS, market mechanisms would allocate capacity on the basis of willingness to pay, and would might result in increases in frequencies, without the use of larger aircraft, on routes where users placed a high value on service frequency.

4.4.4. High external costs

The use of airport capacity may also be inefficient if the services that use the airport produce high external costs, for example as a result of excessive noise or pollution.

This may be the case because existing slot allocation mechanisms do not take environmental costs caused by particular types of services into account. The main mechanism, grandfathering of slots, does not provide for the withdrawal of grandfather rights if slots are used by environmentally unfriendly services. The environmental performance of airlines is

of course influenced by other legislation (for example Council Directive 92/14 banning all Chapter 2 aircraft from European airports after April 2002), but this does not involve changes to the allocation of slots.

Regulation 95/93 does not provide for the use of environmental criteria in the allocation of pool slots by coordinators, although local rules could in theory provide for this. In Member States where environmental criteria are taken into account, this is usually done by setting airport capacity in environmental terms (for example, setting overall annual limits on movements or on the amount of noise produced), rather than taking environmental criteria into account in the slot allocation process itself.

4.5. Slot Mobility

In Section 4.2 we argued that excess demand for slots, combined with the system of historic rights, were barriers to changes in service patterns (or slot mobility), and that this was perhaps the greatest source of inefficiency in the current system.

It is instructive to examine the extent to which the use of slots changes from one season to the next within the current framework at airports experiencing different degrees of excess demand. This provides an indication of the types of changes to services which would occur if suitable slots were available. Table 4.1 shows the proportion of allocated slots at EU Category 1 airports which are allocated on the basis of historic rights. The proportions are averages over a number of summer seasons, where these data were provided. The proportions were not found to vary a great deal between years.

Table 4.1
Allocation of Slots at EU Category 1 Airports

	Airports with little or no excess demand	Airports with excess demand at peak times of the day	Airports with excess demand throughout the day
Sample size	3 out of 11	10 out of 14	6 out of 7
Historic	45%	48%	62%
Changed historic	30%	30%	31%
All historic	75%	78%	93%
Other	25%	22%	7%
Total, allocated slots	**100%**	**100%**	**100%**

We found that, of the very congested airports (LHR, FRA, ORY etc), 93 per cent of the allocated slots are allocated to services with historic rights. Around a third of such services had been changed in some way from the previous year, for example as a result of minor retiming or changed aircraft size.

For those airports where excess demand is limited to certain times of the day, the proportion of slots allocated on a historic basis is significantly less, at around 78 per cent. The number of slots allocated for services without historic rights (either new entrants or incumbent operators) is around three times higher than at the very congested airports (22 per cent compared to 7 per cent). However, on the basis of our discussions at interviews, we would expect most of these slots to be allocated at off-peak times, so that the slots at the most lucrative times of the day would be allocated to services with historic rights.

We also found the proportion of slots allocated to services without historic rights was higher still for airports which experience little or no excess demand although the proportion (25 per cent) was not much above the average for moderately congested airports. We note, though, this average is derived from a small sample size (several of these airports are not coordinated and therefore do not monitor historic rights).

This analysis shows that more new services occur at airports where there is less excess demand. This empirical evidence provides some support to the view that under the status quo, there is inertia in the schedules at airports with severe excess demand (and potentially at airports with excess demand limited to peak times), which will be to the detriment of dynamic efficiency and competition.

4.6.   Peak and Off Peak Use of Airport Capacity

Currently, many EU Category 1 airports for which there is excess demand at peak times have a great deal of capacity available at off peak times. This is a form of inefficiency in the current system because airport charges at off peak times will tend to exceed marginal costs, so that some flights for which airlines are willing to pay marginal cost may not operate. If market mechanisms were implemented as part of a package to reform airport charges, it would be possible to make better use of those airports which operate at capacity during peak times but are under utilised for substantial parts of the day.

It may be costly for airlines to reschedule flight times, but we know that they are able to do so. This is demonstrated by some of the most congested EU airports - Heathrow, Gatwick, Linate, Düsseldorf and Frankfurt - where the number of movements is fairly constant throughout the day. In these cases, airlines have been obliged to fly outside their preferred times because slots at those times were not available or too costly to obtain.

Figure 4.5 shows use of runway capacity at a EU Category 1 airport which is constrained at peak times. For several hours during the day there is a considerable amount of excess capacity. Figure 4.6 shows use of runway capacity at a EU Category 1 airport which is primarily used for leisure purposes; there is very little use of the airport on Tuesdays and Thursdays, though it operates at capacity on Wednesdays and at the weekend.

Figure 4.5
Use of an Example EU Category 1 Airport Throughout the Day
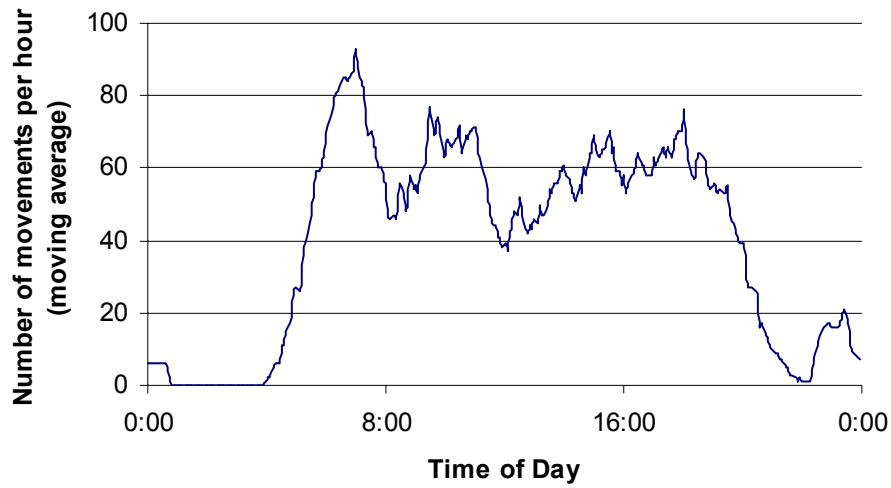
Figure 4.6
Use of an Example EU Category 1 Airport Throughout the Week
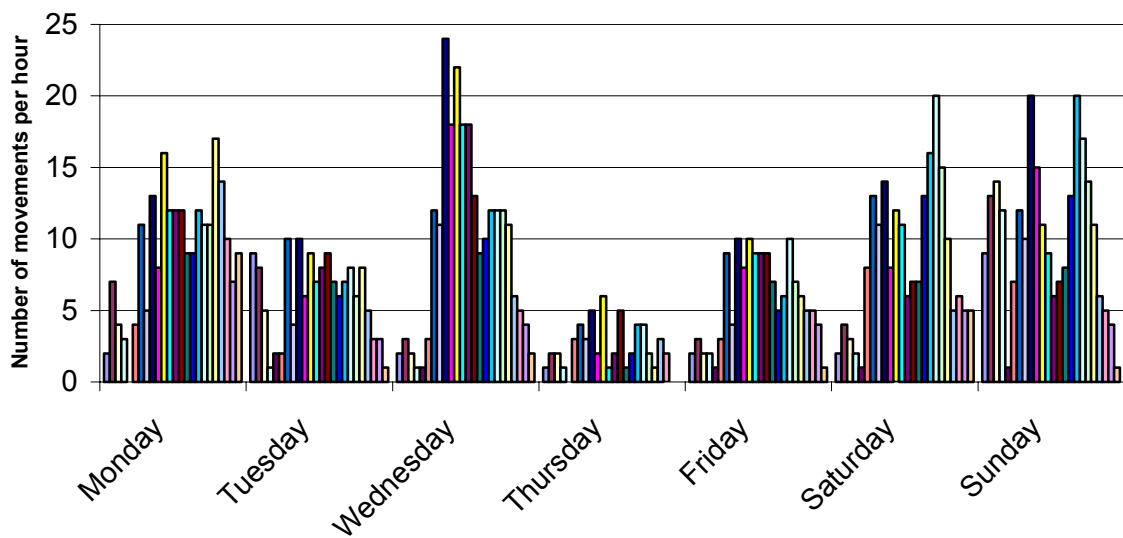
5.   POTENTIAL MARKET MECHANISMS

5.1.   Introduction

In this chapter we examine the scope for using market mechanisms to allocate slots at congested airports. In broad terms, we define market mechanisms as being those which allocate slots primarily on the basis of airlines' (or other parties') willingness to pay for them. There is an important distinction between primary trading and secondary trading mechanisms, which is discussed in Section 5.2 below. Otherwise, the defining feature of market mechanisms is that slots are allocated on the basis of airlines' willingness to buy (and, where relevant, sell) slots, rather than other criteria such as the identity of the airline, whether or not it has used the same slot in previous seasons, the route it proposes to serve, and so on.

All market mechanisms therefore involve slots being bought and sold in some way. But there are important differences between mechanisms, depending on factors such as:

- the identity of the party selling the slot – this relates to the distinction between primary trading and secondary trading, discussed below;

- the way in which the price of a slot is determined; and

- the way in which individual buyers are identified.

Market mechanisms are, of course, used at many airports around the world, through the imposition of cost-related charges. But these charges are intended to cover airport operators' costs, rather than acting as a mechanism to allocate slots. In situations where the demand for airport capacity at these charges exceeds the available supply, capacity is often allocated administratively, for example with reference to historical precedence. This can lead to inefficiencies, both because the initial allocation may be "wrong", and also because there may be no process through which the "right" allocation can be established.

Market mechanisms therefore have the potential to improve efficiency as, compared with administrative or other non-market allocation mechanisms, they are more likely to ensure that slots are allocated to those airlines that value them most. This is in contrast to the current, largely administrative procedure, under which slot allocations are often determined by non-market criteria, such as historical precedence, which may bear little relation to an airline's willingness to pay for a slot.

It is true, of course, that an airline's willingness to pay for a slot may be an imperfect indicator of the value to society of the service provided by that airline. For example, the value of different services may not fully reflect the pollution, noise and other external effects caused by those services. And society may attach a value to regional air services that is not captured by the airlines operating those services. It would often be more effective to take

such factors into account of outside of the slot allocation procedure, for example through explicit taxes for noise and pollution and subsidies for regional services. To the extent that this is not possible, however, such factors could be taken account of through adjustments to, rather than a rejection of, market mechanisms. We consider possible approaches that might be adopted under each specific option in Chapters 7 to 11 below.

Equally, airlines may have a high willingness to pay for particular slots for reasons that do not reflect a corresponding value to society. For example:

- airlines might pay "too much" for slots at particular airports, because they wish to maintain a presence at that airport for reasons of corporate or national prestige, even if they make a financial loss on those services; or

- airlines might pay high prices for particular slots in order to prevent a potential competitor from entering the market.

It could be argued that the first of these may not result in inefficiency, to the extent that the airline paying inflated prices for a slot derives genuine value from the continued use of that slot. But it may lead to inefficiencies if airlines' willingness to pay is affected by the private objectives of airline managers, rather than the corporate or national objectives of the airline concerned. The second factor – the risk of anti-competitive behaviour – poses a potentially greater threat to the efficiency properties of market mechanisms. But competition law, rather than slot allocation procedures, may be the most appropriate way to deal with any such problems.

To date, the main experience of using market mechanisms to allocate airport slots is in the US, where slot trading is allowed for domestic services at four specific airports. This experience is reviewed in Section 5.4 below, where we also consider more general issues arising with the use of market mechanisms to allocate airport slots. Before this, in Sections 5.2 and 5.3, we describe the distinction between primary trading and secondary trading and summarise the experience of using market-based allocation mechanisms in other sectors. Section 5.4 then considers the potential to use particular market mechanisms to allocate airport slots, and Section 5.5 lists the specific options that we examine in the rest of this report.

5.2. Primary and Secondary Trading Mechanisms

The distinction between primary and secondary trading mechanisms is an important one. In broad terms:

- primary trading mechanisms may be used to determine an initial allocation of slots among airlines. The selling party in this case might be a national government, an airport or an airport co-ordinator;

- secondary trading mechanisms may be used, once an initial allocation of slots has been determined, so that airlines can sell (or lease) slots that they have been allocated on to other airlines. Usually, both the buyer and the seller under secondary trading will be airlines.

Primary trading has the potential to improve the efficiency of slot allocations by ensuring that more slots are allocated to the users that value them most. And secondary trading can improve efficiency by allowing further changes once the initial (or primary) allocation of slots to airlines has been determined.

5.2.1. Primary trading mechanisms

The general category of primary trading describes the use of market mechanisms to achieve an initial allocation of slots to airlines. Such mechanisms could be used, in theory at least, by governments, airport operators or co-ordinators to allocate slots to airlines. All primary trading mechanisms share a common general aim – to find a set of prices that matches the demand for slots with the available supply (both overall and also at particular times of day or week). In this way, the mechanism seeks to identify those airlines with the highest willingness to pay for particular slots, and ensure that, as far as possible, slots are allocated to these airlines.

Primary trading mechanisms differ according to the way that prices for individual slots are determined. The two main alternatives are that:

- the selling party (such as the government, airport operator or co-ordinator) sets a level of prices that it believes will clear the market (or come close to doing so);[32] or

- the selling party holds an auction, to determine the price for each slot that will clear the market.

These are basis for the two main primary trading mechanisms that we consider in this report: <u>higher posted prices</u> and <u>auctions</u>. In theory, if these approaches could be applied perfectly, then they would lead to the same outcome – that each slot would be allocated to the airline willing to pay most for it. But in practice there are many practical problems, such as the difficulty of either setting a level of prices that will clear the market or designing an auction mechanism that will lead to the most efficient outcome. And each approach will also have different implementation costs.

An important difference between higher posted prices and auction mechanisms relates to the options available to the seller if the initial price is too low (and therefore there is still

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[32] As we note in Section 8 below, prices may be set at a deliberately conservative level, to reduce the risk that some slots will remain unused.

excess demand for particular slots). With higher posted prices, sellers may not be able to raise prices until the next season, whereas an auction allows for further rounds of bidding so that prices can continue rising until there is no longer any excess demand.

A third possible market-based primary trading mechanism, which lies somewhere between the options of posted prices and auctions, would involve direct negotiations between a body responsible for deciding the allocation of airport slots (such as the government, airport operator or co-ordinator) and airlines.[33] For such an approach to be considered a market mechanism, these negotiations would need to be carried out with the aim of identifying those airlines willing to pay most for the slots. In this case, the mechanism might be equivalent to some form of "informal" auction. If this is indeed the aim, then it seems unlikely that this approach (which might not involve all potential buyers and could be manipulated by strategic behaviour) could offer a more effective or efficient way of discovering how much airlines are willing to pay for slots than a more formal auction process.

A more serious problem with negotiations, moreover, is the significant lack of transparency. This makes them unsuitable as a primary allocation mechanism. There would be a very serious risk that the outcome would be influenced, either intentionally or unintentionally, by non-market considerations. And airlines might have little confidence that they would be treated on a fair and non-discriminatory basis.

Finally, we note that, even though there is a wide range of other possible primary allocation mechanisms, the scope of this study is confined to market mechanisms. Thus we do not consider options such as:

- "beauty contests", where slots are allocated according to a mixture of financial and non-financial criteria; and

- lotteries, where slots are allocated at random. We note that lotteries have been used in the US to distribute slots which can then be traded. But a lottery is not a market mechanism, and in any case it is likely that simple administrative criteria could achieve an initial allocation that is closer to the optimum than a purely random allocation (and therefore will leave less work for the secondary allocation mechanism to do).

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[33] It is perfectly possible, and perhaps sensible, that an airport operator (or other party) aiming to set higher posted prices might have informal discussions with airlines to gauge the likely strength of demand. But this is different from a negotiated allocation mechanism, under which prices would be determined and allocations agreed purely by negotiation.

5.2.2. Secondary trading mechanisms

Secondary trading can occur once a primary allocation of slots has been determined. Secondary trading could be introduced alongside a market-based primary trading mechanism, in which case it might fulfil a valuable role in dealing with any residual inefficiency (which could occur either because the primary allocation mechanism does not produce the outcome that would occur under an ideal market mechanism, or because of developments since the initial allocation was determined). Or secondary trading could be introduced on its own, alongside the current administrative allocation procedure.

The most straightforward way of introducing secondary trading is simply to allow airlines the freedom to buy and sell slots, in which case we would expect most deals to result from a process of bilateral negotiations between potential buyers and potential sellers. But other approaches are possible, including the establishment of a formal marketplace where slots can be bought and sold, perhaps on an anonymous basis.

In theory, there might be nothing to prevent an individual airline organising an auction for slots that it wished to sell, particularly if it was intending to sell a significant number of slots. But in addition to the sheer complexity of such an exercise, airlines might be concerned by the risk that collusion between participants (or even sheer confusion) would lead to lower than expected revenues, and some airlines might wish to retain the ability to block sales to certain airlines (which would be much more difficult to achieve in an auction).

5.3. Use of Market Mechanisms in Other Sectors

While there has been only a limited use of market mechanisms to allocate airport capacity, both auctions and trading mechanisms have been used in other sectors. Various forms of "beauty contest", often including a financial bid alongside qualitative criteria, have been used over a number of years to allocate licences for broadcasting and telecommunications services (where capacity is determined by the availability of radio spectrum). But in recent years a number of telecommunications licences (particularly for mobile phone services) have been allocated through sophisticated auction mechanisms. This experience is summarised in Section 5.3.1.

Capacity constraints can also arise because of environmental concerns about the impact of a particular activity. Fixed quotas have been established for fishing rights and environmental emissions, and Sections 5.3.2 and 5.3.3 summarise the trading systems that have developed in these cases.

5.3.1. Radio spectrum

Complex auction mechanisms have been used in a number of recent competitions to award telecommunications licences. In many of these, multiple lots have been on offer, covering cases where different lots have been either substitutes (for example because they offer

equivalent coverage of the same region) or complements (because they relate to different regions).

The US Federal Communications Commission (FCC) has been at the forefront of the development and implementation of "simultaneous ascending auctions", and has carried out around 40 such auctions over the past eight years. Similar approaches have subsequently been used in a number of countries, including Austria, Germany, Greece, Hong Kong, Italy, Latvia, the Netherlands, Singapore, Switzerland, Taiwan and the UK.

The basic idea of a simultaneous ascending auction is that bidders are allowed to bid for more than one lot, and the auction continues, potentially over many rounds, until there is no further bidding.[34] Bidders can therefore "manage" their portfolio of lots by adjusting their bids during the course of the auction.

Over time, FCC has refined the design of its auctions to take account of emerging evidence about how particular approaches work in practice. For example, it introduced an "activity rule" that allowed bidders to focus initially on securing core licences, and once they were reasonably sure of winning a core licence they could then extend their bidding to more peripheral licences. This rule was introduced in response to complementarity problems, but as a side effect it tended to make the auctions last longer.

Another problem, due to the approach of dealing with complementarities by the means of an activity rule, arose when bidders were suspected of colluding, in particular by submitting unusually high bids for certain lots, in order to signal their intentions to other bidders. FCC attempted to address this by placing constraints on the ways that bids could be increased between rounds, though it is not clear that the approach it adopted has in fact eliminated the possibility of collusion.

More recently, FCC has carried out a simultaneous ascending auction that also allowed for conditional or "package" bidding. In addition to submitting bids for individual lots, participants could also submit bids for complete "packages", such that the bidder would win either all or none of the individual lots making up the package. This represents a powerful way to address the so-called "exposure risk", that a bidder will be left with peripheral licences (which are not useful on their own) and fail to win a core licence. While combinatorial auctions are theoretically superior to standard simultaneous ascending auctions for markets in which complementarities are a problem, they are still relatively untested and only very limited experience is available.

Further details of these auctions, together with a description of theoretical arguments for applying different auction designs, are contained in Appendix D.

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[34] In practice, to prevent the process extending over an excessive number of rounds, some auctions allow for a final, sealed bid, round to be applied. But we are not aware that this provision has ever been enforced.

5.3.2. Fishing

A number of states around the world apply quotas to limit the quantity of fish (of different kinds) that can be caught in a particular year. In the EU, this falls within the Common Fisheries Policy. Internationally, the UN's Food and Agriculture Organization (FAO) has promoted a *Code of Conduct for Responsible Fisheries* and is promoting a number of international action plans in support of these principles.

In most states that have implemented fishing quotas, there is an initial allocation of quotas based on the historic catch rates of quota holders, often combined with criteria such as vessel size or power. There are also a few cases where particular quotas are divided equally among the fishing industry.

Many of these quotas are transferable, and therefore trading has taken place in a number of states, including Australia, Canada, Chile, Iceland, the Netherlands, New Zealand and the US. The most common approach is simply to allow trades to be agreed through bilateral negotiations between potential buyers and sellers.

In Iceland, however, where quota trading is most developed, trading has involved both brokers and, between 1999 and 2001, an official exchange. Fishing quotas have been used by Iceland since 1975, with individual transferable quotas (ITQs) introduced in 1979 and applying across all fisheries since 1991. ITQs are infinitely divisible and, though fishing permits are associated with vessels, this has not restricted market participation by brokers and others not owning vessels.

There are currently three to five quota brokers in Iceland, operating on a commercial basis and typically charging commission of about 0.5 per cent. The Association of Vessel Owners has also set up a trading room to facilitate trades between its members. Trading volumes for ITQs are equivalent to approximately 80 to 90 per cent of the total annual quota, and up to 20 per cent of indefinite quotas change hands each year.

The computerised official exchange, which operated between 1999 and 2001, was introduced in order to ensure the anonymity of traders. This followed allegations that the provision of cheap quotas by fish processors to vessel owners was resulting in artificially low fish prices. Use of the exchange was mandatory for all ITQ trades. In practice, however, the exchange added to the costs of market participants and slowed the trading process. Because of the importance of quota trading to the fishing industry in Iceland, the exchange was abandoned in 2002.

5.3.3. Environmental emissions

Quotas on environmental emissions have been introduced in a number of states. In the US, restrictions on sulphur dioxide and nitrogen oxides were introduced to tackle the primary causes of acid rain. Trading generally takes place through bilateral agreements between

registered participants, and trades have to be notified in order to update the information used to monitor companies' compliance with their quotas.

More recently, Denmark and the UK have established quotas and trading schemes designed to control greenhouse gas (GHG) emissions. Many other states in Europe, North America and Australasia are considering the introduction of similar schemes.

The UK quota and trading scheme is voluntary, and is backed up by government subsidies for companies agreeing to reduce GHG emissions. The initial allocation of, and rate of subsidy for, emissions reduction targets was determined by an auction. These emission reduction targets can now be traded between companies registered for the scheme, either directly or through brokers.[35]

The Danish scheme is compulsory, but applies only to electricity producers' carbon dioxide emissions. Initial quotas were allocated to companies (rather than plants), based on a grandfathering principle. Trading has been permitted on a bilateral basis since 2000, but volumes have been small and are thought to be insufficient to support a "carbon exchange".[36]

5.4. Use of Market Mechanisms to Allocate Airport Slots

Market mechanisms are used for countless transactions in modern economies. But the examples described in Section 5.3 are distinctive because auctions and trading mechanisms are used to determine the allocation of a scarce resource in cases where there is excess demand. In this section, we consider the relevance of these examples to the case of airport slots, and review the limited experience to date of airport slot trading in the US. We also address the definition of a "slot", as participants affected by any market mechanism would require a degree of certainty about the nature of the commodity being traded.

5.4.1. Comparison with use in other sectors

The most obvious difference between airport slots and the commodities discussed in Section 5.3 is that airport slots are considerably more <u>heterogeneous</u>. Whereas fishing and emissions quotas, in particular, simply convey the right to catch a certain quantity of fish or produce a certain quantity of emissions within a given geographical area and subject to a time limit, an airport slot is specific to particular time and a particular day at a single airport, and slots at other times or at other airports may be very imperfect substitutes. This

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[35] In the first seven months of the scheme, the volume of trading is estimated to be between 800,000 and 1,000,000 allowances changing hands in between 150 and 200 trades. See Department for Environment, Food and Rural Affairs, *The UK Emissions Trading Scheme: Auction Analysis and Progress Report*, October 2002.

[36] There were 14 trades in 2001, and 10 in the first nine months of 2002. See Sigurd Lauge Pedersen, "Danish CO_2 Cap&Trade Scheme: Function and Experiences", Presentation to SERC Workshop on CO_2 Emissions Trading in Europe and its Implication to Japan, Tokyo, December 2002.

heterogeneity greatly increases the number of lots that must be sold in any auction or be assigned a specific posted price, and also decreases the number of potential buyers and sellers if slots are traded (as airlines will be interested in a particular slot, rather than simply any slot).

In some cases, the definition of a slot may be even more specific, reflecting the greater complexity of capacity constraints. It may well specify whether the slot is for a take-off or a landing, and it may also be associated with the right to access a particular terminal, with a specific size of plane and using a particular type of stand. While there may be flexibility to change some of these specifications, this degree of differentiation will nevertheless make the application of market mechanisms more difficult than in the cases discussed above.

A further significant factor is the existence of demand complementarities between different slots. At each airport, airlines will need appropriate combinations of landing and take-off slots so that they may move their planes in and out, and they clearly need suitably timed slots at both the origin and destination airports for each journey. In addition to such basic constraints, the value of a particular slot is likely to be significantly affected by the other slots held by an airline, reflecting factors such as:

- appropriate turn-round times, so that the airline can achieve its desired level of aircraft utilisation while not putting undue stress on its schedules in the event of disruption;

- appropriate connecting flights, particularly at major hub airports; and

- the ability to offer a regular service on a particular route (which is an important factor in attracting business passengers).

As discussed in Chapter 9 below, demand complementarities are likely to pose particular problems for the potential use of auction mechanisms.

5.4.2. Experience of slot trading in the US

The main experience of trading airport slots is in the US, where slots at four airports have been traded since 1986.[37] Access to other US airports is unconstrained, but limits have been placed on the number of take-off and landing slots available at these four airports, in order to limit congestion. After an initial period, during which slot allocations were determined collectively by incumbent airlines, trading was introduced for slots used for domestic services. Other slots, for example for international services and commuter services, are ringfenced and cannot be traded (though straight swaps may be allowed).

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[37] The four airports are John F Kennedy and La Guardia in New York, plus O'Hare in Chicago and Ronald Reagan National in Washington.

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Trading takes place even though airlines enjoy operating privileges, rather than formal property rights, over slots. While it is explicitly recognised that slots can be withdrawn, individual slots are assigned a withdrawal number, and this may allow airlines and others to assess the likelihood of a particular slot being withdrawn. Not only has trading occurred, despite the lack of formal property rights, but some airlines have also mortgaged slots to financial institutions.

Trading occurs through bilateral negotiations between slot owners, which are facilitated both by informal contacts between airlines and also by regular meetings organised by the Air Transport Association. In addition, some brokers are active, though these operate within the framework of bilateral negotiations rather than through any institutionalised marketplace. Trading is purely voluntary, therefore, and selling airlines will generally know the identity of those seeking to acquire slots.

There is some evidence to suggest that the major airlines have increased the proportion of slots they hold at these four airports, compared with new entrants. But commentators disagree about whether this reflects efficiency benefits or anti-competitive behaviour, or indeed whether it simply reflects some entrants' decisions to avoid congested airports.

More recently, slot restrictions have been partially relaxed, and new entrants and new services to small communities have been allowed unrestricted access to the four airports. But this has resulted in a substantial increase in operations, particularly at La Guardia, and a very substantial increase in delays. The Federal Aviation Authority therefore consulted on possible long term options, including congestion-based landing fees, auctions and various administrative mechanisms.

Appendix C contains a more detailed description of the US experience of slot trading.

5.4.3. Experience of slot trading in the UK

In the United Kingdom, slot exchanges involving monetary compensation were the subject of a ruling by the High Court in 1999.[38] The court held that an airline is entitled to be allocated slots pursuant to the system of grandfather rights regardless of whether that airline intends to use them, and that the provisions allowing airlines to exchange slots permit exchanges regardless whether an airline party to the exchange intends to use them or whether financial considerations accompany the exchange.

Since the ruling, trades have occurred at the London airports on a regular basis. Often, these trades have involved the hub carrier BA. BA has managed to increase its slot holding at London Heathrow through the trades, either by outright buying slots from other airlines, or

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[38] *R* versus *Airport Coordination Ltd*, ex parte *States of Guernsey Transport Board*, judgement of High Court (Queens Bench Division) of 25 November 1999

by exchanging Heathrow slots for Gatwick slots. BA has traded with a variety of airlines, including short-haul carriers (for example Swissair in September 2003), regional airlines and airlines in financial difficulty (for example United Airlines in October 2003). The slots that BA has acquired at Heathrow have been used, among other things, to consolidate its long haul operations at Heathrow (previously, significant numbers of long haul services were operated from both Heathrow and Gatwick).

We have taken the UK experience into account in assessing the potential impact of market mechanisms (to be discussed in Chapter 6 and, in more detail, in Appendix E), not only in regard to the specific impacts at LHR and LGW (including the balance of services between these two airports), but also more generally. It has also informed our views on the specific impact of secondary trading, which we will cover in Chapter 7.

5.4.4. What is being traded?

For the purpose of this study, we interpret take-off or landing "slots" as potentially including all services required by an airline (and which it cannot provide itself) to operate a service to and from an airport. At a minimum, airlines will require access to the airport approach, a runway, a stand (which may be a remote stand) and terminal facilities. Aircraft parking (if the aircraft is not departing immediately) and refuelling facilities may also be required.

In relation to the use of market mechanisms, it is important that the mechanism takes account of all services that are capacity constrained at a particular airport. For example, if a terminal reaches full capacity at certain times of day, this should be reflected in the operation of the market mechanism. Otherwise an airline might run the risk of paying a large sum of money for take-off and landing slots, only to find that the "slot" offers no guarantee of access to the terminal and thus the airline is unable to load and unload its passengers. On the other hand, if the terminal operates below capacity, then there may be no need for any market mechanism that is used to allocate, say, runway slots to take account of terminal capacity as well.

The most appropriate approach to such cases will vary between different types of facility and different market mechanisms. In the case of an auction, it is important that bids are unambiguous and binding. Complex capacity constraints might be taken account of in a number of ways, for example:

- by allowing airlines to submit conditional bids, where the size of a bid depends on whether or not the airline is successful in obtaining other services. This is often called a "combinatorial" auction; or

- by requiring airlines to state all relevant aspects of their service (such as arrival/departure time, type of aircraft, stand requirement and number of

passengers) and running a computer programme to calculate the combination of bids that maximises proceeds subject to all relevant capacity constraints.

Conversely, in the case of bilateral trading, a much more flexible approach could be applied. If, for example, capacity constraints apply mainly to runways but also, at certain times of day, to terminals, then runway slots alone could still be bought and sold by airlines. Having conditionally agreed a deal, an airline proposing to purchase a slot would be able to check that sufficient terminal capacity is available before finalising the deal.

In many cases, while the introduction of market mechanisms would require an amendment to the existing EU slot regulation, it might still be possible to retain many of the features of the current framework. In some cases, grandfather rights might continue to apply alongside a market mechanism, so that an airline purchasing a slot might then enjoy grandfather rights in relation to that slot. Nevertheless, there might be some scope to improve the effectiveness of market mechanisms by clarifying the current legal framework. And some market mechanisms, notably auctions, might require the removal of grandfather rights after a certain period of time, in which cases the slots being auctioned might be viewed as the equivalent of time-limited concessions.

5.5.   Specific Options Examined

Based on the discussion of potential market mechanisms in Section 5.2 above, we have examined the impact of both primary trading and secondary trading mechanisms:

- under the category of primary trading, we have examined the potential impact of both higher posted prices and auctions;

- under the category of secondary trading, we have examined the potential impact of trading based on bilateral negotiations between airlines.

Within these broad types, there are a number of different options that could be applied. For example, there are different kinds of auction that could be used, or a variety of possible frameworks for slot trading. The possible variations, together with our reason for selecting particular approaches, are discussed in Chapters 7 to 11 below.

5.5.1. Scope of market mechanisms

We envisage that market mechanisms would be applied only in situations where there is likely to be excess demand for slots. With secondary trading, this might occur automatically, as airlines would be unlikely to pay other airlines for slots when they could obtain similar slots, free of charge (except for conventional airport charges), directly from the airport operator or co-ordinator. Under primary trading approaches, it might be necessary for airport operators or co-ordinators to identify the set of slots for which they

expected there would be excess demand, and declare that these slots would be subject to the appropriate market mechanism (either higher posted prices or an auction).

Market mechanisms would therefore only operate at some (and perhaps a relatively small number of) EU airports, and possibly only at certain times of the day at some of these. It is essential, therefore, that the operation of any market mechanism is consistent with the timing and processes currently used to allocate airport slots worldwide, as described in Section 2.5 above. This is addressed in our discussion of specific mechanisms, as set out in Chapters 7 to 11 below.

In the specific cases of auctions, for the reasons set out in Chapter 9 below, we have very serious doubts about their suitability for allocating a large proportion of airport slots. We have therefore restricted our analysis of auction mechanisms to two specific options:

- auctions applied only to pool slots;

- auctions applied to both pool slots and 10 per cent of grandfathered slots.

5.5.2. The role of primary and secondary trading mechanisms

Either primary or secondary trading mechanisms could be used, in isolation, to allocate airport slots. Where a primary mechanism (such as higher posted prices or auctions) is applied, then this will generally replace the existing administrative allocation mechanism, though there may still be a role for an additional allocation mechanism to deal with any cases where the new primary mechanism fails to produce a single or comprehensive allocation. For example, if higher posted prices are introduced but they are not quite high enough to remove all of the excess demand for some slots, then an administrative mechanism could be used to allocate the available slots among those airlines willing to pay the relevant posted price.

It would also be possible to use a combination of different primary allocation mechanisms, with market mechanisms being used to allocate some slots and administrative mechanisms being used to allocate others. In one sense, all of our options feature this type of approach, as we envisage that market mechanisms would apply only at airports, and potentially only at times of day, where there is expected to be excess demand for slots. And even at congested airports, it is possible to use a mixture of administrative and market mechanisms, in particular by declaring that existing grandfather rights should continue to apply, but market mechanisms (such as an auction) should be used to allocate other slots – either newly created slots or slots for which grandfather rights no longer apply.

In contrast, if only a secondary trading mechanism is introduced, then there will still need to be some other mechanism (such as the existing administrative procedures) to achieve an initial allocation of slots. Theoretically, if secondary trading is completely effective then almost any mechanism could be used to generate a primary allocation, on the basis that

secondary trading will then act to remove any remaining inefficiencies. Indeed, as noted above, lotteries have been used to distribute airport slots in the US, which could then be traded between airlines. In practice, however:

- as discussed in Chapter 7, there are possible reasons why secondary trading may not be completely efficient. The more efficient the primary allocation, therefore, the more likely it is that secondary trading will deliver an allocation that is close to the optimum;

- airlines allocated scarce slots may enjoy windfall gains as a result of being able either to use those slots themselves or else to sell them to other airlines. The primary allocation mechanism therefore needs to be fair and defensible.

Finally, it is possible to use a combination of both primary and secondary trading mechanisms to allocate slots. In such cases, we would generally expect the primary allocation mechanism to remove some (and perhaps quite a high proportion) of the inefficiency that might have resulted from applying an administrative mechanism. The main role of secondary trading will then be to help remove any inefficiencies that remain after the (market-based) primary allocation has been completed, or else to help deal with subsequent changes that mean that an alternative allocation would now be preferable. But there are cases where secondary trading can have a more prominent role, in particular:

- in cases where the primary allocation mechanism is only applied to some slots (for example, an auction applied only to pool slots), then secondary trading can help improve the allocation of other slots; and

- in other cases, the impact of a primary mechanism might be delayed (for example, because posted prices are increased only gradually), in which case secondary trading might also be able to help bring forward efficiency improvements that would otherwise be delivered at a later stage by primary trading.

5.5.3. Options and combinations examined

Based on the discussion above, we have selected four potential market mechanisms for further examination:

- three primary trading mechanisms – higher posted prices, auctions applied only to pool slots, and auctions applied to both pool slots and 10 per cent of grandfathered slots;

- one secondary trading mechanism – with airlines trading slots on the basis of bilateral negotiations.

In theory, each of these mechanisms could be applied either in isolation, or else in combination with other market mechanisms. But we have rejected options that involve:

- more than one primary mechanism. In theory, it might be possible to use higher posted prices to narrow down the field of potential purchasers, and then to hold an auction to determine the allocation of slots among those airlines still willing to pay the relevant posted prices. Our main reason for rejecting this option, however, is that it could potentially lead to a high proportion of slots being auctioned at the same time, which we do not think is feasible;[39]

- any auction mechanism applied without the backup of secondary trading.[40] This is because the ability to buy and sell slots after the end of an auction is likely to increase the effectiveness of the auction, perhaps quite significantly, as airlines will have some confidence that they would be able to sell on a slot that they purchased at auction but then could not use. Equally, secondary trading will give airlines flexibility to adjust their slot holdings at other airports, if this is necessary following the outcome of an auction.

This leaves the five options listed in Table 5.1 below. Chapters 7 to 11 examine the feasibility and likely impact of these options.

Table 5.1
Options for Examination

Secondary trading	Higher posted prices	Auction of pool slots	Auction of 10% of grandfathered slots
✓			
	✓		
✓	✓		
✓		✓	
✓		✓	✓

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[39] In addition, this approach would be complex to operate, and in any case might be equivalent simply to the use of a minimum reservation price for each lot in an auction.

[40] One implication of this is that the supply of pool slots could well be lower than at present, as airlines would attempt to sell slots before returning them to the pool. But even if auctions are applied only to pool slots, they would still have a role in allocating new slots that result either from ongoing efforts to make more efficient use of existing capacity or from the addition of new increments of capacity (such as a new runway, terminal or stands).

6. POTENTIAL IMPACT OF MARKET MECHANISMS

6.1. Introduction

In the previous chapter, we have discussed potential market mechanisms and concluded with a list of mechanisms for detailed examination. In the remainder of the report, we focus on the potential impact that each of these mechanisms may have.

In our analysis, we will distinguish between the following two types of mechanism:

- The first type is a theoretical "frictionless" or "ideal" market mechanism. Our assessment of this mechanism illustrates the potential impact that market mechanisms may have in "an ideal world" defined among other things by perfect information, rational and profit-maximising behaviour by airlines, no transaction costs and no feasibility problems. While these assumptions will not hold in practice, it is useful to analyse such a hypothetical scenario in order to establish the potential impact of market mechanisms in general.

- The second type is formed by the actual mechanisms as set out in Table 5.1 above.

To understand the potential impacts of market mechanisms on airlines' decisions, it is useful to have an idea of the importance of airport charges in the total costs of operating a particular route. Although these costs will vary according to particular routes and airports, the costs will in many cases be as shown in Table 6.1. These differences reflect the relative size of the total cost to airlines of operating different types of service, rather than differences in airport charges (and indeed we note that, with weight-related charges, the absolute level of charges may be highest for long-haul services).

Table 6.1
Importance of Airport Charges in Total Airline Costs

Category	Airport charges as % of total costs
Long-haul	2 to 5
Short-haul	5 to 10
Regional/low-cost/charter	10 to 15

Source: Interview programme; NERA estimates

In the remainder of the present chapter, we focus on the potential medium to long term impact of the frictionless mechanism. We will refer to this mechanism as the "ideal" mechanism. In Chapters 7 to 11, we discuss the potential impact of each of the actual mechanisms.

6.2. Potential Impact: Airports with Severe Excess Demand throughout the Day

At airports with excess demand throughout the day, so that all daytime slots are allocated, market mechanisms could involve substantially higher prices during peak hours and somewhat higher prices during off-peak hours. These price increases could take the form of either actual increases (in the case of higher posted prices and auctions) or increases in terms of opportunity costs (in the case of secondary trading).

Below, we examine the impacts of this on a number of airline categories.

Regional airlines

We consider that regional airlines, particularly those which do not have agreements with the hub operator, will tend to be the first to reduce operations to a particular airport in response to the introduction of market mechanisms. This is the result of two factors:

- Airport charges account for a relatively high proportion of regional airlines' costs.

- Prices payable under market mechanisms will be a fixed rate per slot, whereas currently aircraft charges tend to be highly differentiated by aircraft size. Regional airlines tend to operate small planes so would be more affected than airlines operating large planes.

It would often not need a dramatic cost increase for regional services to be put under pressure. For example, if current airport charges account for 15 per cent of the total costs of operating a regional route, an increase in airport-related costs of 33 per cent will increase total route costs by 5 per cent. Such an increase would render a substantial number of regional routes unprofitable.

It is likely to be the case that even at airports with congestion throughout the day, any increases in slot prices during peak hours will substantially exceed increases during off-peak hours. However, off-peak prices (or prices payable for such slots in an auction) might still increase to a level that many regional routes could not afford. Moreover, regional airlines often have limited flexibility to move to different times of the day. Some carry high proportions of business passengers who need to fly at particular times, for example arriving at their destination in early morning and departing in late afternoon or early evening.

The withdrawal of regional *airlines* from an airport does not necessarily mean that all regional *services* will be withdrawn. Other airlines, notably low-cost airlines, may come in and take over some of the regional services, though perhaps using less congested airports where this is possible. Hub carriers are likely to continue operating regional services, or pay other airlines to operate such services, where these act as important feeder services for long-haul routes.

Charter airlines

We expect that charter airlines will in some cases shift some or all of their operations to other airports, provided suitable alternatives are available. Although they generally operate on thin margins, charter airlines tend to operate large planes which means that the percentage increases they may face will be smaller than for many other airlines. However, charter airlines have a degree of flexibility in choosing which airports to fly from. Even shifting parts of operations can be feasible; charter airlines sometimes fly from airports by basing just one aircraft there.

On the other hand, shifting to other airports can be unattractive for charter airlines if the alternative airport is too far away. Especially in the case of large cities, competition between charter airlines will ensure that airports close to these cities will continue to be served as long as this is still feasible. This could mean a shift of operations to off-peak hours either because prices at these times are lower than during peak hours, or because the difference in value between peak and off peak slots can be realised through a slot trade. In our assessment, although charter airlines need to maximise the utilisation of their aircraft, they will in the medium term be sufficiently flexible to adjust their schedules to an extent, for example by avoiding congested airports during peak hours and flying to less congested airports instead at these times. It could also mean using larger aircraft from these airports.

The situation is likely to be different at *destination* airports (holiday destinations) of charter airlines. Most of these airports are either not congested or congested only at certain times and they are therefore discussed in Section 6.3.

Short-haul services by full-service carriers other than the hub alliance

After regional services and charter services, the information we collected during the interview programme suggests that short-haul services operated by full-service airlines other than the hub carrier will be the next group to come under pressure. The cost base of these services, the competition from low-cost airlines and the lack of significant feed from long-haul services mean that some of these services are unprofitable at present.

Full-service short-haul services that serve a hub at the other end are likely to be in a better position, since withdrawing such services may have an adverse effect (in terms of reduced feeder traffic and connectivity) on the entire hub-and-spoke network. If an alternative airport is available, such operations may be switched to that airport. It should be noted however that many short-haul services rely on feeder traffic from long-haul services at both ends of a route. But where the feeder and long-haul are operated by different airlines, it may be difficult for the short-haul airline to capture the benefits generated by such connections.

Frequency cuts and a switch to larger planes are also possible. For example, if a carrier currently operates some services into its banks and some services in between, it may decide

to remove the services in between and concentrate on those that feed the banks. However, the scope for this will be limited by the penalty that frequency cuts impose on the attractiveness of the service for high-yield point-to-point business passengers.

Low-cost airlines

In Europe, there are currently a number of low-cost carriers. The business models of these carriers can be divided into the following two broad categories:

- Airlines that seek to minimise costs, serving secondary airports and focusing primarily on leisure travellers. Cost-minimising low-cost airlines generally try to avoid congested airports. Of the Category 1 airports, Ryanair for example only serve London Stansted, Dublin and (with a very few services only) London Gatwick. The largest airline in this category is Ryanair.

- Airlines that also seek to operate at a low cost level but focus also on yields as well as on containing their cost level. These airlines largely serve main airports, including many congested Category 1 airports, and seek to attract both business and leisure travellers. To attract business travellers, they aim to offer frequent services on all their routes. The largest airline in this category is easyJet.

To the extent that cost-minimising low-cost airlines do serve congested airports, we expect them to be very sensitive to any increases in costs at these airports. Many of their customers are attracted by their low fares and would not otherwise have flown. Passing on cost increases to such customers is likely to be very difficult, and such airlines have few business passengers against whom they might price discriminate. In our view, Ryanair at London Stansted might be able to absorb some increase in charges but would start cutting services rapidly once costs became too high.

The position is likely to be different for yield-oriented low-cost airlines like easyJet. Yield-oriented low-cost airlines compete directly with full-service airlines, but have considerably (in the order of 40 per cent per seat-kilometre) lower costs. The impact of higher slot costs at congested airports may be that particular routes can no longer be operated profitably by full-service airlines, which would then withdraw the route. It may be the case, however, that the slot could be picked up by a yield-oriented low-cost airline if such an airline would be able to operate the route profitably.

We believe that using a market mechanism in allocating slots creates opportunities for yield-oriented low-cost airlines and therefore expect them to be able to increase their slot holdings at congested airports. We expect this to be the case despite the possibility that some of their existing routes might become unprofitable as a result of market mechanisms and can no longer be operated.

However, we do not expect that low-cost airlines will often replace the short-haul services of hub carriers. The low-cost business model is not suitable for feeding hubs. The need for interlining agreements, luggage transfer facilities and consequent longer turnaround times than currently achieved by low-cost carriers would eliminate many of the cost advantages that low-cost carriers enjoy at present.

In view of this, we consider that low-cost carriers will be able to achieve the largest increases in their slot holdings at busy non-hub airports or at hub airports that are important destinations in their own right. Market mechanisms would accelerate the current trend towards low-cost services seen at, for example, Paris Orly and London Gatwick.

More generally, however, low-cost carriers may be prevented from increasing their slot holdings at congested airports if there are other airlines that would like to enter the market or expand their services from those airports and who value the available slots more highly than the low-cost carriers. Where airlines wish to establish new or expanded long-haul services, they may well be willing to pay more than low-cost airlines for the slots available.

Hub-and-spoke networks

In Chapter 3, we discussed the economics of a hub-and-spoke network. In Europe the hub-and-spoke system is generally used to feed intercontinental flights with connecting passengers from short-haul destinations. Intra-European flights are dominated by point-to-point services.

Historically, hub operators have been able to build up their operations at airports without facing the full opportunity cost of their slot holdings. Hub operations are by their nature "peaky" and tend to create excess demand at peak times. The introduction of market mechanisms will lead to hub operators facing the full opportunity cost of this pattern of operation, and could result in pressure on the hub-and-spoke system.

We do not believe, however, that market mechanisms will eliminate hub-and-spoke systems in Europe, and indeed they might well strengthen it. The reason for this is that hub-and-spoke systems are mainly used to feed intercontinental flights. Most intercontinental flights can only be operated on a hub-and-spoke basis; there is little scope for point-to-point intercontinental flights from small or medium-sized European cities to, for example, the Far East.

Nevertheless, market mechanisms are likely to impact on how hub-and-spoke networks would *otherwise* have developed, following the possible future consolidation in the European airline industry. In the US, one of the main impacts of deregulation was a significant shift towards hub-and-spoke networks for domestic traffic. The scope for this in Europe is more limited given the geographical proximity of many key European destinations. But some development towards hub-and-spoke services for intra-European services could have been expected following airline consolidation, in particular for medium-

distance services. Market-based slot allocation mechanisms could limit or even prevent this development, for example, if short haul services that might have helped an airline establish a new hub are put under pressure or even replaced by low cost services.

Regulatory changes elsewhere in the civil aviation industry, and in particular the possible development of a Transatlantic Common Aviation Area (TCAA), might also affect the development of hub and spoke networks. Market-based slot allocation mechanisms might enhance possible opportunities for airlines to establish new hubs within the TCAA. In practice, however, we expect any opportunities in Europe to be limited by the size of the potential market and the strong position of existing hub carriers at airports that are also popular destinations in their own right.

A potential response for a hub operator that is faced with an increase in slot prices in its peaks would be to move some flights outside the banks, ie "widen" the banks. The scope for this is however limited as it results in increased transfer times for those connections that are moved away from the banks. Increased transfer times increase the "elapsed time" for a particular journey, reducing its competitiveness. We nevertheless expect that hub operators will widen their banks somewhat, moving those flights for which the value of short connecting times is low. Some carriers, eg American Airlines and SAS, are already moving in this direction in response to severe financial pressure.

We believe that there is limited scope for hub carriers to reduce the numbers of, for example short-haul feeder services. Long-haul services in hub-and-spoke networks carry substantial numbers of transfer passengers. These transfer passengers need to be fed to the long-haul services by connecting short-haul services. If short-haul services were withdrawn, this could reduce the number of passengers transferring to long-haul services, thereby affecting the long-haul services indirectly.

In the section on low-cost carriers above, we have also seen that the low-cost business model is not suitable for feeding hubs. The need for interlining agreements, luggage transfer facilities and consequent longer turnaround times than currently achieved by low-cost carriers would eliminate many of the cost advantages that low-cost carriers enjoy at present. We therefore consider that hub carriers will continue to operate most of their short-haul feeder services themselves, though they may need to reduce the cost base of some services.

Instead, hub carriers that currently have excess demand for slots at their airport may be able to pick up slots in their banks as other airlines reschedule or withdraw their services. As discussed above, market mechanisms are likely to result in slots becoming available following the withdrawal of particular regional, charter and other short haul services. This may enable the hub carrier to increase the number of both long-haul and short-haul services from the hub.

We therefore believe that hub carriers will either increase their slot holdings at hub airports following the introduction of market mechanisms or at least retain their present position.

This is what has happened under slot trading at the London airports with BA (see Section 5.4.3). However, to the extent that market mechanisms result in higher costs to airlines, this may have an adverse impact on their financial position.

In part, the financial impact depends on whether hub carriers will be able to pass on any cost increases to their customers. There may be some scope for this in short haul markets, where we expect some reduction in services from regional and non-hub alliance carriers, but in long haul markets competition may become stronger under market mechanisms. And even in short haul markets, we anticipate that market mechanisms will provide low cost carriers with opportunities to expand their services from congested airports, thereby allowing them to offer closer substitutes to hub carriers' existing services. In this event, hub carriers may need to reduce their other costs in order to be able to absorb any increase in airport-related costs. There may be scope for this in some cases.

Other long-haul routes

Our assessment is that most other long-haul routes will not be adversely affected by market mechanisms. They may lose some feeder traffic as a result of a possible reduction in short-haul services. In addition, they may face a cost increase, although this would be relatively minor as a proportion of their total costs (in part because they fly very large planes). We do not consider that either of these two factors will significantly threaten the viability of most long-haul routes operated by other carriers.

There will however be exceptions to this general principle. Some long-haul routes, for example from particular African destinations, may not be viable anyway. Market-clearing prices, or the ability to sell slots, could trigger the withdrawal of some of these services. However, given the political constraints under which many of these routes operate, this is unlikely to be the case for all of them. Some routes will continue to be operated even if they are actually loss making, but others may transfer to less congested airports.

If market mechanisms lead to the withdrawal of other services, there will be scope for competitive long-haul entry on particular routes, in particular at those airports with large catchment areas. In view of this, we would generally expect the proportion of other long haul services at airports to increase somewhat following the introduction of market mechanisms.

6.3. Potential Impact: Airports with Limited Excess Demand

At airports that only have all slots allocated during certain peak hours (which may vary by airport), market mechanisms may involve increased costs during peak hours and, where revenues from auctions or higher posted prices allow, reduced costs during off-peak hours. Though off-peak airport charges will not be reduced if secondary trading is applied alone (without a market-based primary allocation mechanism), airlines will still have the option of selling valuable peak slots and moving services instead to off-peak slots.

Below, we examine the impact of this *de facto* "peak pricing" on particular categories of airlines. We note that "peak pricing" as interpreted here would involve not only variation in slot charges by time of day, but also a move towards fixed charges per slot at peak times as opposed to differentiated charges by aircraft size.

Regional airlines

Above, we have seen that regional airlines often have limited flexibility to move to different times of the day given the fact that they carry high proportions of business passengers who need to fly at particular times. These times often coincide with peak hours at an airport.

In view of this, our assessment is that regional airlines will generally be negatively affected by peak pricing. Although any total increase in costs will be more limited in the case of airports with peak-time congestion only (since off-peak charges might actually fall), we consider that they may still be such as to render many regional services unviable. In part, this is due to the small planes that regional airlines operate, which will also be hit by a move towards fixed charges per slot.

Regional airlines may be able to avoid some of the cost increases by making small timing changes (eg 30 minutes), but will not generally be able to move away from the peaks altogether.

Charter airlines

Charter airlines may face the impact of peak pricing in two ways: some of their "origin" airports may be affected as well as some of their "destination" (holiday) airports.

We consider that charter airlines will be quick to respond to peak pricing at their origin airports. There are already precedents for this when night time surcharges were introduced at certain airports. Certain charter airlines moved their services outside the night periods in response to these charges. They can be expected to respond in similar ways if daytime "peak pricing" is introduced. In our view, the business model of charter airlines is in the medium term sufficiently flexible to move their services into off-peak times.

The situation is different if peak pricing would involve higher prices at particular times of year. At certain airports, seasonal peaks are largely caused by charter airlines that operate considerably more services in the summer season than in other periods of the year. In response to higher costs for departing services during the summer months, we expect that charter airlines will move some or all operations to alternative airports where these are available for a particular catchment area. If no suitable alternative airport is available, charter airlines may respond by using larger planes, increasing fares (to the extent this is possible given alternative modes of transport and holiday options) and operating fewer services.

Charter airlines may also be confronted by peak-pricing at their destination airports. Certain airports in the Mediterranean are severely constrained at particular days of the week, such as Gran Canaria on Wednesdays.

In our view, market clearing prices would in practice only mean small increases at most of the holiday destinations. Competition between destinations is fierce and many package-holidaymakers are not interested in the particular destination for their holiday but rather base their choice on price, expected weather, quality of hotel, etc. In these circumstances, implementing peak pricing at a holiday airport could severely reduce the number of passengers flying into that destination and staying in the region's resorts, and tour operators would be quick to divert their services to other destinations.

It is also worth noting that peak pricing is already widespread at holiday destinations; not necessarily in the form of airport charges but in the form of higher accommodation costs. Peak pricing at the local airport would reduce the demand for the hotel facilities during the peaks and hotel owners may respond by reducing the peak pricing element in their pricing structure. The net impact of peak pricing at a holiday airport in terms of passenger demand may therefore be mitigated or could even be neutral. Charter airlines would charge more for peak-time flights, but hotel costs at these times would be reduced correspondingly so that the total package cost remains competitive.

Short-haul services by full-service carriers other than the hub carrier

Short-haul services not operated by the hub carrier may have some flexibility to move to off-peak periods. However, this flexibility will be limited if such services carry high proportions of originating and terminating business passengers. In the absence of such flexibility, such services will be vulnerable if peak pricing were to be introduced.

The flexibility of services that serve a hub at the other end would be limited by the bank timings at the other end. At many hub airports, short haul services in a particular bank arrive and depart within about one hour of each other. A retiming of 30 minutes in response to higher charges at the spoke airport may be possible, but a 90 minute retiming will usually result in prohibitive transfer times. If a suitable alternative airport is available, such services may move there in response to higher peak prices at the main airport.

A further possible response is for airlines to reduce frequencies and switch to larger planes. This is most likely to occur at airports where excess demand is relatively widespread (rather than just affecting a few hours each day), and we do not expect a very large impact. Nevertheless, the introduction of a high fixed charge per slot, other things being equal, makes the use of larger planes relatively more attractive than at present.

Low-cost airlines

In Section 6.2, we have seen that low-cost carriers can be grouped into two categories: cost-minimising low-cost airlines and yield-oriented low-cost airlines.

Low-cost airlines often tend to operate regular services throughout both the day and the year. To the extent that peak pricing does not result in an overall increase in their costs, they are unlikely to respond by making changes to their schedules or services. They may be able to pick up additional slots if peak pricing removes other carriers from the airport – and the slots are not taken by other services (such as new long-haul services) that are willing to pay more for them.

Cost-minimising low-cost airlines that are faced with an overall cost increase as a result of peak pricing may be more sensitive to these increases. Where they operate irregular services, there may be scope to move away from peak periods while maintaining the same number of services per day. For regular services, limited cost increases would not necessarily imply withdrawing services but it could imply a freeze on expansion at the airport. Beyond a certain overall increase, however, service withdrawals would become inevitable.

The net impact of peak pricing resulting in higher airport charges on slot holdings by yield-oriented low-cost airlines is likely to be positive, as in the case of market mechanisms applied at airports with severe excess demand throughout the day. Reductions in some existing services as a result of higher prices may be more than offset by increases as a result of any services that these low-cost airlines take over from full-service airlines (if the latter can no longer operate these profitably, particularly at non-hub airports) in other services, for example on routes formerly served by full service airlines.

Where yield oriented low-cost airlines are able to obtain previously unavailable peak slots, and this allows them to serve new routes, this may lead to increased demand for off-peak slots as well. As these airlines compete with full service carriers (for business passengers as well as leisure travellers), and also aim for high levels of aircraft utilisation, they will often seek to establish regular services on a new route and will therefore require both peak and off-peak slots. We therefore expect significant increases in the number (and proportion) of services provided by low cost carriers at partially congested airports.

Hub-and-spoke networks

At many airports, peaks in traffic throughout the day are largely accounted for by the banks of the hub operator. The impact of peak pricing on a hub airline will therefore be similar to the impact of higher posted prices at airports with congestion throughout the day (see Section 6.2).

The only difference is that peak pricing at airports with congestion only at certain times of day may allow some scope for lower off-peak charges. By contrast, at airports with congestion throughout the day, prices will increase both in the hub carrier's banks and at other times, though probably by different amounts. Therefore, at airports with peak-time congestion only, hub operators would have a stronger incentive to move certain services out of the banks (ie "widen" the banks), and we do indeed expect this to happen to some extent. However, the scope for this will be limited by inter-hub competition and the extent to which peak pricing is implemented at competing hubs.

If the hub carrier has unsatisfied demand for slots at its hub and other operators withdraw from its banks in response to peak pricing, it may be able to pick up more slots in its bank windows to strengthen its hub.

Other long-haul routes

Many long-haul routes will not be greatly affected by peak pricing – the resulting cost increase will not be such as to make the service unprofitable. In fact, the removal of other services may enable competitive long-haul entry into markets with sufficiently large catchment areas.

There will be exceptions in the case of marginal long haul services. To the extent these are dependent on feeder traffic, they will have limited flexibility to move away from the banks or to any alternative airports. Whether such services will be withdrawn or continue to be operated will depend on the political constraints under which these services operate.

All airlines

An additional impact, which could affect some or all categories of service, is likely to be an improvement in the utilisation of slots. We note, in Section 4.3, the relatively high incidence of late slot returns at some congested airports, which leads to around six to nine per cent of slots remaining unused. In addition, we note that the application of the 80-20 rule, and the possibilities for some airlines to switch services around (or even to run extra services) in order to protect their grandfather rights, may contribute further to low levels of slot utilisation.

We expect that the introduction of market mechanisms will reduce the incidence of late slot returns. If airlines are required to pay for slots that are not returned by the required date

(even if they are not used), this will provide a strong incentives for airlines to avoid late returns. And even under secondary trading, airlines will have an incentive to sell any unwanted slots to another airline, rather than simply return them to the co-ordinator.

In addition, the use of market mechanisms will increase the cost to airlines of any underutilisation of slots. In future, therefore, rather than retaining more slots than they really need (with the result that they have to either switch services around or else operate special "babysitting" services), we would expect the increased fixed costs of holding slots to encourage airlines to reduce their slot holdings. Under mechanisms where airlines pay a direct cash cost for slots, they will simply demand fewer slots. And under secondary trading, they will sell any excess slots on to other airlines. In each case, the utilisation of slots should improve.

6.4. Impact on the Use of Airport Capacity

6.4.1. Identification of possible impacts

We have identified a number of potential impacts of market mechanisms. The quantitative analysis described in the rest of this section takes account of the following:

- a change in the mix of services using congested airports. This will include a general switch from short haul to long haul services, and within short haul services an increase in the proportion of services operated by low cost carriers (mainly at the expense of regional airlines and full service airlines other than the hub carrier);

- some switching of demand from peak to off-peak periods. These will be mainly charter services, but also some other short haul and long haul services operated by airlines other than the hub carrier;

- some switching to larger aircraft and often lower frequencies, particularly for short haul services;

- some increase in demand for off-peak slots as a result of new regular services provided particularly by low cost carriers; and

- an improved utilisation of slots. Though our quantitative analysis is based on evidence about the likely reduction in the number of slot returns, we also note that market mechanisms are likely to discourages airlines from holding onto more slots than they need (which they can do at present, provided they do not breach the 80-20 rule).

6.4.2. Introduction to quantitative analysis

Below, we describe the results of the modelling work that we have carried out to assess the potential impact of the service changes outlined above on the use of airport capacity. The

analysis in the present chapter is based on the ideal market mechanism as referred to in Section 6.1. As noted there, the impacts for each individual mechanism will be assessed in Chapters 7 to 11.

We have concentrated our analysis on a small number of airports, so that we are able to understand the relevant issues specific to those airports in greater detail. They have been selected to be broadly representative of major EU slot constrained airports and are the following:

- Airports with severe excess demand throughout the day: LHR, LGW;

- Airports with excess demand limited to peak times and / or particular capacity constraints, so that some runway slots are available during the day: CDG, MAD, VIE.

We have assessed the likely impact on service patterns and passenger numbers. To do this we analysed schedules data to derive the number of movements and the number of seats – and hence estimates for the numbers of passengers - for different categories of service. We then estimated the extent of excess demand at each airport by time of day and the airlines' responses to changes in slot costs, which in turn allowed us to estimate likely service changes if slot costs were set so that demand was equal to capacity. These estimates were derived from a mixture of empirical data (including data on slot usage, requests and allocation, and capacity), findings from the programme of interviews, other evidence and our judgement. They have to be regarded as highly indicative; their purpose is to illustrate potential orders of magnitude only.

The analysis makes a number of simplifications. For example:

- Our analysis is based on schedules data for a typical week in the 2002 Summer season only. As a result, we do not consider the additional impacts that may result from, for example, market-based mechanisms resulting in the replacement of a seasonal service by an all-year service.

- No account is taken of possible constraints in terminal capacity limiting passenger numbers.

We make the assessment with respect to, in particular, changes in the number of passengers using each airport. As we have discussed in Section 4.4.1, the number of passengers is a useful indicator of the extent of benefits, but is not a perfect measure. In particular, services will have varying levels of benefits per passenger.

A more detailed discussion of the methodology that we have used to estimate the impacts may be found in Appendix E, and a sample calculation for one particular hour (at MAD) is provided in Appendix F.

6.4.3. Airports with excess demand throughout the day: LHR and LGW

Since LHR and LGW are part of an airport system, changes in the mix of services at one of these airports may impact on the other airport, for example if certain services switch between them. Many of the changes at the two airports are therefore interrelated.

The current share of movements by various types of services, and the current estimated passenger numbers per movement at LHR and LGW are shown in Table 6.2.

Table 6.2
Current Usage Statistics: LHR and LGW

	LHR		LGW	
	Movements (%)	Pax per movement	Movements (%)	Pax per movement
Hub alliance short-haul	34.3%	104	32.6%	69
Hub alliance long-haul	12.9%	188	4.4%	184
Other alliances short-haul	12.3%	102	1.6%	68
Other alliances long-haul	5.5%	194	1.6%	171
Low cost	0.0%		7.9%	118
Charter	0.2%	152	27.3%	208
Other short-haul	24.4%	95	18.6%	73
Other long-haul	10.4%	187	5.9%	195
All services	**100.0%**	**126**	**100.0%**	**126**

Source: Schedules data, NERA estimates

Our assessment is that the key impacts will be the following:

- LHR would see a substantial reduction in short-haul services operated by carriers outside the OneWorld alliance. Some of these services would be replaced by OneWorld short-haul services; some others would disappear from LHR. LHR would also lose a limited number of marginal long-haul routes operated by third parties. All of these would transfer to LGW.

- The capacity freed up at LHR by the removal of these services would be used by additional long-haul services. Many of these would be operated by the OneWorld alliance, though other alliances (assuming the necessary traffic rights are available) and third parties (eg Virgin Atlantic) would increase their long-haul flights from Heathrow as well.

- LGW would see a reduction in short and long haul OneWorld services as some of these services are moved to LHR. Some other OneWorld services however would no longer be viable at Gatwick in the face of increased low-cost competition. Long-haul

services operated by other alliances would disappear as these services are moved to LHR. However, there would be an increase in the number of long-haul services operated by non-alliance airlines as some of these carriers move services *from* LHR.

- Low-cost airlines would substantially increase their presence at LGW, in part at the expense of other short-haul services. Charter airlines would lose some slots but would retain a substantial presence due to the lack of suitable alternative airports south of London.

Our estimates of the magnitude of these shifts are contained in Table 6.3.

Table 6.3
Modelled Shift in Services: LHR and LGW

	LHR		LGW	
	Current Movements (%)	Predicted Movements (%)	Current Movements (%)	Predicted Movements (%)
Hub alliance short-haul	34.3%	37.7%	32.6%	26.1%
Hub alliance long-haul	12.9%	15.8%	4.4%	2.1%
Other alliances short-haul	12.3%	10.2%	1.6%	2.3%
Other alliances long-haul	5.5%	7.4%	1.6%	0.0%
Low cost	0.0%	0.0%	7.9%	26.8%
Charter	0.2%	0.2%	27.3%	24.7%
Other short-haul	24.4%	15.9%	18.6%	11.3%
Other long-haul	10.4%	12.9%	5.9%	6.6%
All services	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Schedules data, NERA estimates

The estimated impact of these changes on movements and passenger numbers at the two airports is shown in Table 6.4.

Table 6.4
**Estimated Impact of Market Mechanisms on Movements by Segment and
Passenger Numbers: LHR and LGW (% change)**

	LHR	LGW
Long-haul scheduled movements	25.2%	-24.5%
Short-haul scheduled movements	-10.2%	12.7%
Charter movements	not significant[41]	-6.9%
Total movements	**0.0%**	**2.9%**
Total passengers	**7.2%**	**4.8%**

Source: NERA estimates

There would be a substantial increase in long haul movements at LHR, offset by a reduction in short haul movements. The total number of movements at this heavily congested airport would not change. The increase in long haul movements at LHR is partly at the expense of LGW (but since LHR is bigger than LGW, the total number of long haul movements at the two airports still increases). The long haul movements lost at LGW are replaced by short haul movements, particularly low cost carriers. Charter airlines, for whom LGW is an important airport, would reduce their presence. Since LGW is congested throughout the day, there is little scope for them to move their operations to off-peak periods.

Overall, passenger numbers at LGW would increase by 4.8 per cent and those at LHR by 7.2 per cent.

6.4.4. Airports with excess demand at peak times of the day: CDG, MAD, VIE

In 2007, we expect CDG, MAD and VIE will have some excess demand, but also some slots available at other times and ∕ or unaffected by the capacity constraint.[42] As noted above, market-based slot allocation mechanisms will lead to higher prices for peak slots and, in the case of primary mechanisms, could also involve off-peak charges falling from the present levels. This could result in some additional movements at the airport, either because new services are introduced in response to lower charges at off-peak times or, perhaps more likely, existing peak services are switched to off-peak slots (and the peak slots are taken up by other services).[43]

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[41]   Charter flights only account for 0.2 per cent of the total number of movements at LHR.

[42]   At CDG there will be some excess demand for much of the day, but for several day time hours slots are available (for example there may be excess demand for arrival slots in a particular hour, but some departure slots are unallocated); at MAD and VIE excess demand will be restricted to certain peak times.

[43]   A further possibility is that the greater availability of peak slots will allow airlines to launch new, regular services that require both peak and off-peak slots.

In addition, slot utilisation may increase, especially as a result of higher posted prices and auctions since these require airlines to enter into a binding agreement to pay the relevant price. Currently, typically around 6 to 8 per cent of allocated slots are not used in airports with limited excess demand. We would expect that to reduce to around 2 per cent following the introduction of market mechanisms.[44] Slot utilisation may also increase under secondary trading if this results in holders of peak-time slots retiming their services to off-peak times and selling the peak-time slots: this would imply an increase in off-peak movements (and no change in peak movements).

Key statistics regarding the current use of slots at the three airports are shown in Table 6.5 below.

Table 6.5
Current Usage Statistics: CDG, MAD and VIE

	CDG		MAD		VIE	
	Movements (%)	Pax per movement	Movements (%)	Pax per movement	Movements (%)	Pax per movement
Hub alliance short-haul	39.0%	85	40.7%	101	61.7%	58
Hub alliance long-haul	12.3%	166	4.1%	193	6.3%	121
Other alliances short-hl	12.7%	74	7.8%	78	5.4%	84
Other alliances long-hl	3.0%	171	1.1%	159	0.0%	
Low cost	2.1%	112	1.1%	117	0.0%	115
Charter	5.1%	163	1.1%	155	8.2%	149
Other short-haul	19.7%	46	41.2%	71	17.0%	49
Other long-haul	6.0%	147	2.8%	142	1.4%	114
Total	**100.0%**	**97**	**100.0%**	**93**	**100.0%**	**70**

Source: Schedules data, NERA estimates

The impacts of market-based slot allocation mechanisms will vary by airport. Our assessment is that the key impacts will be the following:

CDG

- The hub alliance (Skyteam) would slightly increase its slot holdings at the airport but not by much; we believe that its excess demand for slots at the airport is limited. Long haul services by the alliance would increase, but there would be a slight

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[44] This was the rate for Madrid when fines were introduced, though it has subsequently increased due to the fines not being enforced – see Section 4.3.

reduction in the share of short haul movements. It would improve some of its slot timings by exchanging them for slots in its banks.

- There would be an increase in long-haul services from the airport, in part as a result of some competitive long-haul entry both by other alliances and by other airlines. However, the extent of this would be limited when compared with London Heathrow.

- Low-cost services would increase their presence at the expense of short-haul services by carriers outside the Skyteam alliance. Charter airlines would retain their presence at the airport but would retime many of their services.

- Some switching to times when slots are available occurs as a result of higher peak charges.

MAD

- The changes would be limited as the predicted extent of excess demand in 2007 at this airport would be limited. The main change would be a substantial increase in the share of movements operated by low cost carriers, at the expense of short haul carriers operated by both the hub alliance and by non-alliance carriers. But there will also be a significant increase in the total number of movements as a result of higher off peak usage and fewer late returns.

VIE

- Like at MAD, excess demand at this airport in 2007 will be limited as will be the impact of market mechanisms on the share of slots held by different types of carriers. At this airport too, low-cost airlines would increase their share at the expense of the relative shares of all other carriers. However, the total number of movements increases substantially so that in absolute terms, most categories of airline increase their movements. There would however be little or no long-haul entry into this airport due to the (when compared to CDG and MAD) relatively small catchment area of Vienna.

Our estimate of the magnitude of these impacts is contained in Table 6.6.

Table 6.6
Modelled Shift in Services: CDG, MAD and VIE

	CDG		MAD		VIE	
	Current Movements (%)	Predicted Movements (%)	Current Movements (%)	Predicted Movements (%)	Current Movements (%)	Predicted Movements (%)
Hub alliance short-haul	39.0%	38.8%	40.7%	39.4%	61.7%	59.1%
Hub alliance long-haul	12.3%	13.2%	4.1%	4.0%	6.3%	6.2%
Other alliances short-hl	12.7%	11.9%	7.8%	7.5%	5.4%	5.1%
Other alliances long-hl	3.0%	3.2%	1.1%	1.1%	0.0%	0.0%
Low cost	2.1%	4.9%	1.1%	4.9%	0.0%	4.7%
Charter	5.1%	5.2%	1.1%	1.1%	8.2%	7.9%
Other short-haul	19.7%	16.7%	41.2%	39.3%	17.0%	15.7%
Other long-haul	6.0%	6.2%	2.8%	2.7%	1.4%	1.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Schedules data, NERA estimates

The estimated impact of these changes on passenger numbers passing through the three airports is shown in Table 6.7.

Table 6.7
Estimated Impact of Market Mechanisms on Passenger Numbers by Segment: CDG, MAD and VIE (% change)

	CDG	MAD	VIE
Long-haul scheduled movements	11.1%	3.3%	5.3%
Short-haul scheduled movements	2.9%	6.5%	8.3%
Charter movements	5.7%	2.8%	3.7%
Total movements	**4.8%**	**6.3%**	**7.8%**
Total passengers	**9.1%**	**7.6%**	**11.4%**

Source: NERA estimates

As can be seen, due to the significant increases in the total number of movements at these airports, the number of movements increase for each category at the three airports. There are however shifts in the relative importance of the categories. At CDG, the biggest increases are seen in the numbers of long-haul passengers, whereas short-haul passengers increase most at MAD and VIE. The number of movements operated by charter airlines at

each of the three airports increases slightly (though there are significant shifts to off-peak periods by this category).

Overall, passenger numbers at the three airports increase by between 7.6 per cent and 11.4 per cent.

6.5. Overall Impact

In the previous sections, we have estimated the potential impacts of market mechanisms on the numbers of passengers using particular airports. In the present section, we attempt to generalise these impacts across all Category 1 airports.

Table 6.8 contains the forecast shares of passenger numbers at each type of Category 1 airport in 2007.

Table 6.8
Categorisation of Airports (2007 estimates)

Type	Share of passengers[45]
Airports with little or no excess demand	12%
Airports with limited excess demand	67%
Airports with severe excess demand throughout the day.	21%

Source: NERA estimates

In Section 6.4, we have analysed examples of airports with excess demand at some or all times of the day. The estimated increases in passenger numbers are greatest at the airports with limited excess, as we believe that market-based mechanisms have the potential for increasing the total number of movements at these airports (at off-peak hours and through a higher utilisation of slots). Taking account of the relative sizes of the airports, our central estimate of the average potential magnitude of passenger number increases at these airports is 8.5 per cent.

The category of airports with severe excess demand throughout the day will in 2007 consist of only LHR, LGW, LIN and ORY. We see little or no scope for increasing movements at these airports; at LHR and LGW because these airports are used very intensively already, at LIN and ORY because these airports are subject to stringent limits on numbers of movements. As a result, the expected increase in passengers on these airports as a result of market mechanisms will be lower. Our central estimate of the average increase at these airports, taking their relative sizes into account, is 6.3 per cent.

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[45]   Based on forecast passenger numbers in 2007

We have not analysed the category of airports with little or no excess demand. Still, we expect some potential increases here, for example as a result of knock-on effects from schedule changes at airports with excess demand. Our central estimate of the average increase in passenger numbers at airports with little or no excess demand is 1 per cent.

Our estimates are summarised in Table 6.9.

Table 6.9
Summary of Passenger Growth Estimates

Type	Share of passengers[46]	Central estimate of passenger growth
Airports with little or no excess demand	12%	1.0%
Airports with limited excess demand	67%	8.5%
Airports with severe excess demand throughout the day.	21%	6.3%
Total (weighted average)	**100%**	**7.2%**

Source: NERA estimates

Over the medium to long term, we would expect the use of an ideal market mechanism to result in a total increase in passenger numbers at Category 1 airports of around 7.2 per cent. Given total forecast passenger numbers at Category 1 airports in 2007 of 719 million, this would amount to a total increase in passenger numbers at Category 1 airports in the order of 52 million.[47]

This analysis is based on an ideal market mechanism, rather than any of the specific mechanisms discussed in Chapter 5. In practice, all the mechanisms have imperfections which will mean that the actual impacts will be below those presented above. We discuss the impacts of the individual mechanisms in Chapters 7 to 11 below.

6.6. Impact on Airline Competition

The introduction of market mechanisms will affect consumers initially through the effects on the costs to airlines of accessing airports where there is currently excess demand. In the longer term, there may be further effects stemming from changes in competitive conditions in airline markets provoked by the redistribution of slots between different carriers and market segments. In principle, the use of market mechanisms to allocate scarce airport capacity might affect conditions of competition in airline markets in two ways:

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[46] Based on forecast passenger numbers in 2007

[47] These numbers are based on passengers through airports. Since some of these passengers will travel between Category 1 airports, the absolute impact on total numbers of passengers travelling will be less than these numbers (though the proportionate impact will be the same).

- first, through its effects on the level of concentration in the relevant markets;

- second, through its effects on market entry conditions in the relevant markets.

We begin by analysing the competitive effects in the context of the ideal market mechanism whose impacts on slot holding patterns were analysed in Section 6.4 above. We go on to examine the need for regulatory intervention in the markets for slots at congested airports over and above the powers already available under existing EU competition policy legislation (in the form of Articles 81 and 82, and the Merger Regulation), and the types of regulatory intervention that might be applied.

We consider whether there might be differences between the candidate market mechanisms in their impact on airline competition in Chapters 7 to 11 below. These chapters also explore the practical issues arising in applying different types of regulatory intervention under the candidate market mechanisms.

Before examining the effects of market mechanisms on competition, we briefly discuss the nature of the relevant market for air transport services.

6.6.1. The relevant market

The concept of the relevant market stems from analysis of the competitive constraints that influence firm conduct and performance in respect of the level of prices set and the quality of service offered. In the context of air transport, the process of defining the relevant market would take as its starting point the services offered by an individual carrier on a particular route between two airports. It would then consider, first, on the demand side, the set of potential substitute products to which consumers might turn if the airline in question were to increase its fares (or reduce the quality of service offered whilst holding fares unchanged). By far the closest substitute would be services provided over the same route by other carriers. However, consumers might also be able to switch to services provided by carriers operating at other airports serving the same geographical areas at either end of the route ("city-pair markets"), or other modes of transport, such as high speed rail that also offered services between the city pair concerned. Especially on some long haul routes, for example between Member States and North America or the Far East, consumers would also be able to choose between services via another network airline's hub airport.[48]

On the supply side, the analysis would also need to consider the possibility that airlines not already operating on routes between the airports or city pairs concerned would be able quickly and without incurring significant sunk costs to switch existing capacity so as to provide services in response to a price increase by an incumbent supplier.

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[48]   More remote substitution possibilities might be identified for certain types of travel, such as the option to switch between holiday destinations in the case of leisure travel, or to substitute teleconferencing for face-to-face meetings, in the context of business travel.

The extent of the competitive constraint offered by each potential substitute would be considered until a group of products was defined in respect of which a hypothetical monopoly supplier would be able to impose a small but significant non-transitory increase in price. This set of products would be defined as the relevant market.

Well-established practice in the analysis conducted by European competition policy authorities has been to define the relevant market in terms of the services available between city pairs, including, in the case of long-haul intercontinental travel, both direct and indirect services between the city pairs concerned.[49] In the present context, this approach would imply that the effects of market mechanisms need to be assessed in respect of their impact on competitive conditions across airport systems serving city regions, not simply in relation to services on routes to and from particular airports where there is excess demand.

6.6.2. The effect on the level of concentration

Previous research, surveyed in an earlier NERA report for the Commission,[50] has examined the effects of variations in the level of concentration in city-pair markets on the level of fares and service offered. Researchers found that the level of concentration, as measured by the Herfindahl Index, was an important determinant of performance in liberalised air transport markets both in the EU and in the US.[51]

Our assessment of the possible effects on concentration in airline markets of introducing market mechanisms to allocate scarce airport capacity at EU Category 1 airports takes as its starting point the results of our modelling work, reported in Section 6.4 above, on the changes in the pattern of slot holdings at particular airports. The analysis reports such changes in terms of the distribution of air traffic movements by different categories of carrier and market segment that might result if excess demand were removed by the application of market mechanisms. As such, the results do not translate directly into changes in concentration in any particular relevant airline market, and must be treated instead as indicators of average changes in concentration levels across relevant short-haul and long-haul markets.

At those airports where excess demand seemed likely to be restricted to peak periods, our analysis indicates that the extent to which slots are redistributed either between market segments, or between carriers, will be limited. For example, at Paris CDG, we expect a small net transfer of slots from short-haul to long-haul markets, and within the short-haul markets, a very small increase in the proportion of slots held by the hub carrier and its alliance partners (across long-haul markets, the hub carrier plus alliance partners' share is

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[49]   Thus recognising the possibility of inter-hub competition.

[50]   NERA, *Impact of Regulation and Certain Commercial Practices on the Development of Competition in the Air Transport Market*, A Final Report for DG-VII of the CEC, March 1999.

[51]   See, for example, SA Morrison and C Winston (1987), "Empirical implications and tests on the contestability hypothesis", *Journal of Law and Economics*, 1987, Vol 30, pp 483-499.

not expected to alter). At these locations, however, our assessment, shown in Table 6.10, is that low cost carriers will significantly increase their holdings of slots. Although their share of slots will be small compared to the hub carriers', their increased presence could signal stronger competition in short haul markets.

Table 6.10
Predicted Shift in Services: CDG, MAD and VIE

	CDG		MAD		VIE	
Short-Haul	**Current Movements (%)**	**Predicted Movements (%)**	**Current Movements (%)**	**Predicted Movements (%)**	**Current Movements (%)**	**Predicted Movements (%)**
Hub alliance	53.1%	53.8%	44.8%	43.2%	73.3%	69.9%
Other alliance	17.3%	16.5%	8.6%	8.2%	6.4%	6.0%
Low cost	2.9%	6.7%	1.2%	5.4%	0.0%	5.5%
Other short-	26.8%	23.1%	45.4%	43.1%	20.3%	18.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Long-Haul						
Hub alliance	57.7%	58.5%	51.3%	51.4%	81.8%	82.0%
Other alliance	14.1%	14.1%	13.7%	13.7%	0.0%	0.0%
Other long-	28.2%	27.4%	35.0%	34.9%	18.2%	18.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: NERA estimates

Both LHR and LGW are likely to continue to experience severe excess demand, and at these locations our analysis suggests that the introduction of market mechanisms will have significant effects on the use of capacity, as shown in Table 6.11. This gives the distributions of slots by different categories of scheduled carrier aggregated over the two airports,[52] on the assumption that the relevant market for air travel between London and any other city includes services from both LHR and LGW.

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[52] In estimating the shares for each type of carrier within each market segment, we have weighted the shares by individual airport according to the numbers of air traffic movements by scheduled carriers at each airport in 2001. Applying this method resulted in a weight of 0.7 for LHR and 0.3 for LGW.

Table 6.11
Predicted Shifts in Services : LHR and LGW

Short-Haul	Current Movements (%)	Predicted Movements (%)
Hub alliance	49.7	53.1
Other alliance	13.4	12.7
Low cost	3.5	12.1
Other short-haul	33.4	22.5
Total	**100**	**100**
Long-Haul		
Hub alliance	43.3	38.0
Other alliance	18.5	14.4
Other long-haul	38.2	47.7
Total	**100**	**100**

Source: NERA estimates - derived from Table 6.3, but combining figures for LHR and LGW and treating long-haul and short-haul as separate markets. Note that we predict a shift from long-haul to short-haul services, and therefore a reduced share of long-haul services may still be consistent with a constant or increasing number of long-haul movements.

The table indicates that across all long-haul markets, the effect of introducing market mechanisms will be to reduce the market shares of both the hub alliance and other alliance carriers, with a consequent increase in the share of non-aligned carriers, such as Virgin, or potential low cost entrants, possibly providing a similar mix of service quality and fares to that offered by Jet Blue in transcontinental markets in the US. As explained above, the reduction in the overall shares of alliance carriers disguises an expansion of services by each type of carrier in long haul markets, and a transfer of long haul services within alliances from LGW to LHR. We also expect that there will be changes in the mix of long haul routes served from LHR and LGW, with the withdrawal of some unprofitable services (for example, to certain African countries), and increased outputs on high density routes to North America and the Far East. Overall, we expect these shifts in market shares and output patterns to result in more effective competition in long haul markets, especially on the more heavily used routes.

Across short-haul markets, implementation of market mechanisms also appears likely to lead to potentially significant changes in competitive conditions. Our assessment is that BA and its alliance partners will increase their share of short-haul services, mainly at the expense of carriers, such as regional airlines, operating outside the major alliances. However, implementation of market mechanisms will also offer opportunities for low cost carriers to increase their market presence very substantially at LGW, enabling them to increase both the range of destinations served and service frequencies. These factors, combined with improved access to congested continental airports which low cost carriers currently find difficult to access, should enable these airlines to offer even sharper and more direct competition than at present to BA and other hub/flag carrier airlines for point-to-point traffic on routes serving the London region.

6.6.3. The effects on entry conditions

Table 6.12 shows the distribution of Herfindahl indices,[53] based on available seat-kms, on routes between the largest 25 EU airports in May 1998, as reported in an earlier NERA study for the Commission.[54] At that time, a third of all routes were monopolistic or quasi monopolistic (HI>0.75) and a further 43 per cent were duopolistic (0.5<HI<0.75). Only the remaining 22 per cent of routes had three or more competitors.

Table 6.12
Distribution of Herfindahl Index Values for Intra-EU Airport Pairs, May 1998

Herfindahl Value	Number of Routes
1.0	80 (30%)
0.75-0.99	11 (4%)
0.5-0.74	112 (43%)
0.33-0.49	51 (19%)
< 0.32	9 (3%)

Source: NERA (March 1999), op cit.

The average level of concentration in short-haul markets has almost certainly declined over the intervening five years, especially as a result of the development of low cost carriers; relevant city-pair markets would also be somewhat less concentrated than the airport pair markets on which the data in Table 6.12 are based. However, it remains the case that many airline markets both inside the EU and on long-haul routes between the EU and non-EU states remain highly concentrated, and the levels of concentration observed would be sufficiently high to give rise to concerns about the likely effectiveness of competition. Such concerns may, however, be moderated if there are no substantial barriers to entry and exit in the relevant markets.

Although the provisions of the existing EU Slot Regulation dealing with the allocation of pool slots[55] are intended to encourage new entry, it is widely believed that the provisions are ineffective. It is particularly difficult to build up packages of slots that enable a carrier to operate competitive moderate-to-high frequency services on busy routes, where incumbent carriers offer high frequency services that enable them to attract premium fare-paying passengers.

Implementation of any of the candidate market mechanisms ought to reduce this barrier to entry, and the greatly increased level of slot turnover that would occur following the implementation of market mechanisms will provide more opportunities for new entry at

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[53] This is a measure of market concentration defined as the sums of the squared market shares of suppliers in the relevant market or markets concerned.

[54] See NERA (March 1999), *op cit.*

[55] See Section 2.2.2 above.

certain "premium" airports than have existed in the past. We would expect the removal of this entry barrier to have most impact on short haul routes that low cost carriers wish to serve (sometimes at the expense of a full service carrier) and on certain long haul routes where increased competition is feasible. But even though potential entrants may now be able to obtain slots, entry will be more expensive if airlines have to purchase slots (either from other airlines under secondary trading, or by paying higher posted prices or bidding at auctions under primary trading) rather than simply requesting them from the co-ordinator.

As discussed in Section 6.7.3 below, moreover, some entry barriers will remain. These might include the more attractive frequent flyer programmes that hub carriers (and their alliance partners) can offer, or hub carriers' ability to combine both point-to-point and connecting traffic. On some long-haul routes, bilateral agreements may also limit the number of airlines that can operate. Such barriers, combined with natural limits on the number of competitors that some routes can support (especially if airlines need to offer regular services in order to attract business travellers), mean that the scope for additional competition on some routes may still be severely restricted despite the lowering of entry barriers in relation to slots.

6.6.4. The impacts of changes in slot concentration at airports

As noted above, market mechanisms may result in an increase in the share of slots at airports held by (incumbent) hub carriers.

In some cases, an increase in the share of slots held by a hub carrier may be efficient. It might enable the hub carrier to launch new routes or to increase the frequency on existing routes. This would increase the number of travel opportunities available through the hub and/or decrease connecting times, with passenger benefits as a result.

There may also be ways in which increased slot holdings by hub carriers would have negative impacts on the market, by enabling them to strengthen still further the competitive advantages they already enjoy over other carriers. These negative impacts may mean that the potential efficiency benefits generated by increased slot holdings are not fully passed through to consumers. Perhaps the most important single source of competitive advantage enjoyed by the hub carriers arises from the effects of frequent flyer programmes. Hub carriers' programmes are especially attractive, first, because the large number of routes served by hub airlines, enables programme members to accumulate points much faster than with other airlines; second, because the benefits of frequent flyer programmes (eg lounge access), and sometimes the number of points awarded, increase more than proportionally with the number of points already earned; and, third, because the hub airline offers a much greater choice for redeeming the points earned. The impact of frequent flyer programmes is especially significant in the high-yielding market for business travellers. In addition, airlines with large shares of slots may have other advantages, such as increased scope for attracting business travellers through high frequency levels, and scope for offering incentive deals to local travel agents.

The literature on the impacts of high slot holdings on airline market power is inconclusive. It has been suggested, in the context of the US market, that a carrier with a 50 per cent share of the number of passengers at an airport can charge fares that are approximately 12 per cent above those of a carrier with only a 10 per cent share.[56] On the other hand, an analysis of slot usage at the US's most concentrated airport, Chicago O'Hare, concluded that the evidence was more consistent with the observed concentration being the result of efficient hub use rather than with anti-competitive behaviour.[57] In general, higher fares at congested airports may of course be necessary to ration demand to the available capacity rather than be a result of the exercise of market power.

However, we note that the evidence on the impact of high slot holdings relates to the US. Although there are airports in the US where slot holdings are highly concentrated, this often involves high slot holdings by a combination of two or three airlines. For example, at Chicago, about 85 per cent of slots are jointly held by American and United. While this implies a large discrepancy between these two carriers and the other carriers at the airport, at least the two large carriers compete against each other.

In Europe, by contrast, high slot holdings are almost always held by a single carrier, such as at Frankfurt, Schiphol and Vienna. Only in the case of London Heathrow is there some sort of inter-hub carrier competition, where the Star alliance offers a small competing hub at that airport. Whereas the hub dominance issue, if any existed, in the US might be characterised as "collective hub dominance", at most European airports it would rather be "single carrier hub dominance".

In addition, the high slot holdings at US airports have developed in a relatively competitive market. By contrast, the high slot holdings of European flag carriers are all the result of being the (former) state carrier.

For the above reasons, while the literature on the consequences of hub dominance in the US is inconclusive, it might be a more serious issue at some European airports. As noted in Section 6.6.3, moreover, there are other potential entry barriers that will remain even if existing entry barriers in relation to slots are removed following the introduction of market mechanisms. Some of these barriers, especially those related to frequent flyer programmes and the ability to offer flight connections, are also likely to be closely linked to the scale of the hub carrier's activities. Therefore, an increase in the number of slots held by hub carriers may in some cases be a concern. We deal with possible remedies in the next section.

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[56]   Borenstein, S (1989) "Hubs and high fares: dominance and market power in the US airline industry". *Rand Journal of Economics*, Vol 20, No 3, p.344-365.

[57]   Kleit, A N, Kobayashi, B H (1996) "Market failure or market efficiency? Evidence on airport slot usage" *Research in Transportation Economics*, Vol 4, p 1-32.

6.6.5. Regulation and the use of market mechanisms

Our analysis suggests that the application of market mechanisms to allocate scarce airport capacity will tend to increase competitive pressures in airline markets, although any effects will be significantly less than those resulting from major market liberalisation initiatives, such as the creation of the internal aviation market, or the establishment of a transatlantic common aviation area (TCAA).[58]

The effects on airline competition of introducing market mechanisms to allocate capacity at congested airports would depend on two opposing effects:

- on the one hand, the likelihood that hub alliance carriers will increase their slot holdings at their hub airport, and the potential impacts on competition of this that we have discussed above;

- on the other hand, the likelihood of increases in the services provided by low cost carriers in short haul markets, and by non-hub alliance carriers (possibly including innovatory low cost airlines) in long haul markets.

The question may be asked whether the pro-competitive effects of using market mechanisms would be enhanced if restrictions were placed on the ability of hub alliance carriers to acquire additional slots. Such restrictions can take either of two forms:

- regulatory scrutiny over slot acquisitions by hub carriers, possibly in combination with a notification requirement; or

- a cap on the proportion of slots that airlines can hold at an airport.

We discuss each of these approaches below.

6.6.5.1. Regulatory oversight on a case by case basis

Ex-ante regulatory intervention in the market for slots might be justified by analogy with the EU merger regulation, which enables the EU competition authorities to assess ex-ante the possible adverse effects of mergers, and to propose remedies if a prospective merger is deemed to affect consumers in relevant markets adversely. By analogy with the merger regulation, the acquisition of additional slots by an airline that already controlled a large proportion of slots at a congested airport might be made subject, possibly through an amendment of the slot regulation, to the approval of a regulator.

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[58] The use of market mechanisms to allocate slots would greatly enhance the effectiveness of other market liberalisation measures, such as the creation of a TCAA. At the same time, further liberalisation of aviation markets would lead to an increase in the overall demand for slots, and hence the potential efficiency gains from the use of market mechanisms. The two types of measure should therefore be regarded as mutually reinforcing.

However, we think there are a number of objections to such an approach, of both a theoretical and practical nature.

The most fundamental issue is how, in practice, regulatory oversight would be applied. The regulator would need to undertake a "rule of reason" evaluation of the likely impact of the proposed transaction, including an assessment of the potential efficiency gains, and possible competitive detriments, and, on the basis of this assessment, would determine whether the increase in slot concentration was or was not contrary to the public interest. If it was deemed to be against the public interest, then the regulator might either disallow the deal, or propose remedies to mitigate any potentially adverse impacts.

Some indication of the efficiency gains from the transaction would be available from the price paid by the purchasing airline, although this price would reflect the private benefit to the acquiring airline, and this might exceed the social benefit if the market power of the airline was enhanced by the transaction. However, the principal difficulty in applying such an approach would lie in assessing the competitive impact of the possible transaction. Although its effect on concentration in the market for slots would be known, the effect on concentration in individual airline markets would not be known, or would, at best be highly uncertain, since the additional slots might be used to supply additional or new services on any of a variety of routes. In the absence of firm evidence of impact in what the Commission has hitherto identified in its examination of airline mergers as the set of relevant markets, ie services in a set of city pair markets, it would be impossible to reach a reasoned judgement on the likely competitive impact of the transaction.

We therefore conclude that whilst some form of ex-ante regulatory oversight of slot concentration might be feasible, its application in practice would be fraught with difficulties and might substantially reduce the potential impact of introducing market mechanisms. The difficulties of applying such an approach alongside specific market mechanisms are discussed in Chapters 7 to 11 below.

6.6.5.2.   *A cap on the proportion of slots that can be held by any airline*

The alternative to detailed regulatory scrutiny of slot acquisitions would be the imposition of a cap on the proportion of slots that any airline or airline grouping can hold at an airport. Such a cap would have the advantage of being quick to apply and enforce, since data on slot holdings are publicly available from coordinators, though alliances make enforcement more complex. It would also provide airlines with a clear framework in which they can make their decisions on slot acquisitions and sales without being subject to the uncertainty that detailed regulatory scrutiny of such transactions would imply. It would need to be set at a sufficiently high level so that "acceptable" slot holdings by airlines would not be affected. However, it would provide a limit beyond which further expansion would no longer be possible, and it would prevent airlines with exceptionally large slot holdings from further expanding their portfolio.

A cap on slot holdings would also have a number of significant disadvantages. These include:

- high slot holdings by hub airlines may be efficient from a network perspective, since these enable the airline to operate a hub-and-spoke network with many possible connections. (Though there may be a point beyond which the additional benefits of the extended hubbing possibilities are offset by efficiency losses as a result of the exercise of market power by the incumbent);

- the optimal cap cannot be set with any precision so judgement will be required. An example of a possible cap could be 50 per cent of the total number of slots, or the current slot holding if higher;

- issues will arise in regard to the time period over which the cap should apply. If the cap applies to daily slot holdings, then this would not prevent the incumbent airline from having a higher proportion of slots during the peak, for example. But the more detailed the cap becomes, the more difficult it will be to specify and enforce it; and

- airlines might be able to evade the cap by "parking" slots with alliance partners, franchisees, subsidiaries etc.

A possible variation on this approach would be a cap on slot holdings that is applied in a more flexible way. For example, the carrier might be allowed to increase its holding subject to the condition that the additional slots were used to operate routes that were not already served. Or there might be different limits applying to long-haul and short-haul services. Such an approach might provide more flexibility for airlines to acquire slots and allow regulatory restrictions to be focused on the areas of greatest concerns. But it would also require ongoing monitoring (to prevent the carrier from transferring slots to other types of service), and might prove less flexible than a simple cap in terms of providing airlines with freedom to adjust their schedules in the light of emerging market conditions.

6.6.6. Conclusions on airline competition issues

The results presented in Table 6.10 and Table 6.11 above suggest that the introduction of market mechanisms might lead to some increase in the proportion of slots held by the hub carriers (and their alliance partners) at congested airports. But this increase is likely to be small, and other aspects of market mechanisms (such as the reduction of barriers to entry and the likely increase in low cost services) are likely to lead to increased competition between airlines.

As the net impact on competition is therefore unclear, and in any case a change in slot holdings does not necessarily correspond to a change in market power (which must be assessed on a route by route basis), we are not persuaded that any increase in *ex ante* economic regulation is justified at this stage. But if some form of intervention proves necessary, for example because particular problems occur that cannot be dealt with through

existing competition laws, then we believe that some form of cap on slot holdings is probably preferable to regulatory oversight on a case by case basis.

6.7. The Implications of Market Mechanisms for EU Policy on Airline Mergers

6.7.1. Policy background

An alliance or merger between two airlines sometimes raises competition concerns on particular city-pairs, where the parties would no longer compete after the merger or alliance has been concluded. Under existing arrangements, it is extremely difficult for new entrant carriers, or carriers wishing to expand their operations to obtain the slots required to compete with incumbent carriers. In such circumstances, the European competition policy authorities have often required the parties to make slots available to new entrants wishing to operate competing services on the city-pairs in question. Usually, the requirement to make slots available is accompanied by supplementary obligations.

An example is *Austrian Airlines/Lufthansa.*[59] The alliance between these two airlines would have eliminated actual competition on a large number of routes between Austria and Germany. In addition, potential competition on many routes was also severely restricted as a result of entry barriers, including the availability of peak-time slots at Frankfurt airport.

To encourage viable new competition, the Commission imposed a number of conditions on the parties that were intended to remove entry barriers for potential competitors. These conditions included:

* a requirement to make slots available to new entrants wishing to operate services on one or more Austria-Germany-city pairs;

* to prevent them from forcing out new entrants, a requirement for the parties to freeze their daily frequencies on new entrant city-pairs for two years;

* to take account of the interests of customers on lighter routes without competition, a requirement for the parties to apply any price cuts on routes subject to competition to three other Austrian-German routes on which they do not face competition;

* to make the new entrants' services attractive for business customers, a requirement for the parties to reserve for new entrants up to 15 per cent of the seats offered on a service operated by the parties; and

* to make the new entrants' service attractive for interline passengers, a requirement for the parties to enter into a interline agreement with the parties at its request,

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[59]   OJ [2002] L242/25

including special prorate agreements, at terms corresponding to those offered to their alliance parties or other carriers.

It is significant to note, moreover, that an important factor in the decision to grant exemption to Lufthansa and Austrian Airlines was the fact that the Commission had identified several competitors that were seriously interested in entering the market on major routes (and would also be able to obtain the necessary traffic rights). Indeed, the Commission noted that it might be obliged to revoke or amend the exemption if this situation were to change. Its decision was based, therefore, on a genuine likelihood rather than a mere theoretical possibility of market entry.

The conditions listed above will apply for the duration of the exemption (six years). The parties are required to regularly provide the Commission with information to show that they are complying with the conditions. Even before the Commission granted the exemption, the parties already announced that they would keep to these commitments. As a result, new entry occurred in 2001 between Vienna and Frankfurt, and between Vienna and Stuttgart, in both cases by smaller, regional airlines.

In *Lufthansa/SAS/United*,[60] the Commission did not adopt a formal decision. Rather, following commitments offered by the parties, the Commission took a favourable position on the cooperation agreements between the parties and decided to close its proceedings.

The commitments in this case consisted of a requirement to make slots at Frankfurt available to entrants[61] wishing to commence services on one or more of a total of four identified transatlantic city-pairs.[62] The services for which these slots are used may include both direct and indirect services. Prospective entrants need to demonstrate that all reasonable efforts to obtain the necessary slots through the normal workings of the slot allocation procedures have failed. The commitment to surrender slots applies until one (or in one case, two) competitive air services have been successfully launched and operated on each route for four consecutive seasons.

Here, too, the parties have offered a number of supplementary conditions. These include:

- allowing the new entrants to participate in the parties' frequent flyer programme upon request;

- a requirement to enter into an interline agreement with the entrant; and

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[60] OJ [2002] C264/5

[61] "Entrants" include new entrants, but (subject to certain conditions) also incumbent airlines wishing to introduce new services that would compete with the services offered by the alliance parties.

[62] These were Frankfurt-Chicago, Frankfurt-Los Angeles, Frankfurt-San Francisco and Frankfurt-Washington.

- a commitment not to participate in that part of the IATA tariff conferences concerning EU-origin services on the identified city-pairs.

6.7.2. The implications of market mechanisms

In assessing the implications of the use of market mechanisms for the development of EU policy in airline merger cases, we consider the following questions:

- would the existence of market mechanisms alter the potential adverse effects of airline mergers on airline competition?

- if there were continuing concerns about the competitive impacts of mergers following the implementation of market mechanisms, would the use of market mechanisms alter the potential effectiveness of the types of remedy employed to date by the EU authorities in airline merger cases? If so, what other types of remedy might be used to offset adverse competitive effects?

6.7.3. Market mechanisms and the competitive impact of airline mergers

The analysis at section 6.6 above indicates that the introduction of market mechanisms to allocate airport capacity may be expected to have, on average, only quite minor effects on market structure in European air transport markets, which would therefore remain, on average, highly concentrated. In these circumstances, the likely effects of a merger involving a hub carrier would depend significantly on the likelihood of market entry occurring if the merged company attempted to exploit its enhanced market position to increase prices or reduce service levels

The use of market mechanisms should act to reduce barriers to entry, especially in short haul markets, where entrants must assemble a slot portfolio to compete effectively for time sensitive traffic. However, the likelihood of entry will vary widely from one situation to another, and there may be some cases where operating or other market factors make it unlikely that entry will occur on routes directly affected by a merger, even though a potential entrant would be able, if it chose, to obtain the necessary slot package. For example, whilst competitive long haul entry does not require carriers to obtain complex slot packages, it does usually require access to feeder traffic, which may not be available at airports dominated by an existing hub carrier. Similarly, short haul airlines may require quicker turn-round times than are available at congested airports. In such cases, the practical, as opposed to the theoretical effect, of market mechanisms in freeing up entry will be limited, and the potential adverse effects of a merger or alliance on competition will be little different from those under the status quo.

In the *Austrian Airlines/Lufthansa* case described in Section 6.7.1, for example, the Commission identified seven barriers to entry affecting the Vienna-Frankfurt route. These were:

- the difficulty of obtaining peak slots at (at least) the main airport in Frankfurt;

- the relatively high service frequencies operated by the parties;

- the high proportion of transfer passengers (and the consequent need to obtain slots at times that offer appropriate connections);

- the benefits from co-ordination in relation to fleet size, interlining, networks and frequencies;

- the joint frequent-flyer programme;

- the proportion of tickets sold through corporate customer deals and similar ties to specific airlines; and

- the spare capacity maintained by the parties, which means that they could respond quickly to market entry.

The introduction of market mechanisms would mean that the first (and possibly the most important) of these would no longer represent an absolute barrier to entry. But entrants would need to pay relatively high prices, especially for peak slots,[63] and none of the other six barriers identified by the Commission would have been alleviated by the introduction of market mechanisms.

Moreover, the types of anti-competitive conduct in response to market entry that the Commission's remedies are intended to address can occur in any airline market, and not only on routes serving congested airports. The introduction of market mechanisms is therefore unlikely to remove the need for close scrutiny of airline mergers, although the removal of an absolute entry barrier at congested airports may affect the balance of the competition authorities' assessment of impact (and hence remedies) in particular cases

6.7.4. The effectiveness of remedies under market mechanisms

The rationale for the policy of requiring the parties to a merger to divest slots at congested airports to carriers wishing to establish competitive services on routes where the merged parties no longer compete has been that competitive entry or service expansion would be difficult or impossible because of the unavailability of slots.

This "absolute" barrier to entry would greatly diminish, or disappear, under all of the candidate market mechanisms where secondary trading was permitted, and under the option involving the annual auction of 10% of grandfathered slots, airlines wishing to enter or expand operations on routes affected by a merger would be able to obtain the necessary slots either through the auction process itself, as well as through the secondary market.

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[63] Indeed, under secondary (rather than primary) trading, a potential entrant would need to incur costs that would not be incurred by incumbent airlines with an existing portfolio of slots.

However, we would expect that the competition authorities might be reluctant to forgo the use of the slot divestment remedy altogether, especially during the period immediately after the introduction of secondary trading, before the new market mechanisms had matured, when there might still be considerable "stickiness" in the market, extending the timescale needed to assemble competitive slot packages. In the longer term, the authorities might also wish to retain a slot divestment remedy, to address possible concerns about hub dominance, although, as we have seen, divestment to date has been applied only to address competition issues in specific city-pair markets.

We do not believe that a conflict exists between slot divestment remedies and market mechanisms, since slot divestment remedies will still be feasible under each of the mechanisms that we have examined. However, under higher posted prices and auctions of 10 per cent of slots, slot divestment remedies may become less *effective*. The reason for this is that under these mechanisms, slots would no longer be made available to new entrants at the cost-based airport charge, but at (higher) market clearing prices.[64] For regional and short-haul airlines, this could in some cases mean that entry is no longer attractive.

A further potential problem with applying divestment remedies alongside primary trading mechanisms is that there may be no guarantee that potential entrants will retain their slots in future. Even if incumbent hub carriers are required to sell particular slots directly to entrants, the new service might be squeezed out if those slots are subject to higher posted prices (as the price may rise to a level that the entrant would not be willing to pay) or if some of the slots are auctioned in future years.

In addition, we note that the use of slot divestment remedies alongside market mechanisms might raise questions about whether competition authorities were justified in forcing a departure from the market outcome. At present, slot divestments can be justified quite easily as existing slot allocations are based on historical and largely administrative (rather than market based) criteria. But if airlines in future are required to reduce slot holdings that they have accumulated through market mechanisms, competition authorities may need to demonstrate either that (a) the large slot holding reflects the airline's market power, rather than for example genuine efficiencies associated with its network structure; or that (b) the interference in market outcomes is justified in terms of the harm that might be caused by the incumbent's market power and/or the benefits that would result from increased competition.

Both the *Austrian Airlines/Lufthansa* and the *Lufthansa/SAS/United* cases offer interesting evidence of the European authorities' willingness to expand the set of remedies in airline

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[64] In slot auctions, airlines pay an upfront fee for the right to use a slot over a period that we have assumed is 10 years. We assume here that if a slot for which such a fee has been paid is required to be divested, compensation based on the residual value of the slot would be payable by the entrant to the incumbent.

merger cases. We believe that under market mechanisms, the importance of such additional remedies would increase for the following two reasons:

- the greatly increased opportunities for market entry created by the establishment of secondary trading, rendering divestment remedies less necessary in some cases; and

- the potentially reduced effectiveness of slot divestment remedies under higher posted prices and auctions (as discussed above).

The emphasis in the auxiliary remedies would be different depending on whether the merger or alliance would be a intra-European alliance or a transatlantic one. In the former case, the main purpose of the auxiliary remedies would be to restrict the ability of the incumbent to engage in predatory behaviour in response to market entry. In the latter, the remedies would mainly address concerns about hub dominance, and the effectiveness of competition for interlining traffic.

The position would be different under a regime where posted prices were raised to market clearing levels, but secondary trading was not permitted. This is because we have assumed that prices would, in practice, be set slightly below the market clearing level, so as to avoid the problem of unused but highly valuable slots that would occur if prices were set above the market clearing level, leading to an excess supply of slots. An airline wishing to enter a market or expand its output in competition with a hub carrier might then be faced with the same problem of obtaining additional slots as at present. Under these conditions, there would be a strong justification for a policy of requiring the parties to a merger to divest slots to allow market entry on routes affected by the merger. The policy would be equally applicable, as at present, to trans-Atlantic mergers or alliances as to intra-European mergers or alliances. There would also be a strong case for the application of behavioural remedies that constrained incumbent conduct in response to market entry, and, in the case of trans-Atlantic mergers, that acted to moderate the competitive advantages enjoyed by the hub carrier.

6.8. Impact on Fares and Service Levels

6.8.1. The impact on service levels

In aggregate, market mechanisms are likely to lead to increased service levels. There are two main reasons for this:

- the utilisation of slots may improve, especially at partially congested airports, reflecting the fact that higher posted prices or auctions involve a binding agreement by airlines to pay the relevant slot charge; and

- some services displaced from peak periods at congested airports will transfer instead either to off-peak periods or to less congested airports. As the slots formerly used by

these services will be reallocated to other (more valuable) services, this means that the total volume of services will increase.

Within this overall total, as noted earlier in this chapter, market mechanisms can be expected to result in changes in the composition of services using congested airports. Service levels will therefore increase for some categories and decrease for others.

We have seen that the impact on regional services and on charter airlines is likely to be negative. Some regional services into congested airports may (in the absence of other measures) completely disappear. Some may be diverted to uncongested airports. Charter airlines may switch some or all of their operations to other airports where suitable alternatives are available. Where they remain at congested airports, they may switch services to off-peak hours or use larger planes.

As far as other scheduled services are concerned, a shift from short haul to long haul services can be expected (especially at airports with large catchment areas), subject to the necessary traffic rights being available. Some marginal long haul services may however switch to other airports or to uncongested times. Within short haul services, low cost carriers will substantially increase their share of the market.

As a result of these changes, service levels on the busiest and currently most profitable long haul routes are likely to increase. In many cases, the additional services will be provided by new entrants, providing extra competition to the existing operators of the route. Even in the absence of new entry, incumbents may increase frequency levels on such routes to avoid leaving obvious "gaps" in the timetable into which entrants might enter. Other, less busy, long haul routes will probably be unaffected, though some services on the weakest long haul routes may be moved to off-peak periods or to less congested airports.

The net impact of the reduction of regional and charter services from congested airports and the increase in long haul services could well mean that the number of slots used by other (scheduled) short haul services will remain roughly constant or even increase slightly, notwithstanding the introduction of market mechanisms. Within this overall total, however, we expect low cost carriers to significantly increase their share of services, particularly at the expense of point to point (rather than feeder) short haul services that are operated at present by full service airlines.[65]

The replacement of conventional services by low-cost services is likely to place further downward pressure on fares (see Section 6.8.2 below). To the extent that this stimulates

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[65] Adopting the distinction made Section 6.2, these are likely to be "yield-oriented" low cost airlines, which generally aim to attract business as well as leisure travellers and therefore will tend to provide frequent services on major routes.

increased demand, this could lead either to increased frequencies or the use of larger aircraft.[66]

Certain short haul routes currently have very high frequency levels, eg "shuttle" services with an hourly frequency. This often results in the use of small planes. However, these frequent services cater mainly for the business market and the willingness to pay for them may therefore be high. We expect that there will be some routes on which the "shuttle" pattern can no longer be sustained following the introduction of market mechanisms. On such routes, the yield premium from frequent services is insufficient to cover the increased actual or opportunity costs arising from the introduction of market mechanisms. Other routes will be sufficiently strong to sustain the shuttle pattern (which may be operated by either a low-cost or a conventional operator). It may even be the case that such a pattern can be introduced on additional routes where slot constraints currently act as a barrier to doing so.

6.8.2. Fares

In principle, market mechanisms can impact on airline fares in the following ways:

- by increasing or decreasing the number of services on a particular route. Fares are likely to fall where services levels are increased, and rise where service levels are reduced;

- by changing the level and nature of competition on particular routes. This may be because of a change in the number of carriers serving specific routes, or because of different forms of competition (such as low cost carriers replacing full service carriers); and

- by increasing airlines' costs, the impact of which may or may not be passed on to customers in the form of higher fares.

The first and second of these mean that market mechanisms are likely to lead to lower fares, whereas the impact of the third is uncertain.

The main reasons for the increase in the total number of services are set out in the previous section. Our illustrative calculations, presented in Section 6.4, suggest that these factors lead to an increase of nearly 6 per cent in traffic volumes (as measured by ATMs) at partially congested airports. In the absence of any other changes, this alone would be expected to put downward pressure on airfares.

The increase in the number of services might be more pronounced than this, especially on the most lucrative routes. This is because market mechanisms are expected to lead to some

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[66]   easyJet for example has price protection on 200 and 220 seater Airbus A320 and A321 aircraft.

routes being withdrawn. Even if there were no increase in the total number of services, this fact alone would lead to a slight increase in service levels on the routes that remain.[67]

Equally importantly, we believe that market mechanisms could lead to increased competitive pressure on some routes. This reflects:

- the increase in short haul services provided by low cost carriers. We consider that the impact of competition between a low cost carrier and a full service carrier is likely to be greater than that of competition between two full service carriers; and

- new entry on some long haul routes, either by alliances other than that associated with the incumbent hub carrier or by other airlines such as Virgin Atlantic.

In addition to the impact of increased service levels, therefore, these competitive developments are likely to place further downward pressure on fares.

Finally, the question arises whether the cost increases associated especially with auctions and higher posted prices would be passed on to passengers in the form of higher fares, thus potentially offsetting or even reversing the favourable impacts discussed above. To examine this, it is useful to consider the way that a profit-maximising airline would set fares. For each category of passenger, airlines have incentives to increase fares up to the point where the marginal revenue per passenger is equal to the marginal cost of accommodating an additional passenger (which includes airport charges to the extent they vary with passenger numbers). This is the profit maximising fare.

Higher posted prices or auctions will increase the costs that an airline pays for each slot. But this will be a fixed cost, that does not vary with the number of passengers. On this basis, we would not expect a fixed charge per slot, resulting from either an auction or a higher posted price, to have any impact on the level of fares.[68]

However, a further possibility might be that the cost increase is used as an excuse, by airlines acting in "tacit collusion" to increase fares. Tacit collusion occurs when firms find it rational, given the structure of a particular market, to coordinate their prices without explicitly discussing them with each other. Markets that are susceptible to tacit collusion are those that are, among other things, stable (both in terms of demand and in costs) and transparent, so that any firms deviating from the equilibrium can be detected and punished

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[67] Strictly speaking, one could argue that the withdrawal of routes itself leads to fare increases, as passengers travelling between the same original and destination will now have to use connecting services. Some of these passengers, however, may well decide to use other airports or other modes of transport, while some of the others might decide not to travel at all.

[68] In contrast, if the proceeds from auctions or higher posted prices are used to reduce airport charges at off-peak times or at uncongested airports, this could well result in a lower level of passenger charges. Thus the marginal cost per passenger will fall, and therefore the profit maximising fare will also fall.

(provided an appropriate mechanism is available). In general, for tacit collusion to occur it is necessary for firms:

- to *elevate* prices from marginal cost to a higher level; and

- to sustain or *maintain* those higher prices, without there being incentives to cheat.

We see some arguments that in general, an increase in fixed costs can assist with both the *elevation* and *maintenance* of higher prices. An increase in cost that is *common* to all firms, and is known by all firms to be common to them, can serve to improve the prospects of coordinating a price rise.[69] However, landing charges at highly congested airports tend to be low relative to airfares. Moreover, other components of airline costs can be highly volatile (such as fuel costs), as can demand. There is also minimal transparency in pricing to allow easy "punishment" of those that cheat. These factors suggest that tacit collusion between airlines may be difficult to achieve.

For these reasons, we doubt that increases in airlines' fixed costs per slot, resulting from either auctions or higher posted prices, would have a material long run impact on airfares. At first this conclusion – that an increase in airlines' costs will not lead to higher fares – might appear counterintuitive. But it is important to remember that these cost increases will only take place if there is excess demand for slots at congested airports. This in turn requires that airlines are keen to get hold of slots, notwithstanding the higher prices, presumably because they still think they can use those slots to operate profitable services.

In summary, therefore, market mechanisms are likely to place downward pressure on airfares as a result of both increased service levels and stronger competition (from entrants on lucrative long haul routes and from low cost carriers on some short haul routes). But we do not believe that the increase in airline costs resulting from higher posted prices or auctions will have a long run impact on fares.

6.9. Impact on the Environment

6.9.1. Introduction

Aviation affects the environment in a number of different ways, most notably:

- noise, particularly around airports;

- emissions of pollutants affecting local air quality, in particular nitrogen oxides and volatile organic compounds; and

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[69] According to economic theory, tacit coordination is *an* equilibrium of the repeated "game" that airlines play, but it is not the *only* equilibrium. In essence, firms face a coordination game *between* equilibria. An increase in fixed costs may make the high price equilibrium more of a focal point than before.

- emissions of carbon dioxide and other greenhouse gases, which have global impacts

Market mechanisms will affect the environment in a number of ways. As we set out in Sections 6.2 and 6.3, important impacts are:

- an increase the number of movements at congested airports, because there will be more flights at off-peak times and better slot utilisation through fewer late slot returns;

- a shift from short-haul to long-haul movements, because of the greater price sensitivity of short-haul services; and

- an increase in the number of passengers per aircraft within each individual market segment, as less profitable services are replaced by more profitable ones.

Below, we provide some broad estimates of the size of these effects. But there are likely to be other impacts that we have not quantified, including the effect of any changes in the number of movements (or types of aircraft used) at other airports. Particularly for airports that may be alternatives to congested Category 1 airports, the number of movements at these airports might either increase (because of charter or other services switching away from the congested airport) or decrease (because airlines that are currently using alternative airports but would prefer to use the congested airport can now obtain the slots they require) following the introduction of market mechanisms. If there is a decrease in movements at other airports, this should moderate the expected increase in total environmental costs noted below.

There could also be longer term benefits as market mechanisms allow airport capacity to be managed more effectively, which in turn might delay or even remove the need for additional airport capacity to be provided in some locations.

6.9.2. Quantification of environmental impact

To derive broad estimates of the change in environmental costs following the introduction of market mechanisms, we have used a study on the external costs of aviation commissioned by the UK Department for Transport.[70] The study presents estimates of noise nuisance and climate change costs associated with movements for different types of aircraft. We have used a weighted average value of these estimates to provide equivalent estimates for generic short-haul and long-haul services. These are shown in Table 6.13 The estimates are presented both per movement and per thousand passenger km.

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[70] UK Department for Transport (2001) *Valuing the external costs of aviation.* Although the study was commissioned by the Department, the results do not represent the Department's official views.

Table 6.13
Environmental Costs for Short and Long-haul Movements

	Noise costs	Climate change costs	Total costs
€ per movement			
Short-haul	63	418	481
Long-haul	118	5,259	5,377
€ per 1,000 passenger kms			
Short-haul	0.60	3.98	4.58
Long-haul	0.09	4.09	4.18

Source: Derived from UK Department for Transport (2001).

Long-haul flights have larger noise costs than short-haul flights because heavier, noisier aircraft tend to be used. On average, the estimated climate change cost per long-haul movement is more than ten times that of short-haul flights, reflecting the longer distances travelled and the heavier aircraft used. But as long-haul flights carry more passengers and travel longer distances, their environmental costs per passenger km are typically less than those for short-haul flights.

The relationship between carbon dioxide and climate change is not fully understood, and therefore any valuation of the impact of fuel emissions is highly uncertain. Noise costs are also difficult to estimate because they vary greatly between locations – for example due to the proximity of residential areas – and by time of day – with night-time being most sensitive. Our estimates of environmental costs should be viewed only as a very broad indication of the likely order of magnitude.

We have applied these values to estimate the impact of our predicted changes in slot allocations, as described in section 6.4. The results, shown under the current system of slot allocation and under an ideal market mechanism, are presented in Table 6.14. The table shows the environmental costs expressed per thousand passenger km, for the five airports we have studied in detail.

Table 6.14
Environmental Costs under the Ideal Market Mechanism
(€ per 1000 passenger kilometres)

	Current	Ideal market mechanism
LHR	4.25	3.95
LGW	4.33	4.29
CDG	4.28	4.10
MAD	4.38	4.33
VIE	4.38	4.24
Average (all Category 1 airports)	**4.30**	**4.13**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

These reductions in environmental costs per passenger km reflect both the impact of increasing load factors and also some shifting from short-haul to long-haul services (particularly at LHR and CDG). But these changes, plus the increase in the total number of movements, contribute to an estimated increase of about €620 million per year in total environmental costs at Category 1 airports.

In the following chapters, where we discuss each market mechanism separately, we report the environmental impacts of each individual mechanism in terms of the general framework set out above. We also discuss in these chapters whether the individual mechanisms are consistent with environmental objectives and whether they can be modified to take such objectives into account.

6.10. Impact on Accessibility of the Regions

In Sections 6.2 and 6.3, we have seen that regional airlines and therefore the accessibility of the regions, are likely to be severely hit by market mechanisms. In many cases, regional services will be the first to cease operating in response to market mechanisms. Although some services may be taken over by low-cost carriers, and hub alliances may continue to serve regional routes where these act as important hub feeders, the net impact of market mechanisms on the accessibility of the regions will undoubtedly be negative.

We have seen that the negative impact on services to the regions is due to a number of factors. In particular:

- airport charges account for a relatively high proportion of services to regional destinations, many of which cover relatively short distances;

- services to regional destinations typically use small planes and therefore currently pay relatively low airport charges. Under market mechanisms, a fixed rate per slot would be payable regardless of aircraft size;

- regional services often carry high proportions of business travellers and may therefore depend on peak-hour slots; and

- some regional services operate at low profit margins.

We believe that in the absence of other measures, many regional services into congested airports will be replaced by regional services into medium-sized airports, from where regional travellers can connect into the major hubs. In other cases, especially where there are also land transport (road or rail) links to major hubs, some services may not be replaced at all.

Under the current Slots Regulation, the special position of regional services is recognised by the possibility of reserving particular slots for domestic services to peripheral destinations or on routes where public service obligations have been imposed. Under each of the market mechanisms, it would be possible to continue such "ringfencing" of slots. However, it is possible, and may sometimes be preferable, to use market mechanisms to safeguard regional services (eg regional communities buying slots on a secondary market), or to amend them. In our discussion of the individual mechanisms (Sections 7.3.8, 8.3.8 and 9.3.5), we set our views on how this can be done.

7. SECONDARY TRADING

7.1. Introduction

There is already some experience of slot trading at four airports in the US. In addition, a limited grey market operates in the EU, through which it may be possible for an airline to acquire "junk" slots and then swap these, together with a monetary payment, for more valuable slots at a congested airport.

In this chapter, we consider the potential role for slot trading as a mechanism for improving the allocation of airport slots. By "trading", we mean the buying and selling, or indeed leasing, of slots in return for money. This is distinct from the swaps that are permitted under the current slot regulation. Some swaps might still take place within a formalised trading regime, either because the parties agree to do this and view the slots as roughly equal in value, or because a slot is being offered in exchange as part payment for a more valuable slot.

Slot trading can be used only as a secondary allocation mechanism, operating after an initial allocation of slots has been established. It can be applied alongside a variety of primary allocation mechanisms, including both the current administrative system and the market mechanisms considered in Chapters 8 to 11 below. If trading were introduced alongside ten-yearly auctions, for example, slots might be bought and sold at any time between auctions, but this would not affect the date at which any slot would be re-auctioned (at which point, the purchaser's claim on the slot would cease).

7.2. Description of Approach

7.2.1. Overview

The basic principle of slot trading is very simple: airlines that have been allocated slots may sell them to other airlines, or indeed to third parties. Initially, the rights (including grandfather rights, plus access to stands, terminals, etc) and obligations associated with the slot will simply transfer from the seller to the purchaser.

In some cases, the purchasing airline will require a different set of services at the airport as compared with the selling airline, for example access to a different terminal or a different type of stand. The most straightforward way to deal with such complications might be for the acquiring airline to seek confirmation from the airport operator or co-ordinator that any change envisaged in the use of the slot was acceptable. Such confirmation might be sought by a purchasing airline before contacting potential sellers, or else it might be sought once a specific deal had been agreed (but before it was finalised).

7.2.2. Roles and responsibilities

Our analysis of the impact of secondary trading (either applied in isolation or alongside a primary trading mechanism) assumes that there are few constraints on the nature of trading. We therefore expect most (and very possibly all) transactions to be agreed on the basis of bilateral negotiations between airlines or their agents.[71] There may be a minor role for airport co-ordinators or operators, for example in confirming the technical feasibility of the trade, or the availability of the terminal and stand facilities required by the purchasing airline. But for the most part a slot trade would be a simple transaction agreed and executed between two airlines.

We are not assuming, moreover, that there will be any constraint on parties other than airlines acquiring slots. In theory, this might provide opportunities either for financial organisations to set up business as slot lessors, or independent brokers to engage in speculative buying and selling of slots. In practice, however, we expect such activity will be limited by the lack of formal property rights in relation to slots (which might represent an unacceptable risk for potential lessors), and also the risks associated with the continued application of the use it or lose it rule. Nevertheless, parties other than airlines may still want to purchase slots, and remembering that the use it or lose it rule will continue to apply, then there is no clear reason why this should be prevented.

7.2.3. Nature of slots

As slot trading is a secondary mechanism, the existing rights and obligations associated with the slot will simply transfer to the purchasing airline. If secondary trading is applied in isolation (alongside the existing administrative primary allocation mechanism) and there are no other changes to the legal framework, then the current "entitlement" (which is not a formal property right) will transfer to the purchaser, including the grandfather rights associated with the slot. The purchaser will also be subject to the obligations associated with the slots, including the "use it or lose it rule" which could play a potentially important role in discouraging airlines, or indeed other parties, from acquiring slots for non-operational reasons.

In Chapters 8 to 11 below, we also examine the impact of options where secondary trading is applied alongside a market-based primary allocation mechanism – either higher posted prices or some form of auction. This will affect the nature of the rights being transferred. Under higher posted prices, for example, grandfather rights apply only if the airline is willing to pay the posted price announced for the slot in each future season. And where 10 per cent of slots are auctioned each year, each slot will be due to be auctioned again at a certain date, and this will not be changed at all by the fact that a slot has been traded.

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[71] The main alternative – some kind of formal marketplace – is discussed in Section 7.3.1.2 below.

7.3. Practical Issues

7.3.1. Practicality

7.3.1.1. Trading with bilateral negotiations

There is little doubt that slot trading implemented through bilateral negotiations between airlines is feasible. US experience has shown this to be the case. So the main practical issues to be addressed relate to possible measures that might make trading more effective. These are discussed in Section 7.3.3 below.

7.3.1.2. Trading with a formal marketplace

We have also considered an alternative approach, where secondary trading takes place through some form of formal marketplace. The main potential advantages of this approach are that:

- it might make it easier for potential buyers and sellers to identify each other; and

- it could allow trading to take place on an anonymous basis, thus potentially overcoming problems caused by airlines' reluctance to sell to their competitors.[72]

We do not consider that either of these advantages provides a strong argument for establishing a formal marketplace. As we note in Section 7.3.3 below, we expect that independent agents will offer to identify potential buyers or sellers on behalf of airlines wishing to trade, and this might provide a more effective mechanism for facilitating trades than a formal marketplace. Whereas signals in a formal marketplace might be to some extent binding (or, at least, there might be restrictions on an airline's ability to change its mind), it could be easier in a less formal setting for airlines to signal their potential willingness to trade without committing themselves in any way to do so.

Similarly, we do not consider that anonymous trading is likely to solve the potential problems caused by airlines' reluctance to sell to competitors, as:

- airlines will sometimes be able to guess the identity of a potential purchaser, for example if they belong to the same alliance or through their general industry knowledge;

- a purchaser that does not compete with the potential seller might be able to identify itself to the selling airline outside of the marketplace;

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[72] Though the main rationale for establishing a formal market for fishing quotas in Iceland was to enable anonymous trading, this was prompted instead by concerns about price manipulation rather than any refusal to trade.

- partly for this reason, airlines might be reluctant to sell slots unless they know (through informal channels) the identity of the purchaser, meaning that few genuinely anonymous trades would actually take place.

In addition, we note that a formal marketplace would impose additional costs on the industry, which would reduce the advantages gained from increased slot mobility and perhaps prevent some trades from taking place at all. The marketplace itself might also be complex to operate (and perhaps to participate in), not least because it would need to be designed to be able to cope with an uncertain (and potentially highly peaked) volume of trades.

For these reasons, we have not examined this approach further. Instead, our analysis of the impact of secondary trading is based on a non-prescriptive approach, under which we expect the vast majority of (and very possibly all) trades to be agreed through bilateral negotiations between airlines and/or their representatives.

7.3.2. Legal implications

The introduction of a new slot trading regime would require an amendment to the existing slot regulation (95/93). Apart from this new regulation, there are no other aspects of the existing legal framework that are likely to prevent the implementation of slot trading altogether.

In addition, it may be possible to amend other aspects of the legal framework in order to improve the effectiveness of slot trading. The most obvious change would be to formalise the usage rights enjoyed by airlines. One option would be to clarify the formal property rights associated with slots. Alternatively, the notion of "entitlement" could be retained, but the new slot regulation could clarify the meaning of this term and thereby allow a common standard to be adopted throughout the Community.

Even if such changes are not possible, however, we do not believe this would prevent slot trading from taking place. Indeed, trading already takes place in the current grey market, and trading also occurs in the US despite the fact that airlines do not enjoy property rights and there is even an explicit acknowledgement that slots could be withdrawn.

7.3.3. Potential constraints

There are three main constraints that could impair the effectiveness of secondary trading. The first is that, in contrast to primary trading mechanisms, airlines have the option of simply continuing their operations as if nothing had changed. This option is not available under primary trading mechanisms, for example because airlines are forced to pay higher posted prices or bid in an auction for slots that they previously obtained through purely administrative mechanisms. In economic terms, this means that the introduction of secondary trading creates an "opportunity cost" for airlines. Whereas, under primary

trading, airlines face a direct cash cost as a result of having to pay for their slots, under secondary trading airlines that retain their slots simply forego the income they could have earned instead by selling some or all of their slots.

A second possible constraint is that potential buyers and sellers will not be able to identify each other, and therefore trades that might have been mutually beneficial will not take place. In practice, we would expect independent agents to enter the market and act as facilitators for airlines. Their role might be similar to that of brokers. They would not actually buy and sell slots (not least because of the risk of then losing a slot under the use it or lose it rule if a user cannot be found). Instead, they would maintain informal contacts with the main users at particular airports, and generally keep aware of each airline's likely willingness to either buy or sell slots at each congested airport. Such a service might be provided on a consultancy basis, or in return for a small commission on any transactions arranged. Incumbent hub carriers might feel that they have no need for such a service, for example because of their entrenched position and extensive knowledge of operations (and operators) at the airport. But such a service might be invaluable either to smaller airlines or to large airlines without a major presence at the target airport.

A third possible constraint on the effectiveness of secondary trading is that airlines might be unwilling to sell slots to their direct competitors. We note, for example, that United Airlines and American Airlines have bought and sold slots from each other at Chicago O'Hare.[73] Nevertheless, there remains a risk that EU airlines will be reluctant to sell slots to their direct competitors. For the reasons set out in Section 7.3.1.2 above, we are not convinced that this problem could be solved by anonymous trading within a formal marketplace, and in any case such an approach could have high costs and might actually reduce the volume of trades.

The practical importance of all of these constraints for different types of airline, and therefore the extent to which they might prevent secondary trading mechanisms from achieving the allocation of slots under an ideal market mechanism, is discussed further in Section 7.4 below.

7.3.4. Issues in applying regulation under secondary trading

In Section 6.6.5, we examined two possible alternative methods of regulatory intervention aimed at minimising any potential anti-competitive effects stemming from increased slot holdings by hub carriers and their alliance partners at congested airports. The first involved regulatory scrutiny on a case-by-case basis, and the second a cap on the proportion of slots that airlines hold at a particular airport.

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[73] Of the four US airports where slot trading is permitted, this is the only one which also acts as a major hub. It is also unusual in that it is used as a hub by more than one airline.

A secondary trading regime could accommodate either approach. If a cap on holdings was imposed, then the hub carrier might simply be unable to engage in trades leading to an overall increase in holdings, although it might seek to re-balance its holding by engaging in offsetting trades. Under the case-by-case approach, an airline seeking to acquire a block of slots would be obliged to notify a regulator if the post-acquisition slot holding exceeded a critical level, which would be the same across all airports. The difficulties the regulator would face in conducting such a review were discussed in Section 6.6.5.1 above. In practice, the obligation to seek regulatory approval would also tend to inhibit purchases of slots by hub carriers at their hubs, because potential sellers might prefer to deal with other potential purchasers who could proceed without prior regulatory approval.

Neither of the two approaches is ideal and in any case it is not clear that trading (or other market mechanisms) will necessarily give rise to competition problems that need to be addressed in this way. In the first instance, therefore, we consider that existing competition laws should be used to address any specific problems arising, and further regulatory intervention be considered only in the event that existing competition laws prove unsuitable for dealing with any problems that emerge.

7.3.5. Relationship with existing slot allocation procedures

We envisage that trading should be allowed at any time during the scheduling and operating calendar.[74] This will provide maximum flexibility for airlines, and also avoid a situation in which airlines could attempt to carry out a large number of trades at a single point in time (which might occur if trades could only take place at particular times). Airlines will be required to inform airport operators and co-ordinators of proposed trades, but these parties would only be able to block a proposed trade on grounds such as the unavailability of other (eg stand or terminal) capacity or some other material risk to the safe and reliable operation of the airport.

In theory, a slot might be sold at any time following its initial allocation. The ability to buy slots at this time might also be useful, as this could give greater flexibility for airlines to acquire slots at congested airports to match those they have been initially allocated at other airports. On the other hand, some airlines might be reluctant to buy slots at this time, hoping instead either to arrange a swap with another airline or else to obtain a slot through the existing allocation system.

A further consideration in the case of pool slots, which may have been allocated to an airline for example on the basis of its new entrant status or the service it was proposing to offer, is whether there should be any constraints on that airline's ability to sell the slot on to a different airline (which may not be an entrant or which may be proposing a completely

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[74] The use it or lose it rule would still apply, but could be modified to a change in allocation part way through the season.

different service). If the priority allocation of pool slots to new entrants continues, notwithstanding the introduction of secondary trading, then there should certainly be some minimum period during which a new entrant can only sell its slot(s) to other new entrants. Similar restrictions might also apply if particular criteria were instrumental in determining the co-ordinator's allocations, for example the specific routes proposed by the airlines that received slots.

Such restrictions might help to prevent potential abuse of the administrative mechanism for allocating pool slots. When secondary trading is introduced without a market-based primary allocation mechanism, some airlines (or even other parties) may apply for slots at congested airports with the primary intention of selling them on at a profit. In such cases, it will be important that the co-ordinator adopts fair and non-discriminatory allocation criteria, and that the allocation decision is as transparent as possible. If, for example, the allocation of pool slots at a particular congested airport was perceived as unduly favourable to the relevant national airline, this could trigger disputes and challenges by airlines that did not receive slots.

7.3.6. Applicability to airport systems

Secondary trading is not affected by the existence of airport systems. Slots that are bought and sold are specific to a particular airport and a particular time. This applies whether or not an airport is part of a system.

We note in passing, however, that a liquid secondary market may help the operation of an airport system, as it will make it easier for airlines to transfer services between airports should they wish to.

7.3.7. Consistency with environmental policy

Secondary trading involves transactions between airlines. Whilst secondary trading would not necessarily conflict with existing provisions to contain environmental impacts, it has little or no scope as a tool for pursuing environmental objectives directly. This is because there is no involvement of coordinators or other public bodies in secondary trading (other than blocking trades on feasibility grounds). Transactions are freely agreed between airlines. And while it might be possible for regulatory authorities to have some involvement (for example seeking to ensure that proposed trades did not lead to increased environmental costs), this could significantly reduce or even eliminate the potential gains from secondary trading.

A more important objection, however, is that measures to address the environmental impacts of aviation should apply to *all* services. There is no logic in intervening only when slots are exchanged, as this would mean that environmental measures would affect only those slots that happen to be traded in any particular year. For this reason, we do not

believe that it would be appropriate to adapt secondary trading mechanisms to take account of environmental objectives.

Even if proposed trades were subject to scrutiny on environmental grounds, such intervention might fail to achieve its objectives (as well as reducing the effectiveness of secondary trading). An airline wishing to introduce a new but "dirty" service might circumvent any restrictions that applied to traded slots by either:

- using one of its existing slots for the dirty service, and using the newly acquired slot instead for a more environmentally-friendly service; or

- purchasing a slot in order to operate an environmentally-friendly service, but later changing the use of that slot in order to operate the dirty service instead.

The ability of coordinators or operators to block trades *between* airlines on environmental grounds should therefore be limited to the extent, if any, to which these organisations can also limit changes in slot use *within* airlines for environmental reasons.

While secondary trading is not suitable, therefore, as an instrument of environmental policy, there are no problems of consistency that would prevent (or make unduly difficult) the introduction of environmental measures (such as surcharges on or discounts from conventional airport charges, or a system of emissions trading) alongside a system of secondary trading. In fact, we believe that a market for emissions (or noise permits) would be significantly more efficient if it was accompanied by a secondary market for slots. For example, airlines that wish to sell emissions rights might in some cases also be interested in selling grandfathered slots rights.

7.3.8. Consistency with regional accessibility objectives

Over time, secondary trading will make it more likely that slots are allocated to the airlines willing to pay most for them. Financial considerations rather than, for example, regional policy objectives, will be most likely to determine the outcome.

We believe that in the context of secondary trading, the accessibility of the regions can be safeguarded in either of the two following ways:

- slots can be "ringfenced" for particular destinations, so that they are effectively excluded from the main secondary market; or

- slots can be bought by, for example, regional authorities to ensure the provision of services to their region. This has been done by a number of communities in the US.

In our view, there is much to be said for the second approach. Although ringfencing of slots will ensure the availability of slots for regional services, this approach will lack transparency as it will not reveal the opportunity costs of reserving the slots. As a result, there is a danger

that too few or too many slots will be reserved for regional purposes. By contrast, allowing regional authorities to buy slots (perhaps accompanied by a lump-sum monetary transfer from central government to these authorities for this purpose) will allow the regions to determine whether the best use of the funds is indeed to purchase airport slots, or whether the money can be better spent. It will also allow regions to make better trade-offs between frequency of service and the associated costs, perhaps enabling some to actually enhance the services into their region.

It would also be possible to safeguard regional services outside of the slot allocation framework. For example, in cases where a service could not be provided on purely commercial grounds, a franchising model could be adopted with airlines competing to run the service on the basis of the quality of service provided and the level of subsidy required. Though it will be necessary to structure the subsidies and the tender process to address possible concerns about illegal State Aids, we note that this approach is more flexible than a straightforward purchase of slots by regional authorities. In particular, it will result in a lower level of net subsidies if the subsidy required by the successful tenderer is actually less than the cost of the slot. And it will ensure that some service is provided in the case where, even with a slot provided free of charge, the service would still not be commercially viable.

7.4. Impact Assessment

7.4.1. Assessment of key features of secondary trading

Section 7.3.3 above identifies three key constraints that might frustrate the operation of secondary trading: the fact that airlines are presented with an opportunity cost (rather than a cash cost); the fact that potential buyers and sellers of slots may be unable to identify each other; and the fact that airlines may be unwilling to sell to their direct competitors. We now consider the practical importance of each of these constraints, and the extent to which they might prevent secondary trading from delivering the outcome of the ideal market mechanism described in Section 6.4 above.

7.4.1.1. *Opportunity cost*

A key difference between primary and secondary trading mechanisms is that, under secondary trading, airlines are confronted with only the opportunity cost of continuing to use their existing portfolio of slots. If they continue to use those slots, then their outgoings do not increase. Instead, they simply forego the revenue that they could have earned instead by selling some or all of their slots.

If airlines behaved as completely rational profit maximisers, if there was perfect knowledge about present and future slot prices and if there were perfect capital markets (so airlines could access finance at a cost that simply reflects the underlying riskiness of an investment), then the distinction between cash costs and opportunity costs would be irrelevant. In practice, of course, these conditions do not apply, and therefore there are several reasons

why airlines' responses to the opportunity costs created by secondary trading opportunities may differ from their responses to the cash costs associated with primary trading mechanisms.

If airlines pursue non-profit objectives, such as attempting to maximise network size or maintain a presence at prestigious airports, then this may affect how they react to the introduction of secondary trading. If these objectives are agreed explicitly with the airline's owners and financiers, then airlines may hold onto "unprofitable" slots under either primary or secondary trading mechanisms. But these objectives will often not be explicitly recognised and therefore the finance might not be available that would allow such airlines to retain slots after the introduction of primary trading. In contrast, airlines may be able to hold onto slots for much longer (and perhaps indefinitely) under secondary trading, as there will be no direct increase in their outgoings. Furthermore, as accounting records do not generally take account of opportunity costs, some routes may appear to be profitable, or at least not very unprofitable, simply because the opportunity cost is not recognised.

In some cases, decisions to hold onto slots that a rational profit-maximising airline would instead sell may not be an entirely deliberate action. Airlines may have an overly optimistic view about their ability to increase the profitability of key routes, and therefore misguidedly retain and continue using slots when it would be more profitable to sell them immediately. In other cases, such optimistic projections might be used, deliberately or otherwise, to justify to airline owners or financiers a decision not to withdraw from particular routes.

However, another important feature of the opportunity cost associated with secondary trading is that the decision to sell a slot can be made at any point in time. Airlines may therefore view the continued use of a slot as asset holding, and indeed some airlines might explicitly recognise the option value that arises as a result of delaying any sale of slots.[75] In isolated cases, for example when an airport is likely to become uncongested in future as new capacity is added, the value attached to a particular slot may only be temporary.[76] But in many cases, airlines will expect slots at least to hold their value, and often to appreciate.[77]

Therefore, even though an airline might be using a much sought-after slot to run a barely profitable service, it might decide to retain that slot as more of an investment than an operational asset. Among other things, this will allow the airline, if it does sell some of its

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[75] The option value arises because, as a result of delaying the sale of a slot, an airline can review its decision whether to change its route network in the light of future changes in both its own profitability and also the price of slots. In contrast, if the airline quits a route now, it will incur additional costs in future if it decides to re-establish that route.

[76] This may also apply in some cases where secondary trading is applied alongside a primary trading mechanism. Where posted prices are expected to increase towards market-clearing levels, or where a slot is due to be re-auctioned, then its value may be time-limited..

[77] While the prospect of rising slot prices might encourage airlines (or indeed other parties) to acquire *additional* slots as investments, the cost of raising finance for such acquisitions might be relatively high given the significant uncertainties associated with aviation markets. For this reason, we believe that such considerations will mainly encourage airlines to retain existing slots, rather than acquire new slots.

slots in future, to plan changes to its route network and implement them according to its own timetable, which might be chosen for example so as to minimise any disruption to the rest of the airline's operations.

In some cases, we might expect decisions about the timing of slot sales to be heavily influenced by changes in the financial fortunes of particular airlines. Airlines in financial difficulties may need to sell slots to remain solvent (for example, United Airlines sold slots to BA at London Heathrow in October 2003: see Section 5.4.3). Even though they may be reluctant to dispose of slots at a time where this might be recognised as a "distress sale", they may still be able to achieve a reasonable price for their slots by holding negotiations with a range of buyers or even arranging a mini-auction. Other airlines may also chose to sell slots at times when they want to undertake new investment (for example, in new routes elsewhere) and therefore view slot sales as a convenient and relatively cheap method of raising finance. And some airlines might view secondary trading as an opportunity to "cash in" on the value of certain routes, or even in some cases close down the airline altogether and distribute the resulting revenues to shareholders.

Finally, we note that some airlines might fail to respond to the opportunity costs associated with secondary trading simply because of <u>uncertainty</u> about the value of their slots. If they have underestimated this value, then they may simply do nothing. But if they have overestimated the value, then they might try to sell some slots but withdraw from the process once the true (ie lower than expected) value becomes clear. This is in contrast to primary trading mechanisms such as higher posted prices or auctions, where the price of a slot is very clear.

Overall, therefore, we would expect the fact that secondary trading creates only an opportunity cost to have the greatest impact on:

- airlines that may be pursuing objectives other than pure profit-maximisation. This might include some long-haul carriers from small or distant countries, for which the service to a congested EU airport is a high profile and prestigious service. And it might also apply to some small (though not all) regional airlines, especially if the sale of key slots would leave them without a viable ongoing operation;

- airlines that are in a comfortable financial position, such that they are able to retain slots as investments and they are unlikely to need to sell slots in order to raise money;

- airlines that have only small operations at particular airports, and therefore may be less aware of the extent of trading and the value of slots at those airports; and

- airlines that already attach a high (though not quite the highest) value to a slot, so that the opportunity cost that results from not selling the slot is small. Secondary trading is more suitable for situations where there is a large difference between

airlines' valuations of a slot, rather than "fine tuning" between alternative high value uses of a scarce slot.

But the potential inconsistency between the first two of these categories means that, in practice, the fact that secondary trading gives rise to only an opportunity cost may be less important in the long run. Except for a small number of cases where an airline is both publicly owned and generously funded, airlines that pursue non-profit objectives are unlikely to be in a comfortable financial position. Over time, therefore, airlines may not be able to ignore the potential revenue that can be earned from slot sales, even though this might mean that they operate a slightly smaller network in future or they no longer serve certain prestigious airports.

In general, moreover, we expect those airlines that are more cost conscious to respond more readily to opportunity costs than others. Thus at airports where we believe that an ideal market mechanism might lead to increased traffic in off-peak periods, as a result of charter services switching from the peak and low cost carriers operating more services, we would expect much of this impact to occur under secondary trading as well. And we would also expect secondary trading to deliver many (though probably not all) of the benefits from fewer late slot returns, as airlines realise that they can sell unwanted slots rather than simply return them to co-ordinators.

The fact that secondary trading is less suitable for fine tuning slot allocations may reduce the number of trades that take place. But this will have less effect on the overall impact of secondary trading, as any trades that do not take place for this reason would generally have delivered only marginal benefits.

7.4.1.2.   *Imperfect information*

The second main potential constraint identified in Section 7.3.3 is the possibility that potential buyers and sellers may not be aware of each other, and therefore potentially beneficial trades will not take place. Provided that there is nothing to stop independent agents from setting themselves up as market facilitators, then we do not expect such problems to have a very major impact on the outcome of secondary trading.

We would expect such agents to maintain regular contacts with airlines, especially those that might be potential sellers of slots. Applying their specialist knowledge of operations at particular airports, they will be in a good position to identify airlines that might be willing to sell slots once they are aware of how much money they would earn. As well as facilitating trades, this activity might help to overcome some of the problems noted above (especially the uncertainty about the likely level of slot prices) and also, by regularly reminding airlines of the income they are foregoing, help to maintain pressure on airlines to release slots that they are retaining for non-profit maximising reasons.

Overall, therefore, we might expect a small number of potential trades not to take place, simply because potential buyers and sellers are unaware of their common interest, or perhaps on occasion because either the buyer or the seller adopts an aggressive or unrealistic negotiating position and a potential deal falls through. Perhaps more frequently, there may be occasions when a trade takes place, but a slot is sold to a party other than the airline that could use the slot most effectively. But, in cases where trading can generate significant benefits:

- we expect such trades to take place, though potentially after a short delay; and

- we expect the trade to achieve most of the potential efficiency improvement, even if the slot is not sold to the airline with the very highest valuation of the slot.

Overall, therefore, we do not believe that problems of imperfect information will prevent secondary trading from achieving much of the potential efficiency improvements identified in Chapter 6. But secondary trading is less suitable for fine tuning almost efficient allocations, so there may still be cases where the result falls short of the allocation under the ideal mechanism, either because trades which would deliver only small benefits do not take place, or because some slots end up with airlines that are not quite the highest value potential user.

7.4.1.3. Unwillingness to trade

The third potential constraint reflects the possibility that airlines could simply refuse to trade with their direct competitors. While this might appear intuitively plausible, over time airlines might come to recognise the futility of such behaviour, as:

- except in extreme cases, it is unlikely that an airline could prevent its competitors from obtaining slots. There may be other slot holders that are willing to sell their slots to the same competitor. And indeed, if the original seller decides to sell its slot to another (non-competing) airline, even though the competitor was willing to buy the slot at a higher price, there may be nothing to prevent the new buyer simply from selling the slot on, at a profit, to the competitor that wanted the slot in the first place;

- by retaining slots that it would really like to sell, or else by selling slots at less than full value in order to avoid trading with competitors, the original seller is reducing its sale proceeds. If the competitor will obtain a slot anyway, then the airline is simply reducing its own profits with little or no ultimate benefit.

Even if airlines do not recognise the futility of such action, however, we do not believe that a refusal to trade with competitors will have a major impact on the outcome of secondary trading. This is because the main airlines that might be affected by such considerations are the hub carriers at major airports. It is much less likely that other slot sellers will face such a

dilemma, as the potential purchasers are unlikely to be their direct competitors.[78] And for the reasons set out in Chapter 6 above, we believe that hub carriers will generally seek to increase their slot holdings if market mechanisms are used to allocate slots. Even if they decide to sell some specific slots, we would expect such sales to be more than offset by new acquisitions, and therefore hub carriers are likely to be net buyers, rather than net sellers, of slots.

Instead, we believe that the main supply of slots is likely to come from regional and charter airlines, together with some slots released by full service airlines other than the hub carrier. Some of these airlines may be leaving the airport altogether, or else switching their services to off-peak times. Such airlines are therefore much less likely to have concerns about the purchaser using a slot to compete with one of their existing services. Instead, they are more likely to be concerned with maximising their revenues from slot sales.

7.4.2. Timing issues

The fact that secondary trading introduces only an opportunity cost, rather than a direct cash cost, means that its impact on slot allocations may be delayed. Airlines may be slow to react to such opportunities, especially if they expect the value of their slots to increase over time, and they may want to plan an orderly withdrawal from key routes or airports.

But taking account of wider considerations, there are also good reasons to suppose that the impact of secondary trading might be relatively rapid compared with the primary trading mechanisms considered in Chapters 8 to 11 below:

- compared with higher posted prices or slot auctions, the introduction of secondary trading is less likely to be met with fierce resistance by airlines and other parties (such as non-EU states). It may therefore be possible to introduce secondary trading at an earlier date than a primary trading mechanism;

- once a decision to implement secondary trading has been made, it might be relatively straightforward first to decide the "rules" of trading and second to ensure that airlines and other parties understand these rules. In contrast, it might be a difficult and time consuming task to design an appropriate slot auction, and higher posted prices might be difficult to implement as rules would be needed to ensure prices were set on the basis of transparent and non-discriminatory principles and to prevent possible abuses of monopoly power;

- airlines seeking to increase their slot holdings at key congested airports might perceive the initial introduction of slot trading as creating a unique opportunity to

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[78] Even if the buyer and seller compete on other routes, if the seller is not a major hub carrier at the airport then it is probably unlikely likely that the purchaser would use a newly acquired slot to operate a route in direct competition with the seller.

acquire a significant number of slots. Once the initial inefficiencies have been removed, the potential supply of slots may be reduced and it would then be either more difficult or more expensive to achieve a substantial expansion in slot holdings. For this reason, some airlines might target likely slot sellers and try to persuade them to do a deal as soon as trading is implemented.

In practice, the outcome will also depend on the financial state of the airline industry. If slot trading is introduced at a time when some airlines are under financial pressure, then existing slot holders may be more likely to "cash in" the value of their slots than they would be in more comfortable times.

7.4.3. Estimated impact of secondary trading

7.4.3.1. *Impact on passenger numbers*

Taking account of the points noted in Section 7.4.1 above, we have produced illustrative low, central and high estimates of the possible medium to long term impact of secondary trading.

The central estimate is based on the following adjustments to the estimated impact of the ideal market mechanism as described in Section 6.4:

- recognising the fact that imperfect information will mean that some trades may not occur (though this is most likely to affect trades with only small potential benefits), and that some trades that do occur may deliver most but not quite all of the potential benefits, we have assumed that only 80 per cent of the potential benefits of market mechanisms are delivered across all categories of airline;

- taking account of the risk that some airlines may not respond to the opportunity cost associated with potential slot trades, we have reduced the volume of trades involving non-alliance full service carriers (both long haul and short haul) by a further 10 percentage points;

- at airports with excess capacity only at certain times for the day, we have assumed that secondary trading delivers at most 80 per cent of the benefits from increased off-peak traffic, and only two thirds of the benefits from there being fewer late slot returns.

The principal way in which our low and high cases differ from the central case is through the volume of sales not occurring due to imperfect information and failure to respond to opportunity costs. On the basis of the doubts expressed in this regard by stakeholders during our interview programme, the low cases assumes that only 30 per cent of potential benefits will be achieved (compared to 70 or 80 per cent under the central case, depending on airline category). For the high case, the percentage is 80 or 90 per cent. In our low and high cases, we have also varied the impact of fewer late slot returns.

Full details of our assumptions under each case may be found in Appendix E, Section E.3.

The overall impact on passenger numbers for each of the three cases is shown in Table 7.1 below.

Table 7.1
Increase in Passengers under Secondary Trading

	Ideal market mechanism	Secondary trading		
		Low	Central	High
LHR	7.2%	2.2%	5.1%	5.7%
LGW	4.8%	1.4%	3.8%	4.1%
CDG	9.1%	2.7%	4.9%	6.0%
MAD	7.6%	2.2%	3.7%	4.6%
VIE	11.4%	2.6%	5.0%	6.1%
Weighted average over all Cat 1 airports	**7.2%**	**2.2%**	**4.0%**	**4.8%**

Source: NERA estimates
Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

These illustrative estimates suggest that the medium to long term impact of introducing secondary trading might, under central case assumptions, be an increase in the number of passengers travelling through Category 1 airports of approximately 4 per cent. The range of estimates primarily reflects uncertainty regarding airlines' responsiveness to opportunity cost, and therefore their willingness to sell valuable slots.

The apparent consistency of the impact across the different airports shown in Table 7.1 is slightly misleading, as at LHR this is primarily a traffic mix effect whereas at the other airports it reflects a combination of traffic mix effects and an increase in total air traffic movements.

> **Given total forecast passenger numbers at Category 1 airports in 2007 of 719 million, secondary trading would under central case assumptions result in an increase in the number of passengers travelling through these airports of about 29 million per year.**

7.4.3.2.   Implementation costs

The immediate costs of implementing secondary trading should be very low. We envisage that the main impact on airlines' costs will reflect:

- either the fees charged by independent facilitators, or else the increased time spent by airline staff making sure that they remain aware of potential opportunities to buy or sell slots at key airports;

- a slight increase in business planning overheads, as proposed transactions (especially purchases) would need to be subject to a financial evaluation.[79]

We would expect expenditure incurred in relation to major slot trades to be greater than for trades of small value (though probably less than pro rata), with airlines employing specialists to advise on and execute the deals. Trading commission charges, for example for Icelandic fishing permits, are typically around 0.5 per cent of the value of the trade. Secondary trading will require increased financial evaluation as well as the transaction, so we think it is reasonable to suppose that the transaction costs associated with high value trades could be of the order of 1 per cent of the value of the trade.

There would also be costs associated with changing legislation to permit secondary trading, and establishing systems – within airlines, and amongst trade brokers – to process trades. There would also be a higher number of trades initially before the system had settled down, with associated transaction costs.

Once the system was established, we suppose that perhaps around 5 to 10 per cent of scarce slots would be exchanged each season.[80] Under central case assumptions, such activity would have an associated ongoing cost of around €16 million per year across EU Category 1 Airports as a whole (2007 figures), which is equivalent to €0.02 per passenger or €0.5 per extra passenger generated as a result of introducing secondary trading.

7.4.3.3. *Impact on airline competition*

Table 7.2 below summarises the impact (central estimate) of secondary trading, compared with both the current situation and the impact of an ideal market mechanism, on the shares of slots allocated to the hub alliance and to low cost carriers. In general, this shows that we do not expect secondary trading to have a significant impact on the proportion of slots held by hub carriers, except for the redistribution of slots between LHR and LGW.[81] Hub carriers and their alliance partners will increase their slot holdings as more slots become available at

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[79] Such an evaluation could be carried out either before negotiations commenced, so that negotiators could be given guidance about maximum acceptable prices (or minimum prices in the case of sales), or else it could be carried out once a transaction had been provisionally agreed.

[80] This compares with around 6 per cent of Heathrow slots being exchanged in Summer 2002, and less than 5 per cent of scarce slots being sold in one year under the US secondary trading system, though a much larger number were subject to short term leasing arrangements.

[81] The overall impact of this shift is to increase the One World alliance's share of short haul services at LHR and LGW combined, and reduce its share of long haul services.

congested airports, but so will their competitors and therefore there will be little or no change in the relative proportions (rather than the numbers) of slots held by each.

Table 7.2 also indicates that secondary trading is likely to allow low cost carriers to increase their presence at major airports, and especially at LGW. Although we do not expect secondary trading to deliver quite as many opportunities for low cost carriers as the ideal market mechanism discussed in Section 6, the extent of entry shown in Table 7.2 should still result in stronger competition for existing carriers across a number of short haul routes.

Finally, although not shown in Table 7.2, long haul passengers should also benefit from:

- a general increase in the number of long haul services, which may lead to some downward pressure on fares; and

- some increase in competition, as the overall market share figures hide the offsetting impacts of some unprofitable services being withdrawn and increased competition (from carriers such as Virgin or potential low cost entrants) on some high density routes.

Table 7.2
Competition under Secondary Trading

	Current	Ideal market mechanism	Secondary trading (central case)
Hub alliance share of long haul movements			
LHR	45%	44%	45%
LGW	37%	24%	24%
CDG	58%	59%	59%
MAD	51%	51%	51%
VIE	82%	82%	82%
Average (all Category 1 airports)	**53%**	**52%**	**52%**
Hub alliance share of short haul movements			
LHR	48%	59%	56%
LGW	54%	39%	40%
CDG	53%	54%	54%
MAD	45%	43%	44%
VIE	73%	70%	72%
Average (all Category 1 airports)	**51%**	**51%**	**51%**
Low cost airlines' share of short haul movements			
LHR	0%	0%	0%
LGW	13%	40%	36%
CDG	3%	7%	5%
MAD	1%	5%	3%
VIE	0%	6%	2%
Average (all Category 1 airports)	**3%**	**7%**	**6%**

Source: NERA estimates
Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

7.4.3.4. Impact on the environment

As noted in Section 6.9.1, market mechanisms will in general result in the following main impacts:

- increases in the number of movements, reflecting both improved utilisation of peak slots and some switching to off-peak periods;

- a shift from short to long-haul services; and

- an increase in the number of passengers per aircraft.

In our central case, we estimate that secondary trading would lead to an increase of about 2.4 per cent in total movements at the five airports in our sample. Within these totals,

moreover, there is a shift from short-haul to long-haul services, resulting in an increase of 3.4 per cent in the total number long-haul movements.

The environmental costs per passenger km that would result from these changes are shown in Table . At LHR and CDG, in particular, there are increases in long-haul movements which result in a marked reduction in environmental costs per passenger km. At LGW, the number of long-haul movements falls, but load factors generally increase, so that there is only a small change in environmental costs (per passenger km).

Table 7.3
Environmental Costs under Secondary Trading
(€ per 1000 passenger kilometres)

	Current system	Ideal market mechanism	Secondary trading (central case)
LHR	4.25	3.95	4.03
LGW	4.33	4.29	4.31
CDG	4.28	4.10	4.19
MAD	4.38	4.33	4.36
VIE	4.38	4.24	4.33
Average (all Category 1 airports)	**4.30**	**4.13**	**4.20**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

Though the estimated environmental cost per passenger km falls following the introduction of secondary trading, there is an increase in the total number of passenger kms. As a result, we estimate that total environmental costs at Category 1 airports might increase, in our central case, by about €370 million per year. As noted in Section 6.9.1, however, this might be reduced if the introduction of secondary trading leads to a decrease in movements at some other airports or if it results in some delays or even cancellations of airport expansion plans.

8. HIGHER POSTED PRICES

8.1. Introduction

While price signals are used throughout the modern economy, it is still relatively unusual for higher prices alone to be used as a mechanism to allocate scarce capacity. In competitive markets, a more likely reaction to excess demand may be an increase in supply, perhaps with capacity being allocated on a first-come, first-served basis before the increased supply comes on stream. And in less competitive markets, firms may be prevented from raising prices (for example, by the application of economic regulation) in order that they do not abuse market power. Indeed, a restriction of supply in order to increase prices is the traditional way that a textbook monopolist exploits its position, and economic regulation aims to prevent this.

Among European airports, there are several examples of airports that experience significant excess demand, yet their airport charges are held down by economic regulation (often compounded by the impact of the "single till" approach). In theory, some of this excess demand might be removed simply by increasing the prices paid by airlines, and in this chapter we consider whether posted prices, either alone or in conjunction with secondary trading, might be used as an allocation mechanism for airport slots.

One potentially important advantage of higher posted prices, at least for airports that are congested only at certain times of the day, is that the extra revenue raised in this way might allow airport charges to be reduced (potentially down to short run marginal cost) at times when the airport is not congested. Where a congested airport is part of a system, it may also be possible to use the revenues from higher posted price to reduce charges at other airports, if they are not congested. As well as increasing the use of currently uncongested airport capacity, such rebalancing could, at the margin, encourage some airlines to switch from peak to off-peak times. Many airlines, however, will wish to retain their scheduled services at peak times for a combination of commercial and operational reasons.

Other than this potential rebalancing of prices, we are not directly concerned with questions relating to the extra revenues that might be raised through higher posted prices. Instead, the focus of our study is to assess the impact of market mechanisms on the allocation of airport slots and the efficiency of aviation markets. We note that there are a number of options that might be considered for dealing with any excess revenues, including:

- as noted above, any excess over the conventional airport charge being used to fund a reduction in charges at off-peak times or at other (uncongested) airports;

- any excess over the conventional airport charge being treated as a tax and paid to government;

- any excess over the conventional airport charge being placed in a fund to pay for future airport expansion, or to compensate for environmental impacts, etc.

While the focus of our analysis is the potential impact of higher posted prices on the allocation of airport slots, we nevertheless address the issues listed above to the extent that they might affect the impact (perhaps indirectly, for example through the risk of retaliatory measures) or have other, wider effects (for example, on airport operators' incentives to provide additional capacity in future).

8.2. Description of Approach

8.2.1. Overview

At present, airport charges are generally based on the costs incurred in providing airport services, often also taking account of a contribution from non-aeronautical revenues (such as retailing activities at the airport). The same level of charges often applies throughout the day or week, though there are airports where some form of peak pricing has been adopted. Even in these cases, peak pricing is usually applied by seeking to recover a higher proportion of fixed or common costs from peak users, still within an overall approach based on cost recovery.

If, instead, higher posted prices are used as a mechanism for allocating slots, this may require a departure from the current cost basis. We assume that a cost-based charge will continue to operate at times where there is not excess demand, and indeed if there is spare capacity at these times then this charge might be reduced (subject to a minimum level equal to short run marginal cost) to the extent that the revenue shortfall from setting off-peak charges below average cost can be met from the proceeds of higher posted prices at peak times.

At times of excess demand, therefore, the posted prices for slots at congested airports will need to be set at whatever level is required to match demand with the available supply. In order to fit in with the existing slot allocation procedures (which will continue to apply at other airports - see Section 8.3.5), these prices will need to set on the basis of forecasts of demand about one year in advance. Clearly, given the difficulty of forecasting so far in advance, it is likely that posted prices will fail to clear the market in a number of cases,[82] and so demand will continue to exceed supply for some slots. Some additional mechanism will be needed, therefore, to allocate capacity in such situations. We assume that grandfather rights will continue to apply, therefore incumbent airlines will effectively have "first refusal"

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[82] In Section 8.3.1 below, we suggest that airport operators may deliberately set prices too low (rather than too high) and therefore excess demand will be more likely to occur than excess supply. Even if this were not the case, 50 per cent of forecasting errors might still be expected to lead to situations of excess demand.

in relation to slots they have previously used.[83] But there will still need to be procedures to deal with cases where more than one airline applies for a slot that is not subject to grandfather rights (either because the incumbent airline does not want the slot at the new price, or because it is a pool slot in any case).

To address such situations, we assume that administrative criteria will continue to be used to determine priorities, much in the same way that pool slots are allocated at present. Indeed, there may well be scope to redefine these criteria, and to ensure that they are applied consistently across member states. This approach to dealing with situations of residual excess demand is preferable to the main alternatives, as:

- while it would be possible to allocate slots at random (for example, by lottery) between the airlines willing to pay the higher price, this would create more uncertainty and service disruption. In any case, it is likely that carefully chosen administrative criteria will lead to an allocation that is closer to the optimum, on average, than one where excess demand is dealt with by a lottery;

- if, instead, a "mini auction" were to be held in cases where there is still excess demand, this could result in a relatively high proportion of slots being auctioned at the same time, which we do not think is feasible.

8.2.2. Roles and responsibilities

Airport co-ordinators or operators will continue to be responsible, as at present, for the allocation of slots using administrative procedures (including allowing grandfather rights, and allocating pool slots). The main difference from the current situation is that higher posted prices will be set for some or all of the slots at congested airports, in order to reduce (or perhaps even eliminate) the excess demand for slots.

Airport co-ordinators and/or operators are clearly best placed to set the level and structure of posted prices, as this will require an assessment of both the likely level of demand one year ahead and also the way that this demand would respond to different price levels. Even if the domestic regulatory framework requires that these charges are approved by another body (such as an independent regulator or a Minister), airport co-ordinators and/or operators should be responsible for analysis and recommendations about the level of posted prices.

The question of what happens to any extra revenue raised from higher posted prices is beyond the scope of this study, though as noted in Section 8.3.3 below airport operators may have a disincentive to provide additional capacity in future if they retain some or all of any additional revenues. We envisage that the effective posted price for each slot will take the

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[83]   The continuation of grandfather rights is important, as we expect that posted prices might be increased only gradually (see Section 8.3.3), and therefore excess demand for slots might persist for some time.

form of a conventional airport charge plus an additional charge per slot to reflect the likely extent of excess demand. The prices paid by airlines will be the sum of both of these charges, and we would expect airlines to react to this total price (and not be concerned with the division of this total between airport charges and slot charges). The airport operator will retain the conventional airport charge, but not necessarily the additional revenue.

8.2.3. Nature of slots

We envisage that higher posted prices will be applied in a similar way to existing airport charges.[84] In practice, this charge could be collected as a single lump sum per season, or alongside conventional airport charges on the basis of an equivalent daily rate. As the charge applies on a season-by-season basis, it offers no guarantee, beyond any existing grandfather rights, that the airline will be able to use the same slot in future seasons, and indeed even existing grandfather rights will apply only if the airline is willing to pay the posted price determined for the slot in each future season.

Within a general framework of using posted prices to allocate slots, alternative approaches might be possible under which the posted price would be used to allocate a slot for a fixed period of time. This might cover a period of several years, or perhaps even indefinitely. Or, alternatively, a posted price could apply only to a single season and not even confer any grandfather rights in relation to future seasons. We have not considered these alternative approaches, as:

- in the case of longer term (and especially indefinite) rights, we believe it would be extremely difficult for airport operators and co-ordinators to determine the appropriate level and structure of prices. And as prices would be set on an irregular basis, they would have far fewer opportunities to correct any mistakes from year to year;

- in the case of single season usage charge without grandfather rights, we believe this would cause considerable disruption and uncertainty. As posted prices are probably unlikely to clear the market exactly, grandfather rights can play an important role in (a) helping to establish a prioritisation between different airlines all willing to pay the posted price for a slot, and (b) avoiding major changes in schedules and service patterns from year to year.

A further important question to be addressed concerns the process by which an initial request for a slot (at the higher posted price) becomes a commitment to pay that price. We do not think that airlines' initial requests should represent a binding agreement to pay the posted price if that request is accepted. This would create significant difficulties for airlines, and the situation where an airline withdraws a request (that would otherwise have been

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[84] An important difference, however, is that we expect the additional charge for each slot to be payable whether or not the airline actually uses the slot.

accepted) is best dealt with by allowing the co-ordinator to offer the slot instead to other airlines that expressed a willingness to pay the posted price.[85]

At some later stage, however, airlines that have not returned slots should then be regarded as having entered a binding commitment to pay the posted price. We suggest that this should initially occur at the slot return deadline, so that airlines that hold slots beyond this date will be required to pay the posted price. That airline will also be able then to sell the slot, if secondary trading is permitted, and will also be subject to the use it or lose it rule. If in practice this approach were to result in airlines holding on to a significant number of slots and then returning them just before the deadline, consideration should be given to further measures to discourage such speculative applications, such as either:

- bringing forward the date at which each airline is committed to paying the posted price; or

- imposing a slot reservation fee, from an earlier date, that is payable whether or not the airline eventually retains the slot (in effect, this would be a non-returnable deposit that is payable on the basis of initial slot allocations).

The imposition of a binding commitment to pay the posted price effectively means that higher posted prices would be set as a rate per slot per season, or per shorter period for services that only operate during parts of seasons. This way, airlines are provided with incentives for airlines to use slots efficiently.

8.3. Practical Issues

8.3.1. Practicality

Unlike auctions (see Chapter 9 below), the use of posted prices to allocate slots should be relatively straightforward from airlines' point of view. Their short term task will be relatively similar to that at present,[86] with the main differences being that:

- with higher posted prices, they may be more likely to consider withdrawing particular services;

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[85] We envisage that airlines would still be able to agree slot exchanges before the slot return deadline. But each airline would then be liable to pay the posted price that applies to the specific slots they hold at the slot return deadline, even if they were originally allocated slots at a different (and perhaps cheaper) time.

[86] While long term planning by airlines may be more difficult, because of uncertainty about the future level of prices, similar problems are likely to affect airlines under any approach that introduces greater flexibility into slot allocation procedures.

- with at least some of the excess demand likely to be eliminated as a result of increased prices, airlines (including entrants) should stand a higher chance of being able to increase their slot holdings.

In contrast, airport operators will have a new and difficult task to carry out – to set the future level and structure of posted prices. Among other things, this will involve:

- assessing the likely level of demand in approximately one year's time, and how this might be likely to vary by time of day or week;

- developing a level and structure of prices (probably quite finely differentiated by time of day/week) that is likely to achieve an appropriate balance of supply and demand, after taking account of airlines' likely reactions to any price changes.

Given the difficulty of this task, especially in situations where prices must be set across a system of airports, we expect that airport operators will take a conservative approach. In particular we would expect prices to be increased gradually over time, and even in the long term we would expect prices to be set deliberately on the low side, to reduce the risk that some slots will remain unused (we consider options that might be used if this occurs in Section 8.3.3).

We do not expect that airport operators will ever be able to "fine tune" the level and structure of posted prices so as to bring demand exactly into line with supply. Nevertheless, it is clear that higher posted prices could perform a valuable role in addressing at least the worst cases of inefficient slot usage. Moreover, as price setters gain fuller information regarding airlines' responses to increasing prices, their ability over time to set prices close to those that would equate supply and demand should improve.

8.3.2. Legal implications

While the Chicago Convention does not contain explicit requirements in relation to the level of airport charges, *ICAO's Policies on Charges for Airports and Air Navigation Services* states that, among other things:

> "*The Council considers that as a general principle it is desirable, where an airport is provided for international use, that the users shall ultimately bear their full and fair share of the cost of providing the airport ...*"[87] and

> "*The cost to be shared is the full cost of providing the airport and its essential ancillary services, including appropriate amounts for cost of capital and depreciation of assets, as well as the cost of maintenance and operation and management and*

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[87]   From Article 21 of Doc 9082/6 (6th edition, 2001).

administration expenses, but allowing for all aeronautical revenues plus contributions from non-aeronautical revenues accruing from the operation of the airport to its operators."[88]

This approach therefore requires airport charges to be cost-based, and the document also includes a list of facilities and services that may be taken into account.[89]

Similar conditions appear in some, but not all, bilateral agreements between individual states (for example, the agreements between various EU member states and the US). In some cases, these conditions are more explicit than the ICAO *Policies*, stating that charges shall not exceed the full cost of facilities and services (including a return on capital) provided at the airport.

In practice, although ICAO Council Statements may impose a strong moral obligation, there is no formal legal requirements for states to comply with the provisions of such statements. Therefore, it may be the inclusion of similar conditions in bilateral agreements that causes most problems, at least from a formal legal point of view, for the potential use of posted prices to allocate slots. In the first instance, non-EC states might request negotiations with the relevant EC states. But if such negotiations are unsuccessful, a state could submit the issue to arbitration, or to the ICAO Council, or else it could simply cancel the relevant bilateral agreement.

In addition, of course, even though ICAO policies may not be formally enforceable, a decision that led to significant increases in airport prices could provoke very strong protests from non-EU airlines and states. This, in turn, could make future international negotiations (for example between the EU and US) more difficult, and might also provoke retaliatory measures by some states.

Even if higher posted prices are implemented solely through peak/off-peak differentials, with no increase in the total revenue earned by the airport, the increase in peak charges might well be strongly resisted by the airlines most affected. This occurred, for example, following BAA's attempts to introduce peak passenger charges at London Heathrow.[90] It will be particularly important for airport operators to demonstrate that their identification of peak periods, and their determination of the peak/off-peak differential, is based on sound economic principles and rigorous quantitative analysis of cost and demand conditions. Otherwise airports might be accused of designing a charging structure that discriminates against particular airlines.

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[88] Article 22(i).

[89] It might be argued that posted prices designed to reduce excess demand are still cost-based, as they take account of "opportunity costs" associated with potential alternative uses of scarce capacity. But no such costs appear in the list provided by ICAO.

[90] See M R Toms (1994), "Charging for Airports: The New BAA Approach", *Journal of Air Transport Management.*

8.3.3. Potential constraints

In addition to the significant uncertainty that affects any such forecasting exercise, airport operators have relatively little evidence on which to base their assessments of airlines' reaction to higher prices. Very little evidence exists about price elasticities of demand, even for quite small changes in airport charges, and therefore it will be very difficult to predict how the demand for slots will respond to sometimes quite large increases in posted prices.[91]

Given the difficulty of setting a level of prices that might be expected to clear the market, and the risk of forecasting errors (either because the initial forecasts were poor, or because of subsequent events that could not have been foreseen), we would not expect airport operators to set prices so high that they expect to eradicate all excess demand. If they were to do so, then a slight overshoot might lead to very valuable capacity remaining unused.

Therefore, and certainly in the early stages of implementation, we would expect airport operators to build in a certain "safety margin", mainly in order to reduce the risk of capacity remaining unused. As noted above, therefore, administrative criteria (including, but not limited to, grandfather rights) will still be needed to allocate slots between the different airlines that are willing to pay the posted price for a particular slot.

Even with such a conservative approach, there will inevitably be some cases where the posted price is set at too high a level (either because of a forecasting error or because of subsequent events that reduce demand after the posted prices have been set). The most appropriate response to this situation might be to allow airport operators to re-advertise unused slots at slightly lower prices. While it is possible that this approach could provide opportunities for airlines to engage in strategic behaviour (for example, not requesting slots in the hope that the price will then be reduced), we think the risk of such behaviour is very small. Airlines will generally prefer the certainty that they have the slots they need, rather than taking a gamble in the hope of paying slightly lower prices.[92]

Slot holdings are highly concentrated at many EU airports: in some cases, hub operators are allocated more than 50 per cent of all slots. This has certain implications for the implementation of higher posted prices:

- first, it means that market clearing prices may be more volatile. A bankruptcy or a change in scheduling policy (such as the initiative of American Airlines to "de-peak" at Chicago O'Hare) could eliminate excess demand at certain times and so cause market clearing prices to collapse. Often, such events can be anticipated and hence

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[91] One possibly similar precedent is the recent widespread increase in air traffic control charges following the downturn in traffic after 11 September 2001. But the general disruption to aviation markets was so great that it would be very difficult to identify a separate impact of higher air traffic control charges.

[92] In any case, any such strategic behaviour would only be a major concern if it led to a less efficient allocation of slots, as we are not concerned with revenue maximisation *per se* .

prices can be set to reflect changes to market conditions. But the potential for shocks is greater than in markets where the concentration of purchasers is low;

• second, it means that it is possible to discriminate in favour or against an airline with a large slot holding. Such discrimination may be possible because, under our proposed regime of posted pricing, slots are allocated on the basis of historic rights.[93] However, posted prices would only be discriminatory if they *diverged* from market clearing prices in such a way as to affect one or more operator adversely (or to their advantage). Market clearing prices are not discriminatory and will tend to be higher during "banks" of activity because airlines will concentrate their schedules at more lucrative times.

Although setting posted prices is complex, we do not consider that inadvertent discrimination is a substantial concern (and no more so than it is for coordinators under the current system of slot allocation). BAA's experience of peak pricing provides a precedent for this: in two separate arbitrations where discrimination was alleged, BAA's implementation of peak pricing was found to have certain shortcomings (including the speed at which the pricing was introduced), but it was not found guilty of discrimination.

Some potential problems may also arise because of the high profits that may result from the application of higher posted prices. If airport operators keep some or all of the additional revenues, then this will provide a disincentive to provide additional capacity in future.[94] It could also discourage airport operators from making the most effective use of existing capacity, though such behaviour might be easier for airlines and governments to detect. Some form of regulatory oversight may therefore be required, to ensure that existing capacity is being used as effectively as possible and, more importantly, that new investment is being carried out where appropriate. If the proceeds from higher prices were ringfenced, so that they could only be spent on projects that will provide additional capacity in future, this might also help to address the problem.

While an alternative approach might involve "excess" proceeds from airport charges being retained by governments, rather than airport operators, this might also increase the potential political difficulties associated with higher posted prices.

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[93] For example, consider an airline that operates several "banks" of arrivals and departures each day. During these banks, it operates 100 per cent of slots, at an airport with constant excess demand throughout the day. If posted prices were lower during the times of those banks than at other times, diverging from market clearing prices, they would be discriminatory: it would not be possible for other airlines to take advantage of the lower prices because the incumbent would have first refusal of all such slots.

[94] In theory, if airport operators could charge a different price for each individual slot (ie engage in "first degree price discrimination"), then they might deliver the same level of outputs as a competitive market. But this is not possible in practice, and therefore airport operators will have some incentive to restrict supply (and therefore earn monopoly rents) if they retain some or all of the additional revenues from higher posted prices.

8.3.4. Issues in applying regulation under higher posted prices

In Section 6.6.5, we examined two possible alternative methods of regulatory intervention aimed at minimising any potential anti-competitive effects stemming from increased slot holdings by hub carriers and their alliance partners at congested airports. The first involved regulatory scrutiny on a case-by-case basis, and the second a cap on the proportion of slots that airlines hold at a particular airport.

Neither approach is likely to work well alongside a slot allocation mechanism based on higher posted prices. The case-by-case approach might be the most problematic, since airlines would be required to decide which slots to request without knowing whether any increased holding would be acceptable to the regulator. In practice, we would expect the prospect of referral to encourage hub airlines to act conservatively in their slot acquisition decisions, or, as under a cap on holdings, to engage only in rebalancing of holdings.

Even an absolute cap on slot holdings might cause difficulties for hub carriers and create a risk of unintended consequences. As we expect that higher posted prices will often fail to clear the market, then hub carriers may not know which of their slot requests will be successful, except to the extent that they enjoy grandfather rights in relation to some slots and can therefore be confident of retaining those slots (provided they are still willing to pay the posted price). Where hub carriers wish to acquire "new" slots, therefore, they may decide to request more slots than they would be allowed to retain, in the expectation that some of these requests will be unsuccessful. If they are allocated more slots than they expected, they will then need to return some of those slots. More generally, however, such problems are likely to discourage hub carriers from rearranging their slot holdings, even in situations where they might prefer to switch some services to alternative slots.

8.3.5. Relationship with existing slot allocation procedures

Clearly, for higher posted prices to be effective, airlines need sufficient notice of the new prices that they can adjust their schedules accordingly, in particular by withdrawing services if they are no longer willing or able to pay the posted price. In order to accomplish this, we assume that prices would be set twice a year:

- for the summer season, prices would need to be notified to airlines at some point between June (the time of any preliminary capacity declaration) and September (the time of the updated capacity declaration and determination of historics) in the preceding year. This would allow airlines to take the proposed prices into account when submitting their initial slot requests, which are required in mid October;[95]

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[95] Initial slot requests must by submitted at least 27 days before each Scheduling Conference. Conferences start on the second Saturday of the preceding November (for the summer season) and the second Saturday of June (for the winter season).

- similarly, prices for the winter season would need to be notified at some point between November (any preliminary capacity declaration) in the preceding year and April (the updated capacity declaration and determination of historics), as initial slot requests are required by mid May.

In practice, therefore, airport co-ordinators or operators will need to forecast demand for each season about one year in advance, and set prices on basis of these expectations.

On receiving requests for slots, co-ordinators will then need to apply administrative criteria in cases where the demand for slots still exceeds the available supply (notwithstanding the higher price). And they may also need to set in train a process to deal with any cases where the price has been set too high and therefore supply exceeds demand.

If higher posted prices are implemented, procedures will also need to be developed to deal with cases where an airline returns a slot that it received in the initial allocation. Possible options might include the co-ordinator retaining a "waiting list" of the unsuccessful applicants for each slot, and offering the returned slot either to a single airline or perhaps even to all airlines on the waiting list. In the case where a slot is not sold at all, or is returned and there is no waiting list, procedures will need to be developed to enable the slot to be advertised at a lower price. For example, the slot might then be allocated on a "first come first served" basis (with further price reductions if this is necessary to find a buyer), or else the co-ordinator could announce a deadline for applications for the slot at the new, lower price.

8.3.6. Applicability to airport systems

Where an airport is part of a system, and especially when some of the airports in the system are uncongested, the operation of higher posted prices may allow for reductions in airport charges both at off-peak times (if any) at the congested airport and also at the uncongested airport(s).

This may lead, of course, to the uncongested airport being cross-subsidised. Strictly, this may be inconsistent with ICAO charging principles, which state that aircraft operators should not be charged for facilities and services they do not use.[96] But we note that such cross-subsidisation has been practised in a number of cases, including (until recently) Stansted which was cross-subsidised by revenues from Heathrow and Gatwick airports.[97]

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[96]   ICAO (2001), *ICAO's Policies on Charges for Airports and Airport Navigation Services (Sixth Edition)*, paragraph 22(ii).

[97]   Technically, moreover, the use of revenues from higher posted prices to subsidise lower charges at an uncongested airport does not conform to the strict definition of a cross-subsidy. This is because prices at the congested airport would still be at the same (high) level in order to allocate capacity efficiently, even if the revenues were not used to lower charges elsewhere. Cross-subsidies (rather than subsidies) arise only when there is a direct causal link between lower charges in one area and higher charges in another.

8.3.7. Consistency with environmental policy

In general, we believe that environmental objectives are best addressed through measures outside the slot allocation framework, such as taxes or limits on environmental emissions. For each mechanism, however, we nevertheless consider whether the mechanism itself could be used to pursue environmental objectives, and also whether the mechanism might cause any problems if operated alongside separate measures designed to address environmental concerns.

In the case of higher posted prices, it would be possible to take environmental impacts into account when setting the prices for each slot. The posted prices would effectively include a fixed charge per slot and an additional element that varies according to noise or emission categories, much like existing airport charges.[98]

At best, it would seem that higher posted prices could provide a convenient means of collecting any environmental charge (or dispensing any environmental subsidy). But the higher posted price is a once-off charge that provides airlines with a right to use certain slots for a particular period of time, and will not generally vary if the use of the slot changes (for example, a change in aircraft type) or indeed if the slot ceases to be used at all. In contrast, environmental charges should reflect damage actually caused, based on aircraft types and other characteristics, and also the actual number of movements. Furthermore, a system of posted prices that included environmental criteria might make the slot allocation process significantly more complex, as airlines would have to specify service details (such as aircraft type) when requesting a slot, and the price might then need to change if the airline subsequently adjusts its proposed schedules either before the start of the season (perhaps because some of its slot requests were not successful) or during the season itself.

A better option, therefore, would be for any environmental charge to be collected alongside conventional airport charges, as these will be levied on the basis of actual movements and will vary with the type of aircraft and other service characteristics.

In our view, it should also be possible to combine higher posted prices with a system of emissions (or noise permits) trading. However, it would be preferable in that case if secondary trading is permitted alongside the higher posted prices. Airlines that were interested in selling emissions rights might also be interested in selling grandfather rights to slots at the same time.

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[98]   We note that environmental charges at a number of Community airports are currently expressed as a percentage surcharge on or a percentage discount from the conventional landing charge. This approach would not be suitable to apply with higher posted prices, and therefore the level of environmental charges should be independent from the level of the posted price for each slot. The proposed Community framework for noise charges (COM2001) 74 final, amended by COM(2002) 683 final) does provide for noise charges that are unrelated to landing charges.

8.3.8. Consistency with regional accessibility objectives

Under a system of posted prices, it would be possible to ringfence slots for particular regional services, much in the same way as can be done under the existing slot regulation. But in keeping with the purpose of market allocation mechanisms, it would also be possible to offer discounts from posted prices for particular services. Thus if a 25 per cent discount were made available for airlines serving a specific route, an airline could request a slot that had a particular price attached to it, but if its request was successful then it would pay only 75 per cent of the price.

This approach has the benefit that while it provides a comparative advantage to regional services, this advantage is not absolute. Regional services might not be offered, therefore, if other airlines are still willing to pay more for slots, even though they do not benefit from such discounts.

If secondary trading is permitted alongside higher posted prices, then it will also be important to ensure that any such system of discounts is not abused. For example, a regional operator that benefited from, say, a 25 per cent discount should not be permitted simply to sell the slot on to an airline proposing to offer a completely different service. One option would be to ringfence slots benefiting from such discounts, so that they could not be sold on except perhaps to other airlines proposing to offer similar services. But a more general approach, that is also consistent with the underlying rationale for applying market mechanisms, would be to require the original airline to pay back 25 per cent of the amount it received from selling the slot.

As noted in Section 7.3.8, however, there may be more effective ways of safeguarding regional services, outside of the immediate slot allocation framework.

8.4. Impact Assessment

8.4.1. Assessment of key features of higher posted prices

In the medium to long term, the major reason why the impact of higher posted prices may differ from the impact of the ideal market mechanism discussed in Section 6.4 is that prices may fail to clear the market. In order to avoid the difficulties created when prices are set too high (and therefore some potentially valuable slots are left unused in the initial allocation), we assume that airport operators or co-ordinators will deliberately set prices some way below the expected market clearing level. As a result, there will often be cases where there is still excess demand for slots at the prevailing level of prices, and therefore slots may still be allocated to airlines other than the highest value user.

Importantly, we assume that measures are introduced (such as some form of re-advertising at lower prices) to ensure that slots that are not taken up in the initial allocation, because the price is too high, are successfully allocated before the start of each season.[99] If this is not the case, and if there are circumstances in which potentially valuable slots might remain unused because the posted price is still too high, then this could very significantly reduce the expected efficiency benefits from applying higher posted prices.

To some extent, however, the benefits of higher posted prices might be partially offset, particularly during the first few years of implementation, by the potentially disruptive impact on schedules and planning of uncertainty about the future level of prices. This uncertainty may be exacerbated if posted prices are volatile because of the way that market clearing prices are affected by changes in the hub carrier's schedule. Airlines planning future operations, including perhaps the introduction of new routes, will need to take a long term view of the likely level of posted prices, and therefore whether they will be able to afford the necessary slots in future. Some airlines may decide against implementing potential improvements in their schedules because of uncertainty about the future price levels, whereas others might introduce new or revised services only to withdraw them later when slot prices increase by more than they expected and therefore the new schedules become unprofitable.

Airlines' short to medium term planning may also be disrupted in cases where slots remain unsold initially, and therefore need to be re-advertised at a relatively late stage in the allocation process. It is unlikely that slots that are made available at such a late stage can be used as efficiently as they would have been if they had been offered initially at a more appropriate (ie lower) price. Airlines that might have wanted those slots, and be willing to pay the real market clearing prices (but not the initial overestimates) for them, may now have made alternative arrangements, for example by acquiring alternative and cheaper, but ultimately less convenient, slots.

8.4.1.1. *Higher posted prices applied in isolation*

If higher posted prices are applied alone, with no opportunities for secondary trading as well, then it is inevitable that some residual inefficiency will remain. A high proportion of the potential efficiency improvements from introducing market mechanisms will be achieved, as the most inefficient slot users are likely to respond even to relatively small increases in posted prices. And if a slot request becomes a binding commitment at a sufficiently early stage for airlines to pay the posted price for each slot, this mechanism will give good incentives to reduce the incidence of late slot returns.

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[99] This applies only to those slots for which the additional "slot charge" is too high. It does not apply, of course, at off-peak times when demand at the conventional airport charge (after taking account of opportunities for peak pricing) is less than the available supply of slots.

But it is very unlikely, except by accident, that higher posted prices will clear the market. Many slots will therefore continue to be allocated on the basis of grandfather rights or other administrative mechanisms, though these will be applied only after higher posted prices have acted as a filter to exclude all except those airlines with a high willingness to pay for slots.

8.4.1.2.   Higher posted prices and secondary trading

When secondary trading is permitted alongside higher posted prices, this provides a possible mechanism for any residual inefficiencies to be addressed. In addition, on a more practical note, it may be easier to require that slot requests become binding commitments to pay the posted price at a relatively early stage if airlines have the option of selling on any slots that they decide not to use.

In general, however, we believe that secondary trading is best suited to cases where the potential purchaser places a significantly higher value on a slot than the current slot holder. Most such cases will be eliminated by the application of higher posted prices. Secondary trading is much less well suited to the job of "fine tuning" an allocation once the primary mechanism has eliminated the worst inefficiencies. And the following factors may mean that secondary trading will have a rather limited impact when applied alongside higher posted prices:

- because differences is airlines' valuations of similar slots may be relatively small, it may be difficult for prospective purchasers to identify potential sellers;

- because of the risk that posted prices may rise in future (for example, if the airport co-ordinator or operator believes that excess demand has increased), the value of a particular slot may be determined mainly by the expected profits from a single season, rather than the longer term value associated with continued enjoyment of grandfather rights. This short timescale will inevitably lower the differences between airlines' valuations of particular slots, and reduce the scope for trade; and

- because the most inefficient users have already been filtered out through the application of higher posted prices (and in contrast to the situation where secondary trading is applied on its own), it is quite likely that some potential buyers and sellers will be direct competitors. Given the likelihood that slot valuations will mainly reflect profits from the current season, rather than long term profits, the potential gains from trade may be small and therefore airlines may be more likely to turn down offers for slots from their competitors (since the cost of doing so will generally be relatively small).

Overall, there are likely to be some occasions where secondary trading can address residual inefficiencies that persist despite the use of higher posted prices. And the ability to buy and sell slots will provide valuable flexibility for airlines to adjust their schedules after initial allocations. But we expect that a substantial proportion of the residual inefficiencies

following the application of higher posted prices will remain, even if secondary trading is allowed.

8.4.2. Timing issues

An important point to note regarding the timetable for the introduction of higher posted prices is that such measures might be fiercely resisted by airlines and others (such as non-EU states). Disputes and possible legal challenges could well make it difficult to introduce higher posted prices at a relatively early stage.

Even when such obstacles have been overcome, moreover, it will still be necessary to give detailed consideration to a number of important regulatory and contractual issues. These include the precise time at which a slot request becomes a binding commitment to pay the posted price, the procedures to be followed in the event of there being insufficient demand for some slots (ie prices being set too high), and measures to ensure that the principles used to determine posted prices are transparent and non-discriminatory.

Once higher posted prices are eventually implemented, as noted in Section 8.3.1 we expect that airport co-ordinators and operators will respond to the very considerable uncertainty about the level of market clearing prices by raising prices only very gradually. An illustration of the impact of this is provided in Figure 8.1. The value of a slot in year 0 is equal to the area ACD. In year 5, the value has reduced to BCE. In year 10, the value has (assuming the posted price clears the market) become equal to zero.

Figure 8.1
The Value of a Slot When Posted Prices are Increased Over Time
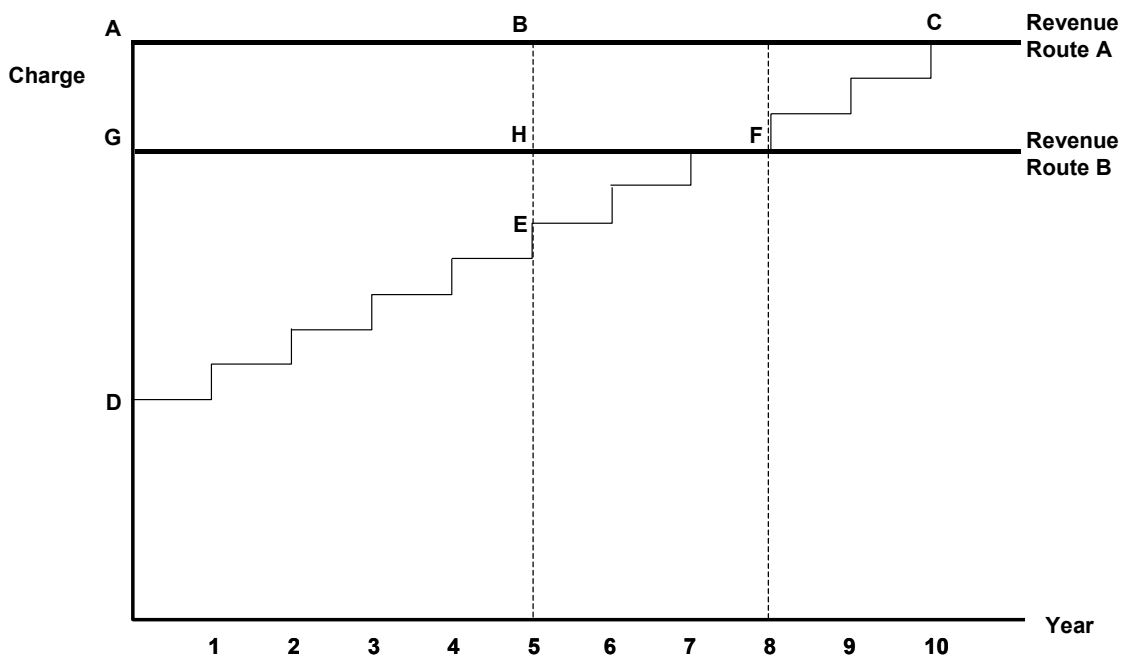
In principle, when posted prices are gradually increased, an airline operating route B will operate the route until year 8 (point F in the chart), at which point the service will be withdrawn. Withdrawing the route earlier would sacrifice future profits on the route, while the route would become loss-making after year 8. But airlines' decisions, and therefore the speed at which the impact of higher posted prices will materialise, will also depend quite significantly on whether or not secondary trading is permitted.

If secondary trading is not allowed, then we would expect airlines simply to hold onto slots until they become unprofitable, as described above. But if secondary trading is permitted, some airlines may decide to sell their slots as soon as possible, in order to extract the maximum value from the slot. If, for example, an airline operating route B sells a slot to an airline operating route A, then the potential gains from trade in year 0 are equal to the area ACFG. These gains will be split between the two airlines according to factors such as the strength of the market and the negotiating strategy of each airline. But if the airline waits until year 5, then the possible gains from trade will have shrunk to area BCFH.

Whether or not airlines take advantage of such opportunities may depend on their expectations about the final level of posted prices:

- if an airline expects the price of a slot to rise above its own willingness to pay, and so it expects to have to give up that slot eventually, then it may decide to sell at the earliest convenient opportunity;[100]

- but if an airline expects the price of a slot to remain below its willingness to pay, then it may be tempted to retain the slot as it will continue to generate value. Once the level of posted prices has stabilised, and therefore the net value of slots (after deducting the higher posted price) is clearer, then the airline can make a more informed decision about whether or not to sell the slot.

Overall, therefore, while the introduction of secondary trading might make a relatively small contribution to the long run impact of higher posted prices, it could nevertheless have quite a powerful impact of bringing forward the benefits, which otherwise might be delayed as prices only gradually approach market clearing levels.

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[100] Airlines may expect prices to rise in this way simply because they are aware of the extent of excess demand for slots and the types of services that could be operated. Alternatively, if an airline receives a generous offer for a particular slot, it might take this as an indication that the eventual posted price will be above its own willingness to pay for the slot.

8.4.3.   Estimated impact of higher posted prices (without secondary trading)

8.4.3.1.   Impact on passenger numbers

In order to illustrate the potential impact of applying higher posted prices (in isolation, ie without secondary trading in addition to the higher prices), we have in the first instance applied the methodology described in Appendix E that we used to estimate the impact of an ideal market mechanism. However, for our central estimate, we have instead assumed that prices are set at each airport, and for each hour, so that excess demand is reduced but it still exceeds the available capacity by 5 per cent.[101] For our low and high estimates, we have assumed this percentage to be 7.5 and 2.5 respectively.

In addition, to take account of the potentially disruptive impact of higher posted prices on airlines' schedules and planning, plus the difficulties created when supply exceeds demand and therefore slots are re-advertised at lower prices, we have reduced the overall volume of air traffic movements in each year by 0.5 per cent for each of our estimates.[102]

Further detail on our assumptions, and the rationale for them, is provided in Appendix E, Section E.4.

The resulting impact of higher posted prices on passenger numbers for the low, central and high cases is shown in Table 8.1.

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[101]   Where estimated excess demand is already at or below these levels, we assume that there is no higher posted price, but instead the existing airport charge continues to apply.

[102]   If schedules are expected to change significantly from year to the next, the capacity declaration must necessarily adopt a conservative approach to allow for changes in the nature of services (such as a different mix of aircraft sizes, or different terminal requirements)..

Table 8.1

Increase in Passengers under Higher Posted Prices (without secondary trading)

	Ideal market mechanism	Higher posted prices alone		
		Low	Central	High
LHR	7.2%	5.5%	5.8%	6.2%
LGW	4.8%	3.9%	4.0%	4.2%
CDG	9.1%	5.1%	5.9%	6.8%
MAD	7.6%	2.8%	3.5%	4.8%
VIE	11.4%	4.1%	4.8%	7.0%
Weighted average over all Cat 1 airports	**7.2%**	**3.8%**	**4.3%**	**5.2%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

In the medium to long term, our central case suggests that the introduction of higher posted prices, even without secondary trading, might increase the number of passengers using Category 1 airports by about 4.3 per cent. There is less uncertainty about the impact of this option than that of secondary trading – where airlines' responsiveness to opportunity cost is unknown – and auctions – where airlines' ability to participate is unclear – and so the range of estimates is smaller.

Given total forecast passenger numbers at Category 1 airports in 2007 of 719 million, higher posted prices (without secondary trading) would under central case assumptions result in an increase in the number of passengers travelling through these airports of about 31 million per year.

8.4.3.2.   Implementation costs

As with secondary trading, the introduction of higher posted prices will add a new complexity to the financial evaluation of proposed services, which will impose certain costs on airlines. The costs of additional financial evaluation necessitated by higher posted prices will be less per slot than that for secondary trading, because the financial commitment is smaller, but more slots would be affected. Using a similar approach to that for secondary trading, our estimate of costs incurred by airlines in planning and executing the slot purchase equate to approximately 0.5 per cent of the posted price of the slots.

A substantial burden of implementation costs will fall on airport operators (or whichever body is responsible for setting posted prices). Among other things, they will now have to:

- produce detailed forecasts of the demand for slots at different times of the day, week and year, and also with different assumptions about the level and structure of prices;

- in support of this, undertake research to increase their understanding of airlines' likely response to price changes. This might include a mixture of informal discussions with airlines, analysis of experience elsewhere, and a detailed analysis of responses to previous price changes.

To the extent that some prices are too high, and therefore slots remain unsold, both airport operators and airlines could then become involved in a further iteration of the slot allocation process, as these slots are re-advertised at reduced prices.

The amount spent on setting, administering and, if applicable, regulating a posted prices regime will be related to the complexity of the tariff structure and the size of the revenue collected, which in turn would both be influenced by the extent of airport congestion. We have estimated settled down costs in the range of €100,000 to €800,000 per airport per season for the partially and highly congested airports. The outturn costs might be somewhat higher than this during the early stages of implementation as information is being acquired about airline responses both to "own price" changes and also responses to changes in prices at other congested airports.

We have already noted that there are substantial legal issues to be tackled before this option is implemented. It is not clear that legal disputes would not continue to arise, where airlines would challenge the principle of posted prices, for some time after a system had been introduced.

However, if we assume that the system is established and not subjected to fundamental legal challenge, we estimate that the cost of implementing higher posted pricing would under central case assumptions be around €24 million a year across EU Category 1 Airports as a whole (2007 figures). This is equivalent to €0.03 per passenger, or €0.8 per extra passenger passing through the airports as a result of introducing higher posted prices.

8.4.3.3.   *Impact on airline competition*

Our analysis suggests that the effects of higher posted prices in the absence of secondary trading on conditions of competition in airline markets will differ quite widely between airports. In the London system, the large increases in slot prices are assumed that will be needed to clear, or almost clear, the market are likely to squeeze out a significant volume of demand from non-aligned, non-low cost airlines, creating opportunities for low cost carriers to increase their slot holdings at LGW (see Table 8.2). Even in the absence of secondary trading, the higher posted price mechanism should therefore result in a significant increase in competition in short haul markets, probably to a greater degree than under secondary trading (see Chapter 7).

At less congested airports, in contrast, the increase in slot prices would be less than in the London system, and hence the pressure on lower value users to relinquish slots would also be less severe. Nevertheless, the implementation of higher posted prices should allow some opportunities for entry by low cost carriers at these airports, even if the likely scale of entry may not be quite as high as under secondary trading. This should result in increased competition on some short haul routes.

As with secondary trading, moreover, we expect that the introduction of higher posted prices will lead to both an increase in the number of long haul services, and also increased competition on some high density routes from airlines such as Virgin or possible new entrants. Both of these factors are likely to place downward pressure on fares on long haul routes.

Table 8.2 also confirms that, in general, we do not believe the introduction of higher posted prices will lead to a large change in the share of slots held by hub carriers and their alliance partners at congested airports. As with secondary trading, both hub carriers and their competitors are likely to increase their slot holdings at these airports, and so we expect there to be very little change in their respective shares of slots held at each airport.

Table 8.2

Competition under Higher Posted Prices (without secondary trading)

	Current	Ideal market mechanism	Higher posted prices alone (central case)
Hub alliance share of long haul movements			
LHR	45%	44%	44%
LGW	37%	24%	25%
CDG	58%	59%	58%
MAD	51%	51%	51%
VIE	82%	82%	82%
Average (all Category 1 airports)	**53%**	**52%**	**52%**
Hub alliance share of short haul movements			
LHR	48%	59%	57%
LGW	54%	39%	41%
CDG	53%	54%	54%
MAD	45%	43%	45%
VIE	73%	70%	73%
Average (all Category 1 airports)	**51%**	**51%**	**51%**
Low cost airlines' share of short haul movements			
LHR	0%	0%	0%
LGW	13%	40%	38%
CDG	3%	7%	4%
MAD	1%	5%	2%
VIE	0%	6%	1%
Average (all Category 1 airports)	**3%**	**7%**	**5%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

8.4.3.4. Impact on the environment

Like all market mechanisms, higher posted prices will several effects on the environment, mainly reflecting:

- increases in the total number of air traffic movements, as a result of both an increase in peak time movements and some switching to off-peak periods;

- a shift from short to long-haul services; and

- an increase in the number of passengers per flight.

In our central case, we estimate that the introduction of higher posted prices (without secondary trading) would lead to an increase of about 2.3 per cent in total air traffic

movements, but the number of long-haul movements would increase by about 4.7 per cent. The environmental costs (per passenger km) that would result from these changes are shown in Table 8.3. These unit costs fall by about 2.9 per cent.

Table 8.3
Environmental Costs under Higher Posted Prices (without secondary trading)
(€ per 1000 passenger kilometres)

	Current system	Ideal market mechanism	Higher posted prices alone (central case)
LHR	4.25	3.95	3.98
LGW	4.33	4.29	4.29
CDG	4.28	4.10	4.15
MAD	4.38	4.33	4.36
VIE	4.38	4.24	4.33
Average (all Category 1 airports)	**4.30**	**4.13**	**4.17**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

Since the number of passenger kms also increases, we estimate the net environmental impact of higher posted prices, across at all Category 1 airports, to be about €450 million per year in our central case. As set out in Section 6.9.1, however, this impact may be reduced if higher posted prices lead to reductions in traffic at other airports or delays to airport expansion plans.

8.4.4. Estimated impact of higher posted prices with secondary trading

8.4.4.1.   Impact on passenger numbers

In order to illustrate the potential impact of higher posted prices combined with secondary trading, we have in our central case assumed that secondary trading eliminates 30 per cent of the gap between the outcome shown above and the outcome of the ideal market mechanism described in Chapter 6. In addition, important benefits from allowing secondary trading alongside higher posted prices are likely to be felt in the short term, as trading is likely to accelerate the impact of higher posted prices on slot usage. In our low and high cases, the proportion of continued inefficiency removed by secondary trading has been assumed to be 10 and 40 per cent respectively. Appendix E, Section E.4 contains some more detail on these assumptions.

The medium to long term impact of higher posted prices in combination with secondary trading on passenger numbers is for each of our three cases shown in Table 8.4. On average, we estimate that the combination of these two mechanisms will under central case assumptions produce an increase in passenger numbers of approximately 5 per cent,

compared with 4.3 per cent when higher posted prices are applied without secondary trading.

Table 8.4

Increase in Passengers under Higher Posted Prices with Secondary Trading

	Ideal market mechanism	Higher posted prices & secondary trading		
		Low	Central	High
LHR	7.2%	5.6%	6.1%	6.4%
LGW	4.8%	3.9%	4.1%	4.2%
CDG	9.1%	5.5%	6.6%	7.4%
MAD	7.6%	3.2%	4.6%	5.7%
VIE	11.4%	4.8%	6.7%	8.6%
Weighted average over all Cat 1 airports	**7.2%**	**4.1%**	**5.0%**	**5.8%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

We expect that the additional impact of secondary trading will be greatest at airports with limited excess demand. This is because, at LHR and LGW, higher posted prices are likely to have eliminated a relatively high proportion of the existing inefficiencies already, whereas more inefficiencies may remain at the other airports.

> **Given total forecast passenger numbers at Category 1 airports in 2007 of 719 million, higher posted prices with secondary trading would under central case assumptions result in an increase in the number of passengers travelling through these airports of about 36 million per year.**

8.4.4.2. *Implementation costs*

Our approach to estimating ongoing costs of posted prices combined with secondary trading is similar to that for previous options. We have assumed that the additional financial evaluation costs are only 75% of that for the posted prices option - reflecting the smaller financial commitment made in this case, because there are opportunities to rectify mistakes through secondary trading. The costs of setting the posted prices, and associated administration and regulation, are assumed to be equal to those for the higher posted prices option. The transaction costs associated with secondary trading, when followed by higher posted prices, are marginally less than for the secondary trading option because potential buyers will already be revealed through the slot request process, and because slots have less value and therefore fewer trades are expected to take place.

If we assume that the system is established and not subjected to fundamental legal challenge, our central estimate is that the ongoing cost of implementing higher posted pricing and secondary trading would be of the order of €29 million a year across EU Category 1 Airports as a whole (2007 figures). This is equivalent to €0.04 per passenger or €0.8 per extra passenger using the airports as a result of implementing this mechanism.

8.4.4.3. Impact on airline competition

Our central case projections of the likely impact of higher posted prices in combination with secondary trading on the distribution between different types of scheduled carrier in long haul and short haul markets are shown in Table 8.5. The introduction of secondary trading, alongside higher posted prices, makes almost no difference to the expected share of slots operated by hub carriers and their alliance partners. But it is likely to enhance the entry opportunities for low cost carriers, especially at the partially congested airports. This will lead to a further increase in competitive pressures in short haul markets, compared with the situation where higher posted prices are applied alone.

Table 8.5
Competition under Higher Posted Prices with Secondary Trading

	Current	Ideal market mechanism	Higher posted prices & trading (central case)
LHR	45%	44%	44%
LGW	37%	24%	24%
CDG	58%	59%	58%
MAD	51%	51%	51%
VIE	82%	82%	82%
Average (all Category 1 airports)	**53%**	**52%**	**52%**
LHR	48%	59%	58%
LGW	54%	39%	40%
CDG	53%	54%	54%
MAD	45%	43%	44%
VIE	73%	70%	72%
Average (all Category 1 airports)	**51%**	**51%**	**51%**
LHR	0%	0%	0%
LGW	13%	40%	38%
CDG	3%	7%	5%
MAD	1%	5%	3%
VIE	0%	6%	3%
Average (all Category 1 airports)	**3%**	**7%**	**6%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

8.4.4.4.   Impact on the environment

When higher posted prices are accompanied by secondary trading, we estimate in our central case that the total number of movements at Category 1 airports will increase by about 2.7 per cent, with long-haul movements increasing by about 5.0 per cent. The environmental costs per passenger km that would result from these changes are shown in Table 8.6. These unit costs fall by about 3.3 per cent.

Table 8.6
Environmental Costs under Higher Posted Prices with Secondary Trading
(€ per 1000 passenger kilometres)

	Current system	Ideal market mechanism	Higher posted prices & trading (central case)
LHR	4.25	3.95	3.97
LGW	4.33	4.29	4.29
CDG	4.28	4.10	4.14
MAD	4.38	4.33	4.35
VIE	4.38	4.24	4.31
Average (all Category 1 airports)	**4.30**	**4.13**	**4.16**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

We estimate the net environmental impact of higher posted prices with secondary trading, under the central case, to be around €490 million. But as noted above, this might be reduced if the combination of higher posted prices and secondary trading leads to a net reduction in movements at other airports or a moderation of airport expansion plans.

9. APPLYING AUCTIONS TO AIRPORT SLOTS

9.1. Introduction

It is not surprising that, from time to time, auctions have been suggested for the allocation of airport slots, as they are specifically designed to establish the price at which demand just equals the supply available. Auctions are often used by sellers who believe that they can maximise sale proceeds in this way. But because they work by identifying the buyer (or buyers) willing to pay the highest sum of money, auctions also provide a potentially powerful tool for allocating scarce resources. Subject to the caveats noted in Section 5.1 about the relationship between willingness to pay and efficiency, auctions have the potential to allocate scarce resources, such as airport slots, to the group of buyers that will use them most efficiently.

In this chapter, we focus on the scope for auctions, in general, to achieve a more efficient allocation of airport slots. The feasibility and potential impact of two specific options – auctions applied to pool slots only, and auctions applied each year to 10 per cent of all slots – are examined in Chapters 10 and 11. Importantly, we assume that secondary trading is permitted alongside any auction mechanism, as the ability to buy and sell slots provides an important safeguard, particular in relation to the risk that airlines will end up paying for slots that they cannot (or no longer want to) use.

The following sections summarise the main issues relating to the use of auctions to allocate airport slots. A more detailed description of the different types of auction, their advantages and disadvantages, and their potential relevance to airport slot allocation is contained in Appendix D.

9.2. Description of Approach

9.2.1. Auction design

As is well known, there are many different types of auction mechanism. Even for the sale of a single object, there is a choice between open and sealed-bid auctions, ascending or descending auctions, and first price or second price auctions. In more complex situations, where a number of related objects are to be sold, there are further important choices between:

- sequential and simultaneous auctions – whether lots are sold in a succession of simple, single lot auctions (sequential), or in a more complex auction designed to sell all lots at the same time (simultaneous);

- whether bids can be conditional, for example where a bid for one particular lot might be higher, lower or withdrawn completely, depending on whether or not the bidder also wins another specific lot; and

- how many auction rounds will be allowed. Even where many lots are to be auctioned simultaneously, a sealed-bid auction with conditional bidding could be carried out in a single round. Alternatively, a "simultaneous ascending" auction with many rounds could be carried out, and this could terminate either at the point that no further bidding takes place or else at some agreed cut-off point.

As noted in Section 5.4.1, airport slots differ from other commodities that have been traded or sold by auction because of the heterogeneity of the product (arising mainly from the time dimension of a slot), the potentially complex nature of the capacity constraint, and the existence of significant demand interdependencies. The latter, in particular, pose serious problems for any auction mechanism that aims to deliver the most efficient use of slots, and means that a single round auction for a number of slots is unlikely to succeed. In such an auction, airlines would have only one attempt at expressing their interdependent preferences across all of the slots being auctioned. In extremely simple cases, it might be possible to achieve this by allowing conditional bidding. But computational constraints mean that this is simply impractical in more complex cases.

We also reject a sequential approach, for example where individual slots are auctioned, one at a time, through a sequence of separate auctions. Airlines participating in such a series of auctions could easily end up with unusable combinations of slots and, more generally, this approach is very unlikely to yield an efficient outcome. This is because bidders in sequential auctions are not able to bid in a way that reflects the interdependent values attached to different slots. As such interdependencies are likely to be very considerable indeed, a sequential approach is unsuitable for identifying an efficient allocation of airport slots.

The most promising option, therefore, is some form of simultaneous ascending auction.[103] Under this approach, participants can submit bids for combinations of slots, and react to the outcome of each bidding round by amending their bids for the next round. The design of such an auction is complex, and any mechanism that was applied to airport slots would almost certainly need to go through a process of gradual refinement, starting from a relatively simple model. This would allow changes to be made to the detailed specification of the auction, in order to improve its performance and address any potential problems arising in the light of experience.[104]

We also propose that a "clock auction" should be considered. Instead of saying how much they would pay for individual slots (or packages of slots), bidders in a clock auction are given a set of prices, for example for slots at different times of day, and asked to say how

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[103] Such an auction was also proposed in DotEcon's study for the UK government (*Auctioning Airport Slots*, January 2001). Our specific proposed auction model differs in some respects from DotEcon's own proposal, which left a number of details undefined and had little analysis of the task facing airlines wishing to bid in such an auction.

[104] A similar process of refinement has been carried out by the US Federal Communications Commission, which has carried out around 40 auctions over the past eight years. The design of the auction has developed continuously over this period, often in response to specific events or outcomes from a particular auction.

many slots they would like to purchase in each time band (up to the maximum number of slots available) at the suggested price. This approach makes bidding in individual rounds simpler (and therefore allows for a shorter period between rounds), as participants only need to decide whether to stay in the auction for each lot and do not need to decide how much to bid.[105] And it also makes collusion between auction participants more difficult.

A further important question is whether conditional bidding (sometimes called "package" bidding) should be allowed in such an auction. This would, for example, allow airlines to make their bids for one slot conditional on whether or not they win another specific slot.[106] The main advantage of allowing conditional bidding is that airlines can express their preferences much more directly than if conditional bidding is not allowed (in which case, demand interdependencies would manifest themselves instead through the pattern of repeated bidding for different combinations of slots). This might be particularly important for hub carriers, where the value of a feeder service may be significantly affected by the availability of long distance connecting flights (and, to a lesser extent, vice versa).

Conditional bidding may also allow the auction to be completed more rapidly, and will reduce the risk of a bidder being left with a lot that it does not really want. A potentially important disadvantage, however, is that it can make the task of specifying and submitting a bid much more complex.

Whether or not conditional bidding is allowed, a central part of the design of any auction will be the set of "rules" that places constraints on bidders' behaviour. These cover issues such as:

- the maximum number of slots that a participant can bid for – this is known as the bidder's "eligibility";

- the extent to which a participant can increase the number of lots it bids for between individual rounds – this is covered by "activity rules";

- the extent to which bidders can switch their bids between different lots. Restrictions may be necessary, for example to prevent all bidders for one particular slot switching their bids to another slot, thus leaving no bids for the original slot.[107]

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[105] A minor exception to this occurs when a bidder stops bidding for a particular slot because the price has become too high. Bidders may be asked to provide "exit bids" in such circumstances, stating the maximum price (somewhere between the old and new prices) at which they would remain in the auction. This is designed to deal with the case where all bidders for a slot leave the auction at the same time.

[106] Examples of conditional bids might include "bid for lot A only applies if I also win lot B" or "bid for lot A is increased by €1 million if I also win lot B".

[107] In an auction (not a clock auction) where participants also bid a price, rules might also cover factors such as the maximum increase in bids between rounds. Large increases in bids are sometimes ruled out, as they can be used by bidders to signal their intentions to other participants in an attempt to arrive at a collusive outcome.

In addition, there are a number of choices in the way that such auctions can be carried out. For example:

- whether the auction continues indefinitely (until all bidding ceases), or whether there is provision for a last and final round;

- what information is provided between rounds, for example the number of bids for each slot, or perhaps even the identity of current "winners".

For the most part, these detailed rules may improve the efficiency of the auction process, but would not be expected to have a very major effect on the eventual outcome. Indeed, these details might change over time, as the auction design is refined in the light of experience. And while the decision whether or not to allow package bidding could have a somewhat more significant effect on both the auction and potentially also the outcome, we would expect the first few auctions to be carried out without this option. A decision on whether or not to allow package bidding could then be taken with the benefit of actual experience of auctioning slots.

9.2.2. Roles and responsibilities

An auction for slots at congested airports could be carried out by national governments, aviation authorities, airport operators or co-ordinators. Airport operators and co-ordinators will need to be closely involved in the design (and refinement over time) of the auction, because of their detailed knowledge of operating conditions, capacity constraints and demand for different types of services from airlines. But this expertise can be used regardless of whether airport operators run the auctions themselves or merely act as advisers. And in the case where airport operators do design or operate the auction, some high level regulatory oversight (from national governments or regulatory authorities) might be advisable, to ensure that the auction is designed to secure the most efficient allocation of slots, rather than an allocation that will maximise revenues (including, for example, income from retail and catering) for airport operators.

We are not directly concerned with maximising the proceeds from any auction, and indeed we are not required to consider what happens to the auction proceeds, except to the extent that different approaches may lead to a more or less efficient outcome.[108] The effect of such decisions on airport operators' (and indeed governments') incentives may be particularly important. The possible implications of different approaches are discussed in Section 9.3.3 below.

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[108] As with higher posted prices, there also may be opportunities to use the additional revenues generated by auctions to reduce charges (down to short run marginal cost where possible) either at uncongested times of the day or at other, uncongested airports.

9.3. Practical Issues

9.3.1. Practicality

The practical difficulties of designing, operating and, perhaps most importantly, participating in a slot auction should not be underestimated. As noted above, we consider it likely that the detailed design of an airport slot auction might be refined over a number of years, with changes to the auction rules introduced from time to time either:

- to address problems that arise when the initial auctions are put into practice; or

- to introduce potentially desirable features that were excluded from the initial auctions so that they would not be too complex.

But it is the difficulties facing bidders in the auction that may pose the greatest threat. If conditional bidding is allowed, then airlines will have to consider how their valuation of individual slots might be affected by the allocation of other slots, and translate this into a coherent bidding strategy.[109] And even if conditional bidding is not permitted, airlines will still have to submit bids for all the slots they would like to use out of the set of slots being auctioned. They will need to take account of interdependencies such as:

- ensuring, where appropriate, that each landing slot is followed, after an appropriate turnaround allowance, by a take-off slot;

- where a shuttle-type service operates, ensuring that the times between a departure from and the subsequent arrival back at the airport are realistic;

- maintaining important connections between flights at each airport;

- providing, where required, a regular scheduled service, and one that has appropriately realistic or challenging (depending on the airline's preferences) implications for aircraft usage.

While a number of complex auctions have taken place, particularly in the US, to allocate telecommunications licences, the nature of demand interdependencies in those auctions has related mainly to geographical coverage and also the overall quantity of services that a bidder wishes to provide. The nature of interdependencies between airport slots appears far more complex, and therefore the task facing bidders in a major auction for airport slots might be much more difficult than the task faced by recent bidders for telecommunications licences.

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[109] Not only will each participating airline need to put together a package of bids that takes account of interdependencies in the demand for each slot, they will also have to revise their bids, perhaps over a relatively short timescale, in the light of the outcome of each round of the auction.

There is little doubt that an auction for a very small number of slots at a single airport would be feasible. Airlines would be likely to take part in such an auction, notwithstanding the opportunities to acquire slots through secondary trading instead. They would find it relatively straightforward to formulate their bidding strategy, and there is a good chance that the auction would allocate the slots to airlines with high (and very possibly the highest) valuations of each slot.

Such an outcome becomes less certain, however, as auctions become more complex. In particular, the chances of holding a successful auction may diminish:

- as the number of slots being auctioned increases, because of interdependencies between the demand for particular slots (and also simply because bidders have more options available, making the task of bidding more complex);

- when auctions are held at several different airports, such that some airlines are bidding in separate auctions for slots at <u>both</u> ends of a route they wish to operate.

In such cases, there are two distinct risks to the feasibility of carrying out an auction for airport take-off and landing slots. First, the complexity of the process, the uncertainty of the outcome and the cost of taking part might deter some airlines from participating in the auction at all. Instead, they might decide to rely on secondary trading to obtain any slots they require. And, second, when airlines do participate, the sheer complexity of the auction may reduce the likelihood that slots will be allocated to airlines that value them most. Bidders may find it difficult to convert their true preferences into a bidding strategy, and may therefore adopt simplifications that make participation in the auction easier (and cheaper). Or they may simply make mistakes.

For these reasons, we have not considered any options that involve more than 10 per cent of slots at congested airports being auctioned at once, and there are still significant doubts about the practicality of even this approach. And for the two specific models examined in Chapters 10 and 11, we assume that the auction design will be refined over time, both to address any problems that emerge and, equally importantly, to allow participants to gain experience of bidding in such auctions before additional complexities are introduced.

9.3.2. Legal implications

Any attempt to introduce auctions for airport slots would require an amendment to (or perhaps a replacement of) the existing EU slot regulation (95/93). Assuming that the current framework (perhaps with the proposed amendments) will continue to apply at other airports across the EU, the new regulation would need to specify the criteria that would be used to determine which slots are auctioned, and also probably set out some general requirements for the conduct of the auction.

For auctions to be successful, however, it would be useful to provide greater certainty about the nature of the good being auctioned. Among other things, this might cover:

- the nature of an airline's entitlement, with a clear definition of the conditions (including periodic reallocations, in the event that slots are auctioned at regular intervals) under which an airline might be required to give up a slot, and the compensation (if any) that might be payable; and

- a clear statement of the airline's ability to transfer the entitlement to other airlines (or to third parties).[110]

Particular potential difficulties arise where grandfather rights would have applied to slots that instead are being auctioned.

9.3.3. Potential constraints

The sheer complexity of the auction mechanisms necessary to take account of demand interdependencies is perhaps the most important constraint on the potential effectiveness of slot auctions. Even if the eventual outcome is efficient, the implementation costs of auctions will be higher than those of our other options. As noted above, moreover, if auctions are held for a large number of slots, airlines may find it difficult to bid effectively, or might decide not to take part at all and rely instead on secondary trading.

While all auctions for a material number of slots are likely to be complex, we would expect the first auctions to be implemented to adopt simplifications wherever this is possible without undue risk. This will allow airlines, airports, co-ordinators and auction organisers to gain valuable experience of applying auctions in practice, and the auction design may be refined gradually over time. While this could mean that the initial auctions might take longer (either more rounds or longer time between rounds – or quite possible both), and the eventually outcome might fall some way short of the optimum, this approach is vital in order to ensure that the auction design is feasible and does not give rise to unintended consequences. Indeed, a proposed auction design should be subject to testing through simulations and experiments, before being put into practice.

Even if the auction is well designed from the start, a further potential problem may be that bidders behave in unpredictable and apparently irrational ways. This could be because of the complexity of the auction, meaning that bidders find it difficult to formulate a consistent set of bids that reflects their underlying interest. Bidders might simply fail to spot potential opportunities to submit a revised set of bids and improve their portfolio of slots. Or they might be attempting to follow a misguided bidding strategy. This risk is the inevitable consequence of the likely complexity of slot auctions. If it appears to have a material

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[110] Other details to be covered would include the situation in the case of airline bankruptcy. Would an airline's administrators be able to sell its slots to other airlines, or would they be returned automatically to the pool?

adverse effect on the auction outcome, then auction organisers would need to consider ways that the auction design could be amended (and probably simplified) in order to address such problems.

A further complexity is introduced in cases where there are other capacity constraints in addition to a shortage of take-off and landing slots – for example particular terminals may get full up at certain times of the day, or there may be a shortage of stands suitable for a particular type of aircraft. There are two main ways that such additional constraints might be reflected in any auction:

- airlines still bid only for take-off and landing slots, but they also have to notify the auctioneer of the other elements of capacity they will require. The auctioneer will then calculate the allocation of slots that maximises revenue subject to these additional constraints. This may be difficult computationally, and there is a danger that surprising and sometimes seemingly perverse outcomes might emerge;[111] or

- hold a more complex auction, with airlines bidding for combinations of, for example, runway, terminal and stand capacity. This would be a form of auction with package bidding, and might be complex both to participate in and to operate.

Each of these approaches has potential faults, and could make it less likely that a slot auction will allocate slots to the airlines willing to pay most for them.

Finally, as with higher posted prices, we note that slot auctions could have an impact on airport operators' incentives to expand capacity, if operators retain some or all of the additional revenues generated by the auctions. If airport operators are able to earn supernormal profits by auctioning slots at congested airports, this will discourage investment that might otherwise have alleviated the congestion. If, instead, the additional proceeds from the auction are not retained by airport operators (for example, because they are paid instead to government, or to a fund for airport investment, or used to subsidise charges either at off-peak times or at other airports), then this risk will be reduced. Otherwise, some form of regulatory oversight may well be required to ensure that airports provide an appropriate level of capacity, and take appropriate action, where possible, to relieve congestion.

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[111] This is due to the potentially complex interaction between different capacity constraints. When there are terminal capacity constraints as well as runway constraints, for example, a "winning" bidder for a particular slot may find itself displaced in the next round, even though the price for that slot has not changed. This could happen because other bids have changed and there is now a new combination of revenue maximising allocations that is consistent with both runway and terminal constraints.

9.3.4. Consistency with environmental policy

In Section 2.4.5, we have seen that the Commission has in the past raised the possibility of setting the capacity of airports in terms of their environmental performance, eg noise quotas per airport. In theory, it would be possible to reflect such an additional capacity constraint in an auction (see Section 9.3.3), so that the outcome of the auction process would be that both the runway and noise capacity constraints are satisfied. However, introducing such additional constraints would render the auction design significantly more complex (and we believe that auctions for airport slots will be complex in any case).[112] We argue in Section 11.4 that the complexity of large slot auctions could well prevent them from delivering some or all of the potential efficiency improvements available from applying market mechanisms. The inclusion of environmental criteria (or any other additional feature that makes the auctions more complex) would increase the likelihood of an adverse outcome.

In theory, it would also be possible to adjust the prices payable in an auction to reflect environmental policy objectives such as the noise performance of aircraft. However, the only sensible way to achieve this would be through a pre-announced series of premia or discounts (expressed as sums of money rather than percentages of bids) from the bid price for different aspects of proposed services that would be either environmental unfriendly or friendly. Applied in such a way, auctions would function only as a convenient collection mechanism for environmental taxes or subsidies. A more profound difficulty, moreover, is that auctions would be carried out on an irregular basis, whereas environmental taxes and subsidies would need to be applied on an ongoing basis and capable of changing if, for example, an airline decided to change the type of aircraft it used for a particular slot. Environmental taxes and subsidies have more in common with conventional airport charges, therefore, and it might be preferable to apply them alongside airport charges rather than as part of any slot auction.

Even if auctions were subject to qualitative environmental criteria (for example, a requirement that airlines meet certain standards before they can enter the auction), this approach would still suffer from the fundamental weakness that it takes effect only at the point that a slot is (re)allocated. An additional mechanism would still be needed to deal with the situation where an airline changes the use of an existing slot (and the new service is more or less environmentally-friendly than the original service).

This weakness would certainly apply to the two specific auction mechanisms examined in Sections 10 and 11 below, as:

- an auction of pool slots would apply to only a small number of slots in any particular year; and

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[112] Where there is only one capacity constraint (such as the runway), for example, airlines might be able to bid for a portfolio of slots without having to specify details such as aircraft type, etc. If the auction is subject to environmental criteria, however, airlines might have to provide a complete schedule for each round of bidding.

- even an auction of ten per cent of slots would only apply to each individual slot at ten yearly intervals. Under this option, moreover, we would expect there to be extensive and regular changes to the use of existing slots, as airlines adapt their existing portfolios to fit in with the outcome of each auction.

We also note that it would be very difficult to introduce emissions trading alongside auctions for airport slots. If these two mechanisms co-existed, airlines might not know during the slot auction whether they would be able to obtain the necessary emissions rights (and competitors might thwart the outcome of the slot auction by subsequently refusing to sell emissions rights). Conversely, airlines might have to negotiate with other airlines about emissions rights, not knowing whether they would be able to obtain the associated slots at the auction. We believe that this would create many problems and significantly reduce the efficiency of both slot auctions and the market for emissions.

9.3.5. Consistency with regional accessibility objectives

As with higher posted prices, it would be quite possible to adapt an auction mechanism in order to reflect policy objectives in relation to regional services. While we consider that the most appropriate means of dealing with these objectives is through direct subsidies for the services concerned, for example within a franchising regime, it would also be possible to offer targeted discounts at the auction. This might mean that airlines seeking to provide certain regional services would participate in an auction, but know that they would only have to pay half (or some other fraction of) the amount they bid. This approach has been used in some auctions carried out by the US Federal Communications Commission, for example to favour small companies or services provided in "tribal lands", though in some of these cases the system was abused mainly because of the lack of an appropriate and enforceable definition of those eligible for a discount.

As already noted in Section 8.3.8, safeguards will be needed to ensure that the beneficiaries of any discounts cannot then sell the slots on at full price. This might be addressed by ensuring that the airline receives less than 100 per cent of the proceeds from any sale of the slot, or by administrative restrictions on secondary trading.

9.3.6. Implementation costs

The cost of designing and operating an auction, and the cost to airlines of planning for and participating in auctions, could be high, as we see from the experience in other sectors.

In other sectors, large auction bidders tend to use legal teams, investment banks, financial analysts and auction consultants to help them prepare for and participate in auctions. The teams may be involved on a part-time basis for up to a year before a major auction: in the telecommunications sector, companies may use up to 10 external consultants for large auctions, plus an internal team of up to 10 people for a period of a few months. Some auctions for telecommunications licences have extended over more than 100 rounds, with

only four or five rounds per day, involving senior management for a period of weeks. In practice, though, the extent of preparation would differ greatly between companies, even if they are similar in size.

The auction operator also tends to incur large costs. Though experience varies, the value of the work to prepare and design an auction tends to be related to the size of the auction proceeds. Small mistakes are much more costly in large transactions and therefore auctioneers are willing to incur significant preparation costs in order to avoid such mistakes.

However, auctions of airport slots have important differences from certain other auctions. They would be repeated regularly, and so there would be economies of experience for the designers and participants. And it may be possible to mitigate an error in the auction through subsequent trading. But the interdependencies are more extensive and complex than in sectors where auctions have typically been applied, so that the bidding strategy would be more difficult to formulate. Hence if such auctions were to be held regularly, and for a number of airports, the cost should be considerable.

The prospect of several auctions taking place at the same time might also raise logistical problems for airlines wanting to participate in several different auctions. In all except the simplest cases (for example, where an airline only requires a single pair of slots from those being auctioned) a bidding team comprising of at least a scheduling expert and a financial expert is likely to be required, and bigger teams might well be required for more complex cases (or cases where the airline is hoping to obtain a large number of slots). If there are several major auctions happening at the same time, then some airlines may not have sufficient staff with appropriate expertise to attend all of the auctions.

10. AUCTIONS OF POOL SLOTS

10.1. Introduction

The first auction option we examine is an auction applied only to pool slots at congested airports. Grandfather rights will continue to apply to existing slots. Since we assume that secondary trading will be permitted alongside any auction mechanism, airlines will also be able to buy and sell slots. For this reason, we would expect any auction to apply mainly (and perhaps exclusively) to new slots, as we would expect existing slot holders to attempt to sell any unwanted slots to other airlines rather than surrendering them to the pool.

In broad terms, the "new" slots that we expect will account for most of the slots being auctioned might be created through one or both of:

- new capacity that is delivered, often in small and relatively regular increments, by ongoing efforts by airport operators and co-ordinators to increase the number of slots that can be accommodated by existing capacity; and

- larger and less frequent blocks of slots delivered as a result of an increase in the physical capacity of an airport (such as a new runway, improved air traffic control, a new terminal or new stands), though in practice these are often released in a series of smaller increases.

This distinction is not clear cut (or important), and there may be minor changes, such as greater use of existing runways following the provision of a new exit, which fall somewhere between the two.

Pool slots would only be auctioned in cases where there is likely to be excess demand for those slots. They could either include slots at all times of day, or only slots at times of day for which there is (or reasonably expected to be) excess demand for slots. Auctions would not be held for slots at uncongested airports.

Auctions would therefore replace the use of administrative criteria to allocate pool slots at certain airports. A further potential advantage of this approach is that it avoids the situation where valuable slots (ie because they can be traded) are "given away" to airlines on the basis of rather loosely defined and subjectively interpreted criteria. If instead, slots that could be traded were still allocated through the use of administrative criteria, we might expect airlines to put considerable efforts into submitting applications for slots on the basis that they think best meets the criteria, even if they have no real intention of running the services proposed for any length of time. Where slots have value, allocations that are based on subjective criteria might be open to allegations of discrimination, bias or even bribery.

Except where significant blocks of new capacity are added to an airport, we would not expect the proceeds from auctioning pool slots to be particularly large in relation to airport

revenues as a whole. For this reason, there will be only limited opportunities to use the proceeds from such auctions to lower charges at uncongested times of day or at uncongested airports.

10.2. Description of Approach

10.2.1. Overview

The overall outline of the auction, and the roles and responsibilities, would be similar to that set out in Section 9.2 above. If only a very small number of slots were to be auctioned, then a simpler format (such as a conventional sealed bid auction) might be considered. Otherwise, we would expect the auction to take the form of a simultaneous ascending clock auction, which may or may not also provide for conditional (or "package") bidding.[113]

As noted above, auctions could either include slots at all times of day, or only slots at times of day for which there is expected to be excess demand for slots. Including slots for all time periods would have an advantage in that airlines can obtain a complete set of slots in the auction to run a frequent service, and would also deal with the potential "shifting peak" problem that might occur if shifting demand due to higher peak prices would cause excess demand during off-peak periods as well. However, including slots for all time periods does extend the scope of the auction to periods where there is no excess demand, rendering the auction more complex. Auctioning peak slots only avoids this. Under this option, airlines could obtain off-peak slots through the conventional allocation procedure or in the secondary market. If auctions are implemented for pool slots, we would expect detailed criteria to be developed by governments or regulatory authorities to determine when it is permissible to hold an auction.

Auctions of new capacity might be keenly contested in situations where activity in secondary markets is relatively limited. But if secondary markets are fluid, functioning well and with a relatively high volume of activity, then airlines might view secondary trading as an easier and less risky means of getting hold of slots.

10.2.2. Nature of slots

Once an airline had been allocated a slot through a completed auction, that airline would be committed to paying the bid price. There would be no facility for winning bidders to withdraw after the end of an auction. But airlines would still be able to sell slots on to other airlines, and indeed the fact that an airline had paid a high price at the auction would indicate that a number of airlines wanted, and were willing to pay for, that same slot.

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[113] The potential advantages of allowing package bidding increase with the number of slots being auctioned. But so does the complexity of bidding. One approach might be not to allow package bidding in early auctions, providing both auction designers and airlines with an opportunity to gain experience of participating in actual auctions, and then to consider allowing package bidding at a later stage.

An auctioned slot would be subject to exactly the same rights and obligations as slots allocated in other ways. Thus both grandfather rights and the use it of lose it rule would continue to apply to all slots, regardless of whether they had been auctioned, traded or allocated administratively.

10.3. Practical Issues

10.3.1. Practicality and potential constraints

The practical problems discussed in Section 9.1 may be less likely to apply to many auctions of pool slots, as:

- there will often be a relatively small number of slots being auctioned at any one time; and

- as the auctions will generally apply to new slots, airlines will be considering incremental changes to their schedules, rather than the more disruptive changes that might occur when existing slots are also being auctioned (or reallocated in some other way).

Such auctions might be particularly valuable for airlines, such as direct competitors to incumbent hub carriers at the major airports, which might perceive (rightly or wrongly) that certain other airlines could be reluctant to trade with them.

Nevertheless, there will be occasions when much more complex auctions are required:

- from time to time, some airports will add substantial blocks of new capacity (for example, a new runway) that will generate a large number of new slots; and

- slot auctions at other airports may be made more complex because there are multiple capacity constraints (for example, involving both runway slots and terminal or stand capacity).

Careful thought will need to be given to the design of these auctions, to achieve an appropriate balance between efficiency (as measured both by the eventual outcome and also the cost of the auction itself) and ease of participation.

The impact of such auctions on airport operators' incentives, if airport operators were to retain the auction proceeds, is rather complex. Operators would have incentives to provide *some* additional capacity, otherwise there would be no pool slots to auction. But these incentives might lead them always to provide insufficient additional capacity, such that slots

would remain scarce and auction proceeds would be healthy.[114] Regulatory oversight would therefore still be required to ensure that additional capacity is provided in an efficient and timely manner.

10.3.2. Legal implications

Auctions of pool slots involve no removal of grandfather rights, and therefore present fewer legal problems than auctions applied to existing slots. It will be important, nevertheless, for auction designers to ensure that auctions are open to all participants on a non-discriminatory basis.

In addition, there might be opportunities to provide additional certainty to airlines about the nature of grandfather rights, the conditions under which these can be transferred to other slots, and the conditions under which grandfather rights might be taken away. This might certainly increase the revenues resulting from the auction, and it might also improve the expected outcome if, without such clarification, some airlines might either adopt a conservative bidding strategy or even not take part at all in the auction.

10.3.3. Issues in applying regulation under auctions of pool slots

Either of the regulatory approaches we have discussed in Section 6.6.5 would be applicable to this type of market mechanism, and each would allow the hub carrier to seek additional slots in the auction process. In both cases, however, we would expect the hub carrier to bid in a conservative fashion, to avoid the risk that it would have to sell slots in the secondary market in the event that any increased holding either breached the slot holding cap, which we would assume would be expressed as a proportion of total slots, or that any increase in holding was deemed anti-competitive by the regulator under a case-by-case approach.

As also noted in Section 6.6.5, however, neither of these approaches is ideal and in any case it is not clear that auctions of pool slots will give rise to competition problems that need to be addressed in this way. In the first instance, therefore, we consider that existing competition laws should be used to address any specific problems arising, and further regulatory intervention be considered only in the event that existing competition laws prove unsuitable for dealing with any problems that emerge.

10.3.4. Relationship with existing slot allocation procedures

We assume that any slot auctions would take place in the month preceding each Scheduling Conference (ie October for summer season, and April for winter season). Clearly, the intention to hold an auction and the rules for participating in the auction would need to be

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[114]   The profit-maximising strategy would depend on the airport operator's discount rate. Capacity brought on stream immediately provides income up front, but it also reduces the amount of revenue likely to be earned from any additional capacity auctioned in future.

announced significantly earlier than this. But the auction itself would take place in the time between the submission of initial slot requests (which would still be required for existing slots and slots at other airports) and the start of the Scheduling Conference.

While such a timetable may create some difficulties, as airlines would be bidding for slots in any auctions before they knew what slots they had been allocated at other airports, we note that airlines will already know their eligibility to benefit from grandfather rights at that airport and also at other airports. In many other cases, we would expect airlines to have a reasonable degree of certainty about the slots that they will obtain, not least because many of the "other" airports may be uncongested ones.

This approach will give airlines an opportunity at the Scheduling Conference to obtain slots at other airports that match those they have received via auctions. This might be achieved through existing procedures for allocating slots and refining schedules. Or it might be achieved through secondary trading.

10.3.5. Applicability to airport systems

As slots at different airports within a system might be viewed as substitutes, and airlines will not know the relative prices of pool slots at each airport until the auctions have been completed, there is a case for holding a single auction that covers all of the pool slots within the system. This will assist particularly those airlines that operate at more than one of the airports (or new entrants that could introduce services from either airport) and therefore may have some flexibility about which airport to use for particular services. And it may also result in lower costs for both the auction organiser and some bidders.[115]

In other cases, we would expect the degree of substitutability to be quite limited. For this reason, if it were the case that a single auction for the system as a whole would be large and therefore complex (for both auction operators and participants), it might then be better to hold separate auctions for the pool slots at each airport.

10.4. Impact Assessment

10.4.1. Assessment of key features of auctions of pool slots

Perhaps the most important aspect of auctions of pool slots is that, because they apply only to newly created capacity,[116] they do not directly affect the allocation of existing slots. Since we assume that auctions of pool slots are always accompanied by secondary trading, then

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[115] There might be higher costs, however, for airlines that are only interested in slots at one airport and now find themselves participating in a larger auction that covers other airports as well.

[116] Auctions might also apply to any slots returned by airlines to the pool. But we do not generally expect any such returns to occur, since airlines will prefer to sell any spare slots rather than return them to the pool.

the main impact on the vast majority of slots will be that resulting from the introduction of secondary trading. Two key questions, therefore, are:

- how will auctions of pool slots affect the allocation of newly created capacity? and

- will the outcome of allowing secondary trading of existing slots, alongside auctions for pool slots, differ in any way from the outcome when secondary trading is applied alone?

10.4.1.1. *The impact of auctions of pool slots*

In Section 11.3 below, we consider a range of factors that may prevent auctions of existing slots from achieving the allocation of slots under the ideal market mechanism. These include:

- the complexity of the auctions, as they will take place each season at each congested airport and will cover a large volume of slots;

- the fact that airlines may be bidding for slots at one end of the route, without knowing whether they will obtain suitable slots at the other end;

- the likelihood that some airlines may choose not to participate in auctions, because of the complexity and cost of doing so, the risk of obtaining an unusable portfolio of slots, and in some cases the low probability of success;

- the advantages enjoyed by dominant hub carriers at major airports, as they will be much better able to absorb such risks.

In general, however, we do not expect such problems to have a serious impact on auctions of pool slots. Only on rare occasions will substantial blocks of capacity be auctioned at the same time. More usually, auctions will be held for small increments of capacity that become available at particular airports, perhaps on a regular basis. At other airports (such as LHR and LGW), no additional capacity is expected to be added in the short to medium term, and therefore we would not generally expect any auctions to take place at all at these airports.[117]

This means that auctions of pool slots are likely to be relatively simple, at least compared with the auctions that would be needed for existing slots as well. And there is a much smaller risk that airlines will be bidding in auctions for slots at both ends of a prospective route.

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[117] There might be exceptions, for example if operational improvements are discovered that can add small amounts of additional capacity. And depending on the treatment of slots in the event of airline bankruptcy (ie whether the airline's administrators are permitted to sell the airline's slots, or whether they must be returned to the pool) it is possible that existing slots might be returned to the pool from time to time.

Furthermore, auctions of pool slots are likely to be carried out alongside an orderly secondary market for existing slots.[118]   This has a number of significant advantages, including:

- the secondary market offers a degree of protection against the risks associated with an auction. An airline that obtains an unsuitable portfolio of slots may be able to buy other slots or sell some of the pool slots in the secondary market, and an airline that obtains a slot at only one end of the route may well be able to acquire an appropriate slot at the other end through secondary trading (or if not, it can simply sell the slot it already has);

- the existence of a secondary market for existing slots, together with auctions of pool slots, offers a choice to airlines looking to acquire additional slots, as

    - airlines that are unwilling to incur the cost and complexity of the auctions (even though they may be relatively simple auctions) can try to obtain slots instead through secondary trading,

    - but auctions may provide a good opportunity for airlines looking to acquire a number of slots (for example to launch several new diagrams) at the same time.

Finally, a further impact of the introduction of auctions for pool slots will be that, in the absence of any other intervention, the current automatic allocation of 50 per cent of pool slots to new entrants will disappear. In many ways, this is likely to be appropriate, as entrants will be able to obtain slots through secondary markets, as well as through auctions, and there may no longer be any rationale for the current quota. But if a policy decision were taken to preserve some kind of prioritisation for new entrants (or indeed for regional services or environmentally friendly services), then there are several ways in which auctions could be adapted to accommodate such objectives, as discussed in Section 9.3.4 and 9.3.5.

10.4.1.2.   *Secondary trading of existing slots*

In general, we are not aware of any reason why secondary trading of existing slots, when applied alongside auctions of pool slots, should not be at least as effective as when it is applied on its own. As a starting point, therefore, we might expect the impact on the allocation of existing slots to be similar to that described in Section 7.4.3.

In several respects, moreover, there may be reasons to suppose that secondary trading alongside auctions of pool slots may be even more effective than when it is applied alone. For example:

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[118]   This is unlikely the situation described in Section 11 below, where the fact that existing slots are auctioned at periodic intervals also disrupts the secondary market.

- the auctions of pool slots are likely to convey information about the values that airlines place on slots, and therefore the prices that might be likely to apply in secondary markets. This information will be available at least to participants in the auction, and ideally to other airlines as well. As well as reducing uncertainty, this will also help to remind airlines (and their shareholders) of the opportunity costs they are incurring as a result of their existing slot holdings;

- if particular airlines feel (rightly or wrongly) they may be disadvantaged in secondary markets, for example because they doubt that certain existing slot holders will trade with them, or because participation in secondary markets might give away information about their plans, then the pool slot auctions provide an appropriate alternative method for these airlines to obtain slots.

10.4.2. Timing issues

As auctions of pool slots (unlike higher posted prices or auctions of existing slots) do not directly affect existing grandfather rights, it is less likely that proposals to carry out such auctions will meet with fierce resistance from airlines and other parties. Nevertheless, the proposals may still be disputed, for example by airlines that might have expected to receive pool slots through the current administrative mechanisms and reject the idea that they will now have to bid for these slots. Any such dispute may risk delaying the introduction of the new policy, and this will therefore also delay the benefits that might be delivered.

Once the new policy has been agreed, it will still be necessary to design and test the auction mechanism(s) that will be used to allocate pool slots, and also to instruct potential bidders. In relation to this process, we note that:

- there is no clear reason to delay the introduction of secondary trading for existing slots, even if the auction mechanism for pool slots is still being developed. Indeed, an early introduction of secondary trading will (a) ensure that the benefits from trading (as described in Chapter 7 above) are enjoyed as soon as possible, and (b) prevent the situation occurring where airlines face major and simultaneous changes to the allocation mechanisms for both existing and new slots;

- while it is important that the auction design is effective and robust, we suggest in Section 9.2 that the first auctions should adopt a relatively straightforward design, which could then be refined over time and in the light of practical experience. This approach might reduce the delays associated with the initial auction design phase.

Overall, we would expect the impact of secondary trading for existing slots to follow broadly the same time pattern as discussed in Section 7.4.2 above, subject only to any additional delay that might arise if some airlines (or other parties) object strongly to the proposal to auction pool slots. The impact of these auctions might be delayed slightly more, because of the time necessary to design and test the initial auctions. After this point,

however, the timing of the impact of such auctions will be determined mainly by the speed at which airports add new capacity (or take other measures to create additional pool slots).

10.4.3. Estimated impact of auctions of pool slots and secondary trading

10.4.3.1.   Impact on passenger numbers

In order to estimate the medium to long term impact of auctions of pool slots, accompanied by secondary trading, we have for our central case made the following main assumptions:

- we assume that the introduction of secondary trading will have the same impact as that described in Section 7.4.3; and

- to take account of the 2 to 4 per cent of slots at partially congested airports that will typically be auctioned in any one year, we make an adjustment to the overall outcome based on the difference between the outcomes of (a) secondary trading and (b) the ideal market mechanism.

The second element of our calculation is based on our expectation that auctions of pool slots will perform relatively well. They will be small-scale, with less scope for disruption to schedules and errors than if existing slots are auctioned. Importantly, given that pool slots would only include newly created capacity, auctions of pool slots would not normally take place simultaneously at a large number of airports. This greatly reduces the coordination problems that bidders face.

We recognise that auctions of pool slots are unlikely to achieve the allocation under an ideal mechanism, as we have implicitly assumed for the central and high cases. Nevertheless, because this adjustment to our calculations is applied to only a proportion of slots at partially congested airports, it has relatively little impact on our overall results. And it has no impact at all on our results for airports with severe excess demand throughout the day (LHR and LGW), as we do not expect any new capacity at all to be added at those airports.

Our high case also assumes that auctions of pool slots achieve the allocation under an ideal mechanisms for those slots that are auctioned, and is otherwise equal to our high case under secondary trading. In our low case, we assume that auctions of pool slots achieve only 50 per cent of the benefits under an ideal mechanism.

Further detail on our assumptions is contained in Appendix E, Section E.5.

The estimated impact of auctioning pool slots in combination with secondary trading is for each of our cases shown in Table 10.1. The total increase in passenger numbers would under the central case be 4.2 per cent, compared to 4.0 per cent for secondary trading alone. Since we do not expect auctions of pool slots to actually take place at LHR and LGW, there is no change in the impact for these airports. Of the other airports, the increase is most notable at CDG.

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Table 10.1

Increase in Passengers under Auctions of Pool Slots with Secondary Trading

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	Ideal market mechanism	Auctions of pool slots & secondary trading		
		Low	Central	High
LHR	7.2%	2.2%	5.1%	5.7%
LGW	4.8%	1.4%	3.8%	4.1%
CDG	9.1%	3.1%	5.5%	6.5%
MAD	7.6%	2.4%	3.9%	4.7%
VIE	11.4%	2.8%	5.2%	6.2%
Weighted average over all Cat 1 airports	**7.2%**	**2.4%**	**4.2%**	**5.0%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

> **Given total forecast passenger numbers at Category 1 airports in 2007 of 719 million, auctions of pool slots in combination with secondary trading would in the central case result in an increase in the number of passengers travelling through these airports of about 30 million per year**.

10.4.3.2.   *Implementation costs*

Where a small number of slots are being auctioned, then the conduct of each auction might be relatively straightforward. However, except in the very simplest cases (such as where only one or two new slots are available), the auction rules might still be relatively complex. Airlines seeking to participate in such auctions will therefore need to invest resources in first understanding the rules of the auction, and then formulating a bidding strategy. And in the case of more complex auctions, the airport operator or other party running the auction will need to invest resources in the careful design and testing of the auction, and then the capability (very possibly including bespoke software) necessary to run the auction itself.

In simple cases, it might be possible for airlines to formulate a bidding strategy that covers all eventualities (this might be straightforward, for example, where an airline wants only a single slot, and is able to tell its representative the maximum price that it is willing to pay). But in more complex auctions, participating airlines would need to send a small team (including, at minimum scheduling experts and financial experts, very possibly together with auctions or strategy advisers) to act on its behalf, including modifying and amending bids in the light of emerging auction results.

The size of implementation costs will also depend on the degree of co-ordination between airports. If, for example, airports all adopt the same auction design, and stagger their

individual auctions as much as possible, then it might be possible for large airlines to participate in all of these auctions with a relatively small team. Conversely, if airports were to employ different auction designs and hold some or all of their auctions at the same time, airlines would need to establish a number of separate bidding teams, and might also need to devote large amounts of time to learning the rules and procedures of each different auction.

For this option we have assumed that, when the auction system is established, its ongoing administration and development would amount to at least 3 per cent of the value of the auction proceeds – similar to expenditure levels for mergers and acquisitions – and exceed €100,000 per airport per season, for those airports where auctions take place (where capacity is increasing and there is excess demand). Participants' transaction costs are also likely to be related to the expected size of their bids. Ongoing secondary trading costs are assumed to be the same as for the secondary trading option.

Under central case assumptions, we estimate that the total ongoing costs of this option are €29 million per year across EU Category 1 Airports (2007 figures), of which €16 million is associated with secondary trading, and €13 million is incurred by operating and participating in the auctions (which is dependent on the projected increases in airport capacity each season). The cost per passenger using EU Category 1 airports is €0.04, equivalent to €1.0 per additional passenger using the airports as a result of this market mechanism.

10.4.3.3.   Impact on airline competition

Our discussion of a market mechanism involving the auctioning of newly created slots, combined with the introduction of secondary trading is confined to those congested airports, such as CDG and MAD, where a significant number of new slots is likely to become available by 2007 as a result of new runway capacity being completed. Neither LHR nor LGW will be in this position, and at these airports, the outcomes under a system of pool slot auctions are assumed to be the same as under secondary trading.[119]

As shown in Table 10.2, the overall impact of auctions of pool slots and secondary trading is almost identical to the impact of secondary trading alone. In fact, there are small differences, in particular we expect low cost airlines to capture a slightly higher share of slots at partially congested airports as a result of auctions of pool slots. But these impacts are not large enough to show up in Table 10.2.[120]

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[119]   This simplifies the position slightly, since the pattern of demand for slots at LHR and LGW will be affected by the implementation of slot auctions of new capacity at other congested airports. This may result in changes in the values and, hence, the opportunity costs of some slots at LHR and LGW..

[120]   At CDG, MAD and VIE, the proportions of short haul services provided by low cost carriers rises from 3.51%, 2.52% and 1.82% under secondary trading alone, to 3.76%, 2.74% and 1.95% respectively with auctions of pool slots as well.

Auctions of pool slots would also provide opportunities for new entrants to acquire blocks of slots across the day, although these opportunities will be limited.

Finally, because we do not expect the fixed and sunk transaction costs of participating in auctions of pool slots to be as significant as those associated with regular auctions of 10% of slots, the pool auction process combined with slot trading will not favour incumbent hub carriers to the same extent as the auction of existing slots discussed in Section 11.

Table 10.2
Competition under Auctions of Pool Slots with Secondary Trading

	Current	Ideal market mechanism	Auctions of pool slots & trading (central case)
LHR	45%	44%	45%
LGW	37%	24%	24%
CDG	58%	59%	59%
MAD	51%	51%	51%
VIE	82%	82%	82%
Average (all Category 1 airports)	**53%**	**52%**	**52%**
LHR	48%	59%	56%
LGW	54%	39%	40%
CDG	53%	54%	54%
MAD	45%	43%	44%
VIE	73%	70%	72%
Average (all Category 1 airports)	**51%**	**51%**	**51%**
LHR	0%	0%	0%
LGW	13%	40%	36%
CDG	3%	7%	5%
MAD	1%	5%	3%
VIE	0%	6%	2%
Average (all Category 1 airports)	**3%**	**7%**	**6%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

10.4.3.4. Impact on the environment

As with market mechanisms in general, auctions of pool slots in combination with secondary trading will have the following main impacts:

- an increase in the number of movements, reflecting both improved utilisation of peak slots and some switching to off-peak periods;

- a shift from short-haul to long-haul services; and

- an increase in the number of passengers per movement.

In our central case, we expect a combination of auctions of pool slots and secondary trading to lead to a 2.5 per cent increase in total movements at Category 1 airports, with a 3.6 per cent increase in long-haul movements. The environmental costs per passenger km that would result from these changes are shown in Table 10.3. These unit costs fall by about 2.5 per cent.

The results are close to those under secondary trading. At LHR and LGW, they are the same because we do not expect any auctions of pool slots to take place at these airports. At other airports, the costs per passenger km will be slightly lower than under secondary trading.

Table 10.3
Environmental Costs under Auctions of Pool Slots with Secondary Trading
(€ per 1000 passenger kilometres)

	Current system	Ideal market mechanism	Auctions of pool slots & trading (central case
LHR	4.25	3.95	4.03
LGW	4.33	4.29	4.31
CDG	4.28	4.10	4.17
MAD	4.38	4.33	4.35
VIE	4.38	4.24	4.32
Average (all Category 1 airports)	**4.30**	**4.13**	**4.19**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

We estimate that the net impact of auctions of pool slots with secondary trading on environmental costs at Category 1 airports, in the central case, will be an increase of around €390 million. This is similar to the increase of €370 million under secondary trading alone.

As noted in Section 6.9.1, however, this might be reduced if the introduction of secondary trading leads to a decrease in movements at some other airports or if it results in some delays or even cancellations of airport expansion plans.

11. AUCTIONS OF TEN PER CENT OF ALL SLOTS

11.1. Introduction

A more radical application of slot auctions would be to use them to allocate existing airport slots. Because of the likely complexity of auctioning a large number of slots, we consider an option in which only 10 per cent of slots are auctioned at any one time, with all slots eventually being allocated in a rolling programme of ten-yearly auctions.

An inevitable feature of this approach is that it requires the removal of existing grandfather rights, with the consequence that this option might be subject to vigorous challenge by airlines. And the auctions would also be significantly more complex than the auctions of pool slots discussed above. These issues are considered further in Section 11.2.

Under this option, any pool slots would be auctioned at the same time as the existing slots, and secondary trading (of any slots) would also be permitted. As with the auction of pool slots, this approach would apply only at congested airports and could apply either to all time periods or to periods with excess demand only.

The revenues generated each year by such auctions could be quite substantial. Among other things, they could be used to reduce off-peak charges where airports are only congested at certain times of day, or to reduce charges at uncongested airports (especially where there are congested and uncongested airports within a single airport system).

11.2. Description of Approach

11.2.1. Overview

This option involves a rolling programme of slot auctions, such that 10 per cent of existing slots (plus any new slots) are auctioned each year, with the cycle repeating itself so that each slot is re-auctioned every 10 years.

In order to decide which slots would be auctioned first, the following system would apply:

- within each time window (these might be of, say, 15 or 30 minutes duration), slots would be allocated at random to one of 10 groups, which would determine the order in which slots would be auctioned;[121] and

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[121] The simplest approach might be to assign a number between 0 and 9 to each slot, with each slot being re-auctioned in each year ending in that same number. The allocation would be as even as possible within each time window, such that if there were only 10 slots, each slot would have a different number.

- the allocation would aim to ensure that slots from each time period were available for auction each year, in order to maximise opportunities for airlines to establish new services that require several slots.[122]

As with auctions for pool slots, auctions could either include slots at all times of day, or only slots at times of day for which there is expected to be excess demand for slots. If slots for all time periods are auctioned, airlines would be able to obtain complete sets of slots in the auction. This would also avoid the potential "shifting peak" problem that might occur if higher peak prices would cause excess demand during off-peak periods as well. However, including slots for all time periods does extend the scope of the auction to periods where there is no excess demand, rendering the auction more complex.

11.2.2. Nature of slots

Slots would be auctioned at 10 year intervals. Grandfather rights (and the use it or lose it rule) would continue to apply within each 10 year period, but would expire at the end of 10 years. Trading of slots would not affect the time at which a slot would be re-auctioned, though any slots returned to the pool would be re-auctioned at the next convenient opportunity.[123]

As with the auction of pool slots, a winning bid in the auction would be taken as a firm commitment by that airline to pay the bid price and take possession of that slot. The airline would not be able to change its mind, but would be able to sell the slot on to another airline. Airport co-ordinators or operators would need to keep comprehensive records of all trades, and so on, in order to keep track of which slots were due for re-auction at which dates.

An alternative approach would be possible, whereby auctions are held for 10 years (until all slots have been auctioned once) and then are used only to allocate pool slots. Each existing slot would be auctioned only once, therefore, unless it was returned to the pool (which might be unlikely as the slot could also be traded). We have not explicitly modelled such an approach. Over the first 10 years, we would expect it to have a very similar impact to the approach where slots continue to be auctioned every 10 years. Beyond the first 10 years, then the relative merits of these two approaches would depend on:

- the ongoing costs and possible disruption associated with continuing to auction slots on a regular basis; and

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[122] This evenness might be gradually eroded, though not in any systematic or predictable way, as slots are retimed or returned to the pool early (in the latter case they would be reallocated at the next auction).

[123] Slot retiming, if it were permitted, would also not affect the time at which it was due to be re-auctioned. However, slot retiming may be vulnerable to manipulation – airlines may be able to use junk slots to delay or avoid the re-auction of their most valuable portfolio – and so would probably need to be restricted.

- the extent to which, in the long run (and after airlines and airport co-ordinators and operators have had at least 10 years experience of them), auctions might be more successful than secondary trading at achieving an efficient allocation of slots.

11.3. Practical Issues

11.3.1. Practicality and potential constraints

Perhaps the main potential problem with this option is that large numbers of slots will be auctioned each year. One immediate impact of this is that the design of the auctions is likely to be considerably more complex than those which would generally apply to pool slots. This in itself could deter some airlines from participating, especially if they believed that they could obtain the slots they needed through secondary trading.

The likely complexity of such auctions also introduces a risk that the outcomes will be inefficient, in the sense that they will fail to allocate slots to the airlines that value them most. This may be because airlines are unable to convey their true preferences (including, for example, the extent to which feeder services create value for hub carriers) through their bids, or fail to understand the opportunities for doing so, or may simply make mistakes.

Auctions might also lead to frequent service changes and possibly inefficient outcomes because of the potential for specific auctions to have unintended knock-on effects. For example, a service that required three pairs of slots at a congested airport would find one of its slots being re-auctioned, on average, in six out of every ten years.[124]   It is possible that if the airline failed to retain one of the six slots, and could not obtain an appropriate alternative through secondary trading, that the entire service might be withdrawn. This uncertainty might be very disruptive for many airlines, as it might frustrate forward planning and, each time a critical slot is being re-auctioned, it might be impossible for airlines to accept bookings for services until they know that they have retained sufficient slots.

The fact that the vast majority of airlines strongly oppose such auctions is also likely to create problems. Airlines might seek to delay the introduction of auctions through legal challenges, and non-EU states might take retaliatory measures against EU airlines. Conceivably, airlines might agree with each other not to participate in such auctions, or at least not to bid against the airline that would otherwise have enjoyed grandfather rights in relation to each slot.

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[124]   We assume that slots would be auctioned individually, rather than in pairs. One reason for this is that different types of service have very different turnaround times, so restricting slots to existing pairings might make it very difficult for slots to be transferred, for example, between short haul and long haul services.

11.3.2. Legal implications

In the case where auctions are applied to slots that would have otherwise been subject to grandfather rights, a question arises as to whether any form of compensation should be payable to airlines that would have otherwise retained their slots. Particularly where any form of slot trading has taken place, it might be argued that airlines have been allowed to create market value and may therefore have a right to receive compensation. The situation may differ from state to state.

The question of whether or not compensation is payable, or indeed who pays any compensation, is not directly relevant to the current study. However, if auctions were introduced before such issues had been settled, then it is possible that legal challenges and appeals could delay this process, and they might also create uncertainty about the legitimacy of any auction if there is any remaining risk of challenge or appeal.

One possible approach to addressing airlines' concerns would be to delay or soften the impact of the first auctions. This might be achieved, for example, by:

- allowing airlines to continue to exercise their existing grandfather rights for a minimum period of 10 years, with the first auction taking place 10 years after the decision to implement this policy;

- giving airlines discounts (or "bidding credits") in the first auctions, so that they would only be required to pay a fraction of the amount they bid (or perhaps nothing at all); or

- allowing airlines to receive the revenues from the first auctions.

All of these mechanisms, however, might substantially reduce the potential benefits from introducing market mechanisms, either because their introduction is delayed or because the initial incumbent advantages reduce the likelihood that slots will be reallocated, even if the current allocation is inefficient.

11.3.3. Issues in applying regulation under auctions of 10 per cent of slots

As with other market mechanisms, auctions of 10 per cent of slots might well allow incumbent hub carriers to strengthen their position at major airports. Because of their large portfolio of slots, hub carriers would be much less affected than other airlines (such as point to point carriers with only a small number of services) by the uncertainty created by periodic re-auctions. And it is quite possible that some airlines will be reluctant to bid for the hub carrier's slots, especially if they are grouped into "banks" – this might be either because they are afraid of retaliation (that the hub carrier will then bid aggressively for that airline's existing slots), or else they anticipate that the hub carrier will be willing to bid relatively high amounts for slots in its banks, and therefore it is almost inevitable that it will retain (or even increase) its slots at these times.

We have discussed possible regulatory mechanisms involving intervention in the markets for slots, including the introduction of a cap on hub carriers slot holdings in Section 6.6.5 above. Given the practical problems in applying these approaches, we concluded that it would be preferable in the first instance to rely upon existing EU competition law to prevent possible abuse of a dominant position. We recognise that, compared to other market mechanisms, an auction involving 10 per cent of pool slots might carry a greater risk of the hub carrier strengthening it position at its hub airport. Whilst we are not convinced that the risks are sufficient to outweigh the possible disadvantages of additional regulation, we do believe that it may be necessary to keep a close eye on the conduct and outcome of auctions. Authorities should watch out for signs of potential collusion or retaliation, and if necessary consider how the auction design can be revised in order to make such behaviour more difficult.

11.3.4. Relationship with existing slot allocation procedures

As with auctions of pool slots, we envisage that auctions for existing slots would take place in the month preceding each Scheduling Conference. Due to the larger number and much greater complexity of these auctions, however, it is possible that the scheduling calendar (especially the length of time between initial slot requests and the Conference) might need to be lengthened to provide sufficient time to complete these auctions.

Even if it were possible to complete all of the auctions within the current time window, there might be an argument for allowing more time. This would reduce the number of auctions for different airports that needed to be held at the same time, and thereby reduce costs and co-ordination difficulties for airlines.

11.3.5. Applicability to airport systems

Whereas, with auctions of pool slots, we suggest that a single auction might be held for an entire system, we do not think this would be appropriate for auctions of existing slots. The simple reason is that such a move might make already complex auctions even larger and therefore even more complex.

Having separate auctions for each airport within a system will clearly benefit those airlines that are only seeking slots at one airport. For the benefit of those airlines that might view the different airports as substitutes, however, it would be important not to hold the auctions for different airports within a system at the same time.

11.4. Impact Assessment

11.4.1. Assessment of key features of auctions of 10 per cent of all slots

In theory, an auction of existing slots should be capable of delivering the allocation under the ideal market mechanism. From the discussion in Section 11.3, however, it is clear that

annual auctions of 10 per cent of all slots are likely to be very complex, perhaps to an unprecedented degree. This very complexity may create problems, in addition to the impact of having to carry out similar auctions for a number of different airports. We consider these issues below, before moving on to consider how such auctions are likely to affect different types of airline, and the additional impact of secondary trading.

11.4.1.1. The effectiveness of large slot auctions

The sheer size and complexity of some of the auctions could well reduce their effectiveness. Many airlines will find some, but not all, of their slots being auctioned each year, and a natural way to cope with the complexity of such auctions (which will be occurring at a number of airports) for some airlines may be simply to bid for the same slots that they held previously.

For those airlines that are looking to change or increase their slot holdings, they will need to formulate a bidding strategy that captures the relative values of different slots, and the interdependence between the values of different slots (for example, reflecting the need to schedule regular services, to have feasible diagrams for aircraft and to maintain appropriate connections). This bidding strategy will then need to be adjusted, in the light of the emerging prices as the auction progresses.

Except in the very simplest cases, it may be an impossible task for an airline to represent its true preferences in such a bidding strategy. Instead, airlines will need to make approximations, perhaps formulate rules of thumb, and generally achieve a workable compromise between an "accurate" bidding strategy and one that can actually be implemented by those attending the auction. For this reason alone, it is unlikely that auctions of existing slots will achieve the optimum allocation described in Section 6.4. And, in practice, bidders will make mistakes from time to time, or will come across developments that they had not anticipated when formulating their bidding strategy, and this will further reduce the potential benefits from auctioning existing slots.

Yet more complexities are introduced by the fact that a number of auctions will be taking place at roughly the same time. By 2007, we expect some 21 Category 1 airports to be experiencing excess demand at least at peak times of the day. Each season, therefore, many airlines will be taking part in a relatively large number of separate auctions, and inevitably there will be occasions when they are bidding for slots at both ends of a particular route. If the relevant auctions are held sequentially, then airlines will need to bid for certain slots without knowing if they will be able to obtain matching slots at the other end. But the problems may be even more serious where auctions are being held at the same time, and therefore the respective bidding teams will need to be keeping each other up to date and revising their approach as appropriate.

11.4.1.2.   The impact on different types of airlines

We would expect the introduction of auctions for existing slots to lead to the withdrawal of many regional services from the most congested airports or the most congested times of day, perhaps even in the first or second year in which the auction takes place. Most regional airlines will not be willing to bid substantial amounts of money in order to retain their slots, and some small airlines may be reluctant even to participate in auctions due to the likely complexities and the need for specialist expertise. They may also fear that they will be at a disadvantage compared to large airlines which will develop substantial experience of participating in complex slot auctions.

Charter airlines are also likely to withdraw from congested airports, though in many cases this will be achieved either by switching services to alternative airports or else by switching to off-peak periods at congested airports. Such switching is due mainly to the general impact of introducing market mechanisms, rather than any specific features of auctions.

But auctions of existing slots could well act as a barrier to entry for new low cost carriers, both because of the complexity of slot auctions and also because of the risk of paying for slots on new routes where the demand is unproven. Auctions might also accelerate consolidation in the low cost sector, due to the flexibility benefits of large slot holdings and the need to gain experience and expertise. More generally, however, we expect the impact of slot auctions on established low cost carriers to be similar to the impact of market mechanisms in general.

In contrast, hub carriers operating at their hub airports are likely to have a substantial advantage when participating in slot auctions. The fact that hub carriers hold a very large portfolio of slots means that they will have considerable flexibility in adapting their schedules to make best use of the slots they receive at auction. If, for example, they acquired a new slot with the intention of using it on a particular route, but then obtained a slot at the other end of the route at a different time, they would almost certainly be able to adjust their schedules so as to free up a suitable slot at the hub for that new route, and to use the slot originally intended for that route on a different service. This flexibility means that hub carriers face considerably lower risks than other airlines when taking part in slot auctions, and this is likely to be reflecting in a willingness to bid higher than other airlines for apparently equally valuable slots. As a result, it is possible that hub carriers may win "too many" slots, as their higher bids for some slots will reflect their reduced exposure to risk rather than their ability to make best use of a slot.

This inherent advantage for hub carriers may be reinforced if it is recognised by other bidders. If the carrier operates "banks" of long haul services and connecting short haul services, it is possible that other airlines will simply avoid bidding for slots in the hub carrier's banks, as they expect that the hub carrier will be willing to bid a high amount to retain those slots. Again, this could result in the hub carrier obtaining an inappropriately high proportion of slots.

<u>Other long haul services</u> could also be vulnerable in an auction of existing slots. Such carriers sometimes hold only a handful of daily or weekly slots at congested EU airports, and this offers them little flexibility in case they fail to retain any of these slots. In other cases, however, the auctioning of slots previously held by existing carriers could create opportunities for competitive long haul entry, particularly at airports with large catchment areas.

11.4.1.3. *The impact of secondary trading*

The ability to engage in secondary trading should confer some benefit on auction participants. If they fail to win important slots at the auction, they may be able to obtain them instead through secondary trading. Alternatively, if they end up with slots that they cannot use, then they may be able to reduce their losses by selling those slots to other airlines.

However, the ability to adjust slot holdings through secondary trading in no way removes the advantage that hub carriers enjoy as a result of their flexibility to reassign slots. And the benefits from secondary trading may be reduced, for example by:

- the fact that slots are re-auctioned at regular intervals, so that grandfather rights are strictly time limited. This may restrict the operation of the secondary market, as different prices will apply to slots of different duration, and airlines might be reluctant to sell slots with a long duration or buy slots with a short duration;

- the possibility that a large volume of "adjustment" trading may take place immediately after each auction, creating a risk that some airlines will be unable to achieve the changes to their slot holdings they require.

Overall, therefore, we expect the ability to engage in secondary trading to have a relatively minor impact in terms of either reducing the adverse impact of the complexity of the auctions, or offsetting the inherent advantages enjoyed by hub carriers.

11.4.2. Timing issues

As airlines and other parties are likely to put up intense opposition to any proposal to auction existing airport slots, the introduction of such auctions (and therefore the time at which the benefits would be delivered) might be severely delayed. Even when policy decisions had been finalised, there might still be a delay while the auction was designed and tested. As some of the larger auctions might be extremely complex, perhaps to an unprecedented degree, this further delay might also be considerable.

Once such auctions commenced, however, and notwithstanding the fact that it would take 10 years for all slots to have been auctioned once, we would expect much of the impact of these auctions to occur in the first couple of years. One reason for this is that the impact of losing a single slot on a diagram may be to render the entire service unviable.

Because of these factors, many smaller airlines will choose to withdraw services once they have lost a single slot, seeking instead to sell their remaining slots. Other airlines might choose to sell their slots as soon as possible, with the aim of capturing the value of the slots before some of them are lost at auction and the rest are rendered unusable. Equally, we would expect charter airlines to make an early decision to move some or all of their operations to less congested airports or to off-peak periods, rather than wait until they start losing slots. Charter airlines, in particular, are likely to value the ability to market services in advance, and therefore will be uncomfortable with the uncertainty created by auctions of existing slots.

11.4.3. Estimated impact of auctions of 10 per cent of all slots

11.4.3.1.   Impact on passenger numbers

We have assumed that auctions of existing slots differ from an ideal market mechanism in certain important respects. Our central case assumptions are summarised below. Some further detail is contained in Appendix E, Section E.6.

First, for reasons discussed in Section 11.4.1.2 above, we assume that hub operators have a particular advantage when participating in auctions. In addition, airlines which are not part of major alliances will have a particular disadvantage.

Second, we have adjusted the impact so that in the central case only around 70 per cent of the benefits are realised. This adjustment reflects both the complexity of the system, which is likely to produce more errors (which are also more difficult to correct) than other forms of slot allocation, and the fact that, as only a proportion of slots are auctioned each year, the process is not fully dynamic. In the low case, this percentage is 50, whereas it is 75 in the high case. The asymmetric assumptions reflect the risk that major schedule disruption occurs under auctions of grandfathered slots.

As with posted prices, we assume that an auction of 10 per cent of slots will eliminate 90 per cent of the inefficiencies associated with late return of slots. However, the greater disruption to scheduling caused by this system means that the declared capacity is reduced by 1 per cent as a result of this effect in the central case; by 2.5 per cent in the low case; and by 0.5 per cent in the high case.

The resulting overall impacts are shown in Table 11.1 for the low, central and high cases. Our predicted average increase in passenger numbers across all Category 1 airports is 4.1 per cent in the central case. This compares with, for example, an increase of 4.0 per cent under secondary trading, 4.3 per cent under higher posted prices and 5.0 per cent under the combination of these two.

Table 11.1

Increase in Passengers Under Auctions of ten per cent of all Slots

	Ideal market mechanism	Auctions of 10 per cent of all slots		
		Low	Central	High
LHR	7.2%	-2.0%	3.9%	4.6%
LGW	4.8%	-1.0%	3.7%	4.2%
CDG	9.1%	0.0%	5.9%	6.6%
MAD	7.6%	1.4%	3.7%	3.9%
VIE	11.4%	3.4%	5.7%	6.0%
Weighted average over all Cat 1 airports	**7.2%**	**0.4%**	**4.1%**	**4.6%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

With auctions of pool slots, the estimated impact was close to that of secondary trading because auctions would apply to only a small proportion of slots. In contrast, the impacts shown above and discussed further in the rest of this section are primarily due to the auctions (rather than secondary trading). The fact that the impact of such auctions is, in some respects, very close to that of secondary trading is coincidental.

> **Given total forecast passenger numbers at Category 1 airports in 2007 of 719 million, auctions of pool slots in combination with secondary trading would under central case assumptions result in an increase in the number of passengers travelling through these airports of about 29.5 million per year.**

11.4.3.2. Implementation costs

The implementation costs associated with a ten-yearly cycle of auctions are likely to be considerably larger than those of other market mechanisms. The fact that large numbers of slots may be available at each auction means that the design and conduct of the auctions may be very complex, and each auction might well last for a period of some days, if not weeks. Furthermore, airlines may feel they have to take part in auctions, rather than rely on secondary markets, on the occasions that their slots are included in the auction. For some airlines, this will happen every season.

For large airlines, each auction might need to be attended by a team of experts including schedulers and financial analysts, often keeping in close contact with senior managers. This would be particularly demanding if, as is very likely, a number of auctions were due to take

place simultaneously.[125] In addition, substantial costs would be incurred outside the auction itself, to undertake financial assessments and formulate bidding strategies.

The costs to auction organisers might also be considerable. They would formulate a detailed auction design, which would then need to be subject to rigorous testing and simulations before it could be considered for implementation. Considerable resources might also be devoted to teaching airlines how to take part in these auctions, and answering their questions both before and during the auction process.

We would expect the ongoing costs of this form of slot auction to be more than double those of the four other market mechanisms we have considered in this report. In our central case, the cost could be around €70 million a year across EU Category 1 airports (2007 figures). This broad estimate has been calculated using a methodology similar to that for the auction of pool slots. Financial evaluation costs per slot are assumed to be double those for pool slots, reflecting the fact that the slots being auctioned will often form part of an existing diagram, and therefore the outcome of each is likely to have repercussions for far more than 10 per cent of slots. Secondary trading would incur few additional financial evaluation costs, and is assumed to cost less under this option.

The ongoing cost is equivalent to about €0.1 per passenger using these airports, or €2.3 per additional passenger using the airports as a result of the slot auctions.

11.4.3.3.   Impact on airline competition

Compared to the other market mechanisms, we have suggested that auctions of 10 per cent of slots annually will tend to favour certain types of airline, because of the fixed and sunk transaction costs of participating in auctions. Added to these effects will be the advantages of hub carriers in being able to allocate particular slots to a potentially wide range of services, and thus being better placed to deal with any unexpected outcomes from the auction. As shown in Table 11.2, these factors help to explain why we expect hub carriers and their alliance partners generally to secure a marginally higher share of slots than would be observed under the other market mechanisms we have examined. Significantly, their share of slots is also higher than the ideal market mechanism, suggesting that they actually receive "too many" slots. However, the scale of the differences is generally relatively small.

Finally, we believe that the relatively high fixed and sunk costs of participating in annual auctions may act to discourage attempts at market entry via the auction mechanism by small and medium size carriers, although such carriers will continue to be able to pursue entry opportunities via the secondary trading route.

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[125]   While there might be limited opportunities to stagger the times of some auctions, there would be insufficient time available to avoid clashes altogether. Auctions might be scheduled, for example, to commence at the start of each week for four weeks before the Scheduling Conference. But this clearly provides only four different times, whereas many more auctions would be taking place.

Table 11.2

Competition under Auctions of ten per cent of all Slots

	Current	**Ideal market mechanism**	**Auctions of 10% of all slots (central case)**
Hub alliance share of long haul movements			
LHR	45%	44%	46%
LGW	37%	24%	23%
CDG	58%	59%	59%
MAD	51%	51%	51%
VIE	82%	82%	82%
Average (all Category 1 airports)	**53%**	**52%**	**52%**
Hub alliance share of short haul movements			
LHR	48%	59%	62%
LGW	54%	39%	41%
CDG	53%	54%	55%
MAD	45%	43%	45%
VIE	73%	70%	72%
Average (all Category 1 airports)	**51%**	**51%**	**52%**
Low cost airlines' share of short haul movements			
LHR	0%	0%	0%
LGW	13%	40%	34%
CDG	3%	7%	5%
MAD	1%	5%	2%
VIE	0%	6%	2%
Average (all Category 1 airports)	**3%**	**7%**	**5%**

Source: NERA estimates

Note: The weighted average is calculated for all Category 1 airports, including those with little or no excess demand.

11.4.3.4.   Impact on the environment

Auctions of 10 per cent of slots will affect the environment, principally because of the following factors:

- an increase in the number of movements, reflecting both improved utilisation of peak slots and some switching to off-peak periods;

- a shift from short to long-haul services; and

- an increase in the number of passengers per movement.

In the case of auctions of 10 per cent of slots, however, the increase in total movements is partly reduced as a result of the effective reduction in declared capacity we have assumed (to reflect the disruption that large scale auctions might bring).

In our central case, we estimate that a combination of auctions of 10 per cent of slots and secondary trading might increase the number of movements at Category 1 airports by about 2.3 per cent, with long-haul movements increasing by some 4.6 per cent. The environmental costs per passenger km that would result from these changes are shown in Table 11.3. These unit costs fall by about 2.6 per cent.

Table 11.3
Environmental Costs under Auctions of ten per cent of all Slots
(€ per 1000 passenger kilometres)

	Current system	Ideal market mechanism	Auctions of 10% of all slots (central case)
LHR	4.25	3.95	4.04
LGW	4.33	4.29	4.26
CDG	4.28	4.10	4.16
MAD	4.38	4.33	4.36
VIE	4.38	4.24	4.34
Average (all Category 1 airports)	**4.30**	**4.13**	**4.19**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

We estimate that auctioning 10 per cent of pool slots together with secondary trading would lead to an increase in environmental costs of around €420 million per year under our central case. But as noted above, this might be reduced if the combination of auctions and secondary trading leads to a net reduction in movements at other airports or a moderation of airport expansion plans.

12. CONCLUDING COMMENTS

All of the market mechanisms we have examined have the potential to increase the proportion of slots at congested airports that are allocated to the airlines that value them most, and to improve the utilisation of slots. Passenger numbers at congested airports are likely to increase as a result of four types of impact:

- a shift in the mix of services using congested airports, notably an increase in the proportion of long haul services;

- within each category of service, a general shift to services with higher load factors. Within short haul services, for example, some regional services and services operated by full service carriers other than the hub carrier will be withdrawn, and more services will be operated by low cost carriers. Some of the least profitable long haul services will also be withdrawn;

- where possible, airlines will shift services to off-peak times or to uncongested airports. This is most likely to affect charter services and perhaps some long haul services, and will free up peak capacity for other services. For many services, however, shifting to off-peak times or uncongested airports will not be a realistic option;

- slot utilisation will also improve, as the fact that airlines have to pay for slots (or can sell any unwanted slots to other airlines) will reduce the number of slots at congested airports that remain unused.

The illustrative calculations presented in Chapter 6 suggest that, in the medium to long term, such changes could increase the number of passengers at congested airports by approximately 7 per cent, equivalent to an extra 52 million passengers per year.[126]

While each of the specific market mechanisms we have examined is likely to deliver many of these benefits, none is likely to be able to function perfectly:

- <u>secondary trading</u>, based on bilateral negotiations between airlines, would be relatively easy to implement. But some potentially compatible buyers and sellers might be unable to identify each other, and some airlines might ignore the potential proceeds from selling their slots and continue instead to run services that fail to make the best use of scarce capacity;

- <u>higher posted prices</u> would, we assume, be introduced only gradually, as it is likely to be quite difficult to establish the market clearing level of prices, and therefore any efficiency improvements may be delayed, perhaps quite significantly. Even in the

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[126]   Based on forecast passenger numbers in 2007

long run, it is unlikely that higher posted prices will completely clear the market (and therefore administrative primary allocation criteria will still be needed). Some residual inefficiencies are therefore likely to remain;

• a combination of <u>higher posted prices and secondary trading</u> might have the greatest potential of any of our options to achieve the allocation of slots under the ideal market mechanism. The ability to engage in secondary trading may help to address residual inefficiencies that result because higher posted prices do not clear the market. But secondary trading is most effective when there are large differences between the buyer's and the seller's valuation of a slot, and it may therefore only be partially successful in "fine tuning" the allocation of slots among those airlines willing to pay high posted prices;

• a combination of <u>auctions of pool slots and secondary trading</u> also has the potential to achieve a substantial improvement in the allocation of slots. For existing slots, the impact is simply that of allowing secondary trading. But for newly created slots, auctions have the advantage of achieving a more efficient initial allocation of these slots, and also avoid the problem of "giving away" new slots (eg through administrative mechanisms) that can then be sold at a significant profit;

• <u>auctions of 10 per cent of slots, combined with secondary trading</u> could, in theory, achieve the most efficient allocation of slots possible. But in practice, many of the auctions are likely to be so complex, both for auction organisers and for airlines bidding for slots, that it is probably unlikely that an efficient allocation of slots will emerge from this process.

We have carried out some high level calculations to illustrate the potential scale of the impact of each mechanism. The results are summarised in the first few rows of Table 12.1 below. Inevitably, these calculations rely on a large number of assumptions and estimates, as there is very little evidence available about the likely impact of either specific market mechanisms or the use of market mechanisms in general. Nevertheless, we believe these illustrative calculations provide an appropriate (though very approximate) indication of the likely medium to long term effectiveness of each mechanism.

There are also significant differences in the speed at which each mechanism will affect the allocation of slots. Both secondary trading and higher posted prices may have a rather gradual impact. Airlines that might sell their slots will face an opportunity cost rather than a cash cost and therefore may take a while to make the decision to sell. Under posted prices we expect airport co-ordinators and operators to increase prices only gradually, as there is likely to be considerable uncertainty about the impact of price increases.

Perhaps equally importantly, however, is that the impact of some of these mechanisms could be delayed, potentially quite significantly, by difficulties introducing the policy in the first place. Any attempt to introduce higher posted prices or auctions of existing slots, in particular, is likely to be strongly opposed by both EU and non-EU airlines. The resulting

disputes and challenges could significantly delay the implementation of either of these mechanisms, and if implemented then they might also provoke retaliatory measures by non-EU states.

Market mechanisms will lead to increased service levels in certain markets, particularly long-haul ones, and service cuts in others, such as regional, short haul and marginal long haul services. Where service levels increase, we expect fares to fall, whereas we expect fares to rise as a result of service reductions. For the industry as a whole, service levels will increase and therefore, on average, we might expect fares to fall. Fares can also be expected to fall as a result of full service short-haul services being replaced by low-cost services, and increased competition on some long haul routes. Apart from these effects, we do not as a general rule expect other impacts on fares. In particular, we do not expect airlines to be able to pass on increases in fixed airport charges at congested airports. Airline price setting at these airports involves matching demand with the available capacity, neither of which will normally change as a result of market mechanisms.

Since market mechanisms will increase the number of flights to and from EU airports and increase aircraft size, they will have negative impacts on the environment (though there may be offsetting factors, such as delaying the need for new airport capacity, and we note that the predicted change in the traffic mix and increase in load factors will lead to lower environmental costs *per passenger km*). In the absence of other measures, market mechanisms may also have a negative impact on the accessibility of regional airports.

All of the options examined are probably likely to lead to increased slot holdings by the major hub carriers. This may be particularly likely under the auction options (especially the auction of 10 per cent of slots), as hub carriers will be better placed than other airlines to cope with the uncertain outcomes of an auction. The fact that these carriers may hold an increased proportion of slots is not necessarily a sign of inefficiency or abuse of a dominant position, as it may simply reflect the benefits of economies of scale and density, and passengers themselves may benefit from the increased journey opportunities offered by improved hub and spoke networks. And increased concentration at airport level does not automatically imply a reduced level of competition, as competition takes place on the basis of routes rather than airports. Although regulatory mechanisms might be used to restrict hub carriers' slot holdings, they appear likely either to be difficult to implement, or to introduce undesirable rigidities in slot use. These considerations perhaps suggest that specific regulations to limit concentration should only be considered if problems occur in practice that cannot be addressed through existing EU competition law.

More generally, however, we believe that market mechanisms will have positive impacts on the degree of competition in the industry. They will remove important entry barriers for low-cost and competing long haul services, which will increase competition on key routes. In part, this is due to the fact that certain other routes will no longer be served from highly congested airports, and may migrate to secondary airports in major city regions. This

process will free up slots at the busiest airports that can be used by entrants to compete with incumbents on other routes.

In addition, the specific market mechanisms we have examined are associated with a wide range of implementation costs and other practical issues:

- secondary trading is likely to have low implementation costs and is unlikely to interfere with existing slot allocation and scheduling procedures;

- higher posted prices (with or without secondary trading as well) will also have relatively low implementation costs, although airports will need to undertake research on a continuing basis in order to set appropriate price levels. Provided prices change only gradually, this option is unlikely to cause widespread disruption to schedules or to the existing slot allocation (at other airports) and scheduling process;

- auctions of pool slots may be quite costly to organise and participate in initially, though we would expect large auctions to be relatively rare. Because the primary allocation mechanism (ie the auction) applies only to pool slots, this option will not disrupt existing schedules or slot allocation processes at other airports;

- auctions of 10 per cent of slots, in contrast, are likely to be expensive to implement. Costs (including substantial management time) will be incurred by both auction organisers and participants. This option does not fit well alongside existing slot allocation processes, and could also lead to frequent and potentially destabilising changes in schedules.

Our assessment of the impact of each option does not make specific assumptions in relation to the additional revenues raised from either higher posted prices or auctions. There are a number of possible approaches, including excess revenues being paid to government or ringfenced to fund future airport expansion or improvement projects. We note, however, that if airport operators were to retain these revenues, this could act as a strong disincentive for future airport expansion (as this would reduce the proceeds from higher posted prices or auctions). Even in the case of auctions applied only to pool slots, this will reward airports for providing new capacity, but only if they provide insufficient additional capacity and therefore slot shortages remain.

Table 12.1 below summarises our main findings in relation to each option.

Table 12.1
Summary of Main Properties of Market Mechanisms

	Secondary trading	Higher posted prices	Higher posted prices & secondary trading	Auction of pool slots & secondary trading	Auction of 10% of slots & secondary trading
Approximate estimate of impact on passenger numbers					
Low case	2.2%	3.8%	4.1%	2.4%	0.4%
Central case	**4.0%**	**4.3%**	**5.0%**	**4.2%**	**4.1%**
High case	4.8%	5.2%	5.8%	5.0%	4.6%
Implementation costs	very low	low	moderate	moderate	very high
Other factors					
- potential for instability in airline schedules	very low	low	low	low	high
- likelihood of increased concentration at hub airports	moderately high	moderately high	moderately high	high	very high
- consistency with existing scheduling procedures	good	moderately good	moderately good	moderately good	poor
- risk of international disputes, challenges & retaliation	low	high	high	low	very high

APPENDIX A.   INFORMATION GATHERING

A.1.   Introduction

The information gathering took two forms:

- questionnaires and data requests; and

- the interview programme.

A.2.   Questionnaires and Data Requests

Airport coordinators had much of the useful data required for this study, in particular the slot schedules, requests for slots and details of the slot allocation process. Airport operators were able to provide information about current airport capacity, planned increases in capacity and demand forecasts. Hence, we prepared two separate questionnaires, for coordinators and for operators of EU Category 1

A.2.1. Questionnaire for airport coordinators

A questionnaire was sent to each of the coordinators of EU Category 1 airports. We asked for information about the following.

- **Airport capacity**, on the runway and any other part of the airport system for which there is a capacity constraint.

- **Demand for airport slots**. We asked for the number of initial requests for slots, and contrasted these with the number of slots allocated and number actually available.

- **Airport schedules**. The schedules include information on aircraft size, service type (passenger schedule, passenger charter, general aviation, etc), number of seats and origin / destination.

- Various indicators of the **mobility of slots**, including incidences of historic slots, new entrants and new services.

- A description of the **process of allocating slots**.

- The main effects on the schedules of **11 September 2001**, and the associated economic downturn.

We received responses from all the coordinators

We prepared a smaller questionnaire which we issued to operators of EU Category 1 airports. The focus of the questionnaire was to gather traffic forecasts for 2007, to establish how slot constrained airports were likely to be over the next few years. We also asked how

airport capacity was expected to change over that period and the types of inefficiency that they considered to be associated with the current system of slot allocation. We received responses for all the airports and airport systems.

We have treated data from questionnaires as confidential, in the sense that we will not identify data for individual airports, unless they are already in the public domain or unless we have obtained permission to do so.

We also used data by ACI on passengers, freight and aircraft movements for most of the major EU airports.

A.3. Interview Programme

The interview programme consisted of detailed discussions concerning the introduction of market mechanisms. We used the programme to investigate the following areas:

- the **feasibility** of introducing the specific market mechanisms we have short-listed, in particular auctions, including the ways in which such mechanisms would interact with whichever existing slot allocation mechanisms are retained;

- the **impacts on airline behaviour in the short term**, for example behaviour in auctions or participation in secondary trading markets;

- the likely **costs** of implementing market mechanisms, including for example the cost to airlines of participating in any auction or trading arrangements;

- the likely **effectiveness** of each candidate mechanism in terms of improving the efficient use of scarce airport capacity; and

- the **longer term impacts on airline behaviour**, and hence the nature of competition in the air transport industry and the types of service provided.

We undertook 29 interviews in total. We interviewed the following range of organisations.

- A selection of airlines, including representatives of EU based flag carriers, major non EU-based airlines (US, Asia), charter airlines, regional services and low cost airlines.

- A subset of EU Category 1 airports, concentrating on major congested airports. The airports were selected so that we covered a range of situations experienced by Category 1 airports, including hub airports, non-hub airports, airports with severe congestion, or congestion restricted to certain times, and airports with different mixes of schedule, charter, cargo, domestic, short haul and long haul.

- A subset of airport coordinators.

- Several other industry bodies spanning the range of interests, including EUACA, IATA and ACI.

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We also received a number of written submissions from various organisations, and have also used these to inform the study.

Each prospective interviewee was approached and sent a briefing paper outlining suggested topics for discussion should they elect to meet with NERA. Those that accepted the invitation to be interviewed were then sent a more detailed briefing paper containing background information, the executive summary to the interim report and a tailored list of questions that would be asked at the interview. A draft of NERA's internal note was sent to each interviewee for their comments.

In addition, we wrote to Member State and Accession Countries' aviation authorities, describing our report, enclosing the executive summary to the interim report and inviting their views on a range of issues. Only five authorities responded.

Table A.1 lists the stakeholders that took part in the interview programme. Interviewees were selected with the approval of DGTREN. Organisations which declined to be interviewed included the European Consumers' Organisation (BEUC) and the European Federation for Transport and Environment (T&E).

Table A.1
NERA Interview Programme

Airlines	Airports	Coordinators	Industry Associations
Air Berlin	Aena	ACL	Airport Council International Europe
Air France	Aeroports de Paris	Aena	Association of European Airlines
American Airlines	BAA	Assoclearance	European Express Association
bmi British Midland	Copenhagen Airport	SACN	European Regions Airline Association
British Airways	Dusseldorf Airport		European Union Airport Coordinators Association
EasyJet	Frankfurt Airport		International Air Carrier Association
FlyBE	Vienna Airport		International Air Transport Association
KLM			
Lufthansa			
Ryanair			
Singapore Airlines			
Virgin Atlantic			

APPENDIX B.   LEGAL APPENDIX

B.1.   Introduction

In this Appendix, we analyse the legal issues that surround the allocation of slots at Community airports.

The structure of this Appendix is as follows:

- Section B.2 analyses the global framework governing international air services and access to airports, laid down in or explained by:

    - the Chicago Convention on international civil aviation of 1944 - henceforth: the <u>Chicago Convention</u>;

    - bilateral air agreements;

    - the position of slot allocation under the GATS framework; and

    - the International Civil Aviation Organization (<u>ICAO</u>).

    The purpose of this section is to clarify the global framework in order to determine if, and, if so which, the Community and its Member States are bound by rules set by the global framework when drafting a regulation on slot allocation.

- In Section B.3, we investigate the relationship of rules on slot allocation with other EC rules, laid down in:

    - the EC Treaty, including but not limited to the rules on competition and state aid, as well as secondary legislation, including but not limited to:

    - the Regulation on market access (Regulation 2408/92);

    - the Directive on operational restrictions at Community airports (Directive 2002/30);

    - rules on competition, and the "merger" Regulation (Regulation 4064/89, as amended); while taking into account:

    - the Proposals of 2001 and 2002, designed to amend Regulation 95/93; and

    - relevant case law.

    The objective of this section is to assess the legal framework of the EC in order to establish links between a regulation on slot allocation, and other EC rules included in the EC Treaty, and secondary legalisation.

While establishing such links, due attention will be paid to the question whether the present or a future regulation of slot allocation complements, overlaps with, or perhaps even conflicts with existing EC secondary legislation.

- Section B.4 will deal with primary and secondary trading of slots, including but not limited to:

  - the legal status of slots;

  - the permissibility of trading slots, and auctioning slots;

  - the legal value and implications of "grandfather rights";

  - the question whether changing the rules for the allocation of slots may give rise to state aid concerns; and

  - the question whether changing the rules for the allocation of slots may lead to an infringement of Article 1 of the First Protocol to the Convention on Human Rights (the "ECHR").

  In this context, we will also make a comparative analysis with other sectors, such as, the allocation of radio frequencies in the telecommunications sector.

B.2. The Global Framework

B.2.1. The Chicago Convention

B.2.1.1. Introduction

This section will examine:

- membership of the Chicago Convention, in the light of the relevance of its provisions to EC Member States; and

- the provisions which may be made applicable to or are relevant for the process of slot allocation.

We will conclude that:

- The Chicago Convention does not include provisions on slot allocation. However, it does contain conditions regarding to access to airports which may be made applicable to the process of slot allocation.

- The most relevant condition pertains to *national treatment* of air carriers.

- Enforcement of this condition is left to contracting states to the Chicago Convention. In practice, enforcement of national treatment is a matter of policy, conducted in bilateral relationships, rather than of law.

B.2.1.2.   Membership

The Chicago Convention is adhered to by 188 states world wide, so that its provisions are applied on a global level. The fifteen EC Members States are parties to the Chicago Convention, and so are the Central European Countries acceding to this convention. Hence, said states are subject to its provisions.

The Community is not a party to the Chicago Convention, but has the status of a non-permanent observer. The Commission is making attempts to enhance the status of the Community under the Chicago Convention. However, it seems to us that it is too early to anticipate, for instance, Community membership of the Chicago Convention.

The same situation also appears to apply to Community membership of ICAO. In the vast majority of the cases, ICAO Membership coincides with membership of the Chicago Convention, so that the 15 EC Member States, as well as the 10 acceding Central European Countries, are also bound by norms set by this organisation.

The ICAO Annexes to the Chicago Convention are not concerned with slot allocation, or with matters related to slot allocation. Therefore, we will not discuss the standards contained in said Annexes.

At the time when the Chicago Convention was drawn up, the problem of congestion at airports did not exist. Hence, the drafters of the Chicago Convention did not address this point. However, we will analyse a number of provisions of the Chicago Convention which are liable to affect the regulation on slot allocation.

The principal provisions of the Chicago Convention relevant for slot allocation are:

- Article 15, giving conditions relating to *access to airports*;

- Article 68, regarding the *designation of airports and air routes*; and

- Article 11, on *the compliance with national regulations to navigation in national territory*.

B.2.1.3.   Access to airports

In principle, Article 15 of the Chicago Convention deals with the establishment of airport charges. However, its opening sentence contains a provision which is relevant for the present study:

> *"Every airport in a contracting State which is open to public use by its national aircraft shall likewise, subject to the provisions of Article 68, be open under uniform conditions to the aircraft of all the other contracting States."*

Hence, contracting States of the Chicago Convention subscribed at least to the non-discrimination principle with respect to access to airports located in their territory. Hence, all foreign aircraft - in practice, that is: in the majority of the cases: all foreign airlines - must be treated in the same fashion when flying into or departing from an airport located in the territory of a contracting state of the Chicago Convention.[127] As stated above, there are good arguments to consider the process of slot allocation as being part of the process concerning access to airports. Consequently, slot allocation has to be performed in a non-discriminatory fashion.

It could be argued that the quoted provision of Article 15 of the Chicago Convention goes one step further, that is, requiring *national treatment*. Under the national treatment principle, national authorities are required to apply the same conditions regarding access to airports granted to national carriers, on the one hand, and foreign carriers, on the other hand. This argument is based on the combined effect of the words "likewise" and "under uniform conditions".

Neither the application of the national treatment principle, nor of the non-discrimination principle appear to prevent contracting states of the Chicago Convention in practice from engaging into "positive discrimination" - that is, by granting foreign carriers a more favourable treatment than national carriers. This follows from the rules and practices applied by the United States in the 1990s, under which foreign carriers operating international air services received certain priority rights in the process of slot allocation at the so called "High Density Airports" in the US as compared with US carriers.

To grant national carriers a better treatment in respect of, for instance, slot allocation, may be allowed under the non-discrimination principle - which merely forbids discrimination *as between foreign carriers* - but not under the national treatment principle - which is designed to give *all* carriers, whether national or foreign, the same treatment, subject to the option of granting foreign carriers a better treatment than national carriers (as to which see the mentioned US practice).

Access to airports must not only guarantee equal treatment in law (*de jure*) but also in practice (*de facto*). This is the lesson, which can be drawn from several cases, which have as their object the discriminatory nature of slot allocation in the context of access to airports.

Although the provisions of Article 15 of the Chicago Convention are formulated in a general way, we conclude that its terms are sufficiently precise to be applied in practice, including to

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[127]   In practice, a slot co-ordinator allocates slots to air carriers having traffic rights at the co-ordinated airport. We will revert to the relationship between traffic rights and slot allocation in the next section.

the process of a slot allocation, being part of the process of *access to airports* covered by this article. This conclusion is especially true for the non-discrimination - or probably more accurate: *national treatment* - principle. Therefore, the substantive provisions of Article 15 are considered binding on the EC Member States as contracting states of the Chicago Convention.

B.2.1.4. Designation of airports

Contracting States of the Chicago Convention are free to designate airports within their territory, which international scheduled services may use.[128]

The question relating to the freedom to designate airports in national territory - for international scheduled services - may have some relevance for the present subject. If an EC Member State has congested and non-congested airports, it may - at least in so far as international scheduled air services are concerned - refer such services to airports such as to regulate traffic within its territory.

B.2.1.5. Compliance with national regulations

For the sake of completeness, we refer to Article 11 of the Chicago Convention, stipulating compliance with national air regulations.[129] National air regulations include air regulations in general (see the cited Article 11) as well as national safety and operational rules.

Although this was not envisaged in 1944 when the Chicago Convention was drafted, it could be argued that rules and procedures with respect to slot allocation fall under the term "air regulations" as mentioned in Article 11. If that is the case, such slot rules must be applied "to the aircraft of *all* contracting States without distinction as to nationality".[130] Consequently, this provision supports our conclusion (see under *Access to airports* in Section

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[128]   See <u>Article 68</u> of the Chicago Convention:

Designation of routes and airports: "Each contracting State may, subject to the provisions of this Convention, designate the route to be followed within its territory by any international air service and the airports which any such service may use."

Obviously, this freedom is based upon the application of territorial sovereignty, as confirmed by Articles 1 and 2 of the Chicago Convention. It is not clear why Article 68 is restricted to the designation of airports used for the purpose of international *scheduled* air services only, excluding international non-scheduled air services from its scope (see the definition of air service, and international air service, given under Article 96 of the Chicago Convention), but this conclusion follows from the formulation of Article 68 in combination with Article 96 of the Convention.

[129]   <u>Article 11</u>

Applicability of air regulations

Subject to the provisions of this Convention, the laws and regulations of a contracting State relating to the admission to or departure from its territory of aircraft engaged in international air navigation, or to the operation and navigation of such aircraft while within its territory, shall be applied to the aircraft of all contracting States without distinction as to nationality, and shall be complied with by such aircraft upon entering or departing from or while within the territory of that State.

[130]   Emphasis added.

B.2.1.3), that application of national, including local airport rules, is subject to the *national treatment* rather than the non-discrimination principle.

In this context it should be noted that according to Article 307 (ex 234) of the EC Treaty,[131] the rights and obligations arising from agreements concluded before 1 January 1958 shall not be affected by the provisions of the EC Treaty. However, according to the second paragraph of this article, the Member States are under an obligation to take appropriate steps to eliminate the incompatibilities of such agreements with Community law.

B.2.1.6. Conclusions as to the application of the Chicago Convention

We conclude that:

- EC Member States are bound by the application of the *national treatment* principle when granting access to airports located in their territory to air carriers operating international air services. This principle is formulated in a sufficiently precise way in order to be applied in practice.

- The difficult point is *enforcement*. ICAO has no enforcement powers, which is left to contracting states. If a state complains of failure of application of the national treatment principle in the matter of access to airport in another country, it will - at least in practice - take recourse to the bilateral relationship governing the international services in question.

Therefore, the next section will examine the relationship between the operation of international air services in a bilateral context, and analyse the relationship between the exchange of traffic rights - forming the heart of the matter of international air services - and the process of slot allocation.

B.2.2. Bilateral air agreements

B.2.2.1. Introduction

This section will discuss the process of slot allocation under bilateral air agreements.

It will be seen that:

- there is at least an operational, and, in some instances, a legal link between the grant of traffic rights under bilateral air agreements, on the one hand, and slot allocation, on the other hand;

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[131] See in particular the two ECJ cases decided in 2000: *Commission* versus *Portugal*, C-84/98 and C-62/98, regarding Portugal's compliance with Community law pertaining to maritime agreements with third countries.

- slot allocation may be made subject to the principle designed to create a "fair and equal opportunity to compete"; and

- bilateral air agreements confirm that foreign carriers must comply with national regulations, which *may* be deemed to include rules on slot allocation.

B.2.2.2.   *The operational and policy-based relationship between traffic rights and slot allocation*

The exchange of traffic rights forms the central piece of bilateral air agreements. The grant of traffic rights in bilateral air agreements is based upon Article 6 of the Chicago Convention.[132] Whereas this provision regulated the operation of international air services, international access to airports is governed, *inter alia*, by Article 15 of the same convention (as to which see Section B.2.1.3 above).

Obviously, traffic rights can only be operated in case the airline operating the traffic rights has access to the airport or airports located in the territory of the grantor state. Hence, there is an operational link between of traffic rights - grant of access to the airspace of the other country - and access to airports.

The question, which has often been asked, is, whether the grant of traffic rights by one party to another includes access to the airport located in the territory of the grantor state. Generally speaking, the answer to this is now negative: the grant of traffic rights does not imply free access to congested and slot co-ordinated airports. However, the question must be examined on a case by case, or an *ad hoc* basis. We present the following two scenarios in order to illustrate the link between traffic rights and slots.

- When airlines want to fly into congested airports in Japan, such as Narita, the Japanese authorities are prepared to grant the necessary traffic rights, but refer the foreign airline to the Narita airport authorities in order to obtain slots - which is a virtually impossible task. Thus, the grant of traffic rights becomes obsolete, in that they cannot be exercised.

- A bilateral air agreement provides unrestricted operation of international air services by the designated airlines between the two countries (type "Open Skies"). If that agreement does not provide for slot restrictions at airports of one of the two countries, and the concerned country did not mention such restrictions before the conclusion of that agreement, the country whose airlines faces these unforeseen restrictions could claim that the bilateral air agreement proceeds from free and unrestricted trade. Hence, the imposition of unforeseen (at the time of the conclusion of the agreement) slot restrictions infringes free trade of international air services

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[132]   Article 6: *Scheduled air services:* " No scheduled international air service may be operated over or into the territory of a contracting State, except with the special permission or other authorization of that State, and in accordance with the terms of such permission or authorization."

agreed upon by the two countries. In particular, the country whose airlines are affected by such restrictions may appeal to the clause on "fair and equal opportunity to compete" in bilateral air agreements may be invoked (as to which see Section B.2.2.5).

B.2.2.3.   Bilateral clauses on slot allocation

The US-Canada agreement of 1995

In 1995, the Canada and US concluded an Air Transport Agreement. The agreement contains an annex 2, which gives rules on the slot allocation mechanism applying to Canadian carriers at three US "High Density Airports", namely, Chicago O'Hare, New York La Guardia and Washington National Airport.

These rules provide for the following:

- Subject to certain exceptions provided in the Annex, Canadian airlines enjoy *national treatment* at Chicago O'Hare and New York La Guardia, that is, the same treatment as US airlines operating intra-US services to and from these airports.

- Access to Washington National Airport is given under the following conditions:

    - Canadian airlines are subject to the rules applied to access to this airport, including the so-called "perimeter" rule;

    - US carriers are not allowed to start non-stop operations from this airport to a point in Canada unless and until a Canadian airline inaugurates a non-stop service from a point in Canada to Washington National Airport; and

    - other conditions pertaining to customs, immigrations and the non-discrimination principle set out in Article 15 of the Chicago Convention.

In 1999, the US Department of Transportation issued a notice designed to amend the regulations governing take-offs and landing slots and slot allocation at certain High density Airports as a result of the "Open Transborder Agreement" between the US and Canada. That notice was necessary to codify the provisions of the mentioned bilateral air agreement and to ensure consistency between FAA Regulations governing slots and the bilateral agreement.[133]

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[133] [4910-13] Department of Transportation; Federal Aviation Administration – 14 CGFR Part 93; Docket No. FAA-1999-471, Notice No. 99-01, RIN 2129-AG50.

The US-Germany agreement of 2000

The provisions of the US-Germany agreement concluded in 2000 - including amendments of previous agreements between the two countries - are more topical and relevant for the present study.

The US-Germany agreement does not include the term "slot allocation".[134]

This issue is addressed in the following provision:[135]

> **"Article 8**
>
> 1. Each contracting party shall allow a *fair and equal opportunity* for the designated airlines of both parties to compete in the international air transportation covered by the Agreement.
>
> 2. Each contracting party shall allow each designated airline to determine the frequency and capacity of the international air transportation it offers, based upon commercial considerations in the marketplace. Consistent with this right, *neither contracting party shall unilaterally limit the volume of traffic, frequency or regularity of service*, or the aircraft type or types operated by the designated airlines of the other contracting party, *except* as may be required for customs, technical, *operational, or environmental reasons under uniform conditions consistent with Article 15 of the Convention.*
>
> 3. …
>
> 4. …
>
> 5. Each contracting party reaffirms the importance of the *principle of non-discrimination* and will take all necessary steps to ensure that there is no discrimination between its designated airlines and designated airlines of the other contracting party."

In short: US carriers receive free access to German airspace, are granted economic rights without restrictions, but the exercise of these rights is subject to:

- operational restrictions at German airports, including slot allocation; and

- national treatment of US carriers at German airports when being subject to such - and other - restrictions.

Obviously, the same conditions apply to the operations of German carriers into US airspace and US airports.

Again, "positive discrimination" may not be seen as an infringement of the national treatment principle. US carriers operating intra-US services may receive a less favourable

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[134]   See also Open Skies agreements between the US and EC Member States, which include identical or similar clauses.

[135]   Emphasis added.

treatment than non-US carriers operating international services - as to which, see Section B.2.1.3 above.

B.2.2.4.   The ECJ Open Skies cases

In the above mentioned verdict of the ECJ in the case of the *Commission* versus *Germany*, the Court pointed out the following:[136]

> "132. Thirdly, and finally, as has been pointed out in paragraph 14 above, Regulation No 95/93 on common rules for the allocation of slots at Community airports applies, *subject to reciprocity*, to air carriers of non-member countries, with the result that, since the entry into force of that regulation, the Community has had exclusive competence to conclude agreements in that area with non-member countries.
>
> 133. However, the Commission has not identified the international commitments entered into by the Federal Republic of Germany which it claims are capable of affecting Regulation No 95/93.
>
> 134. The failure to fulfil obligations with which the Federal Republic of Germany is charged in that respect therefore appears to be unfounded."

The Court's statement shows that the allocation of slots is a matter of Community competence and that individual Member States are therefore no longer free to negotiate this matter with third countries.

The question could be asked how the principle of "reciprocity" in international air policy discussions is related to the application of the *national treatment* principle.[137] If Germany wants to give less favourable treatment to US carriers than to, for instance, Community air carriers, because German carriers do not enjoy a favourable treatment in respect of slot allocation at US High Density Airports - applying the - lack of - reciprocity principle -, the US government might argue that Germany infringes the national treatment principle of the Chicago Convention. The intention of the drafters of Regulation 95/93 is apparently that the reciprocity principle - a policy principle - supersedes the legal principle of national treatment.

One may wonder whether this provision of Regulation 95/93 - concerning the application of the "reciprocity" principle – is compatible with the above discussed provisions of the Chicago Convention. However, such issues are more often determined by policy than by legal arguments; this point is also discussed in the next section.

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[136]   Emphasis added.

[137]   See Article 15 of the Chicago Convention, and Section B.2.1.3 above.

B.2.2.5.   *The condition on the grant of a "fair and equal opportunity to compete"*

The above quoted Article 8(1) provides that Germany and the US must allow the carriers designated by them under the agreement *a fair and equal opportunity to compete* when operating the agreed services.   The provision is a standard provision in Open Skies agreements as well as in many other bilateral air agreements.

This provision has never been subject to interpretation in legal proceedings, but it has been invoked in a policy context, including in the context of slot allocation. A state party to an Open Skies agreement can use the provision in order to have access to airports in the other country for the benefit of its designated carriers. If slots are refused in the other state, a state can argue that its designated carrier does not have a "fair and equal opportunity to compete" with carriers of the other state.

Obviously, this article is formulated in general terms. Special provisions on the matter of slot allocation may supersede it, that is, *if* they are included in the agreement.

In the Open Skies cases, the Commission argued – we believe rightly so – that this clause can be applied to slot allocation. The clause obliges EC Member States to grant "the other party's designated air carriers access to the necessary airport facilities, such as, specifically, slots, on non-discriminatory terms." However, Advocate General Tizzano noted that the Commission had not supplied sufficient evidence for its claim that the above clause also applies to the allocation of slots. The ECJ did not discuss the argument made by the Commission regarding this point.

Although the clause has never been subject to interpretation by a court or a judiciary instance, parties to a bilateral air agreement do invoke it in a policy context, that is, during negotiations. Its meaning is therefore subject to interpretation by policymakers rather than courts.

The meaning and application of this clause varies according to the market circumstances, as regulated or liberalised in bilateral air agreements. Hence, we must make a distinction between agreements imposing no restrictions *a priori* upon the economic operation of the agreed air services, and agreements imposing such restrictions, for instance, in the field of pricing and capacity.

As noted above, we believe that the clause can be applied to the process of slot allocation. If a country imposes heavy conditions on the allocation of slots to airlines flying under bilateral agreements containing the above clause, the airlines, or the countries designating them, could claim that the slot restrictions and conditions affect the balance upon which they concluded the agreement. Also, airlines coming from developing countries, and new entrant airlines, might argue that a new set of conditions pertaining to slot allocation, for

instance, in the field of pricing,[138] might appeal to this clause when identifying such restrictions and conditions as unfair and unequal opportunities to compete with other airlines, as the new – slot restricted and conditioned – situation puts them in a disadvantageous situation vis a vis other, including incumbent airlines. Last but not least, the US might put forward that, if the Community imposes new restrictions on slot allocation upon its (US) carriers, it will reconsider the preferential treatment EC carriers currently enjoy under the present US slots regime, while invoking the above clause.

B.2.2.6.   Compliance with national regulations

Finally, the mentioned Open Skies agreement includes a requirement pertaining to compliance with national, including local, regulations.[139] This requirement is a standard provision in bilateral air agreements and is based upon, but not identical with, Article 11 of the Chicago Convention, which has been discussed in Section B.2.1.5.

Article 11 of the Chicago Convention not only requires that foreign aircraft and foreign operators of foreign aircraft comply with national regulations, including operational regulations, but also that they shall be applied in a non-discriminatory fashion to the operators of all contracting states of the Chicago Convention. Obviously, the non-discrimination principle laid down in Article 11 also applies to the treatment of US carriers in German territory and airspace, and *vice versa*.

B.2.2.7.   Conclusions with respect to the regulation of slot allocation under bilateral air agreements

Since the 1990s, bilateral agreements either by direct (see the Canada-US agreement of 1995) or by indirect (see Open Skies agreements) reference, are concerned with slot allocation so as to clarify the economic and operational value of traffic rights traded under such agreements. Those agreements provide at least for "national treatment" for the benefit of carriers flying under their provisions.

In order to make the trade in services more transparent, it would be recommendable if bilateral air agreements include provisions on, or refer to, applicable rules on slot allocation, coming under Article 11 and 15 of the Chicago Convention. That means that states must accord national treatment to foreign carriers.

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[138]   See Section B.4.3

[139]   Article 5

(1) The laws and regulations of one contracting party relating to the admission to or departure from its territory of aircraft engaged in international air navigation, or to the operation and navigation of such aircraft while within its territory, shall be applied to the aircraft utilized by the airline or airlines designated by the other contracting party, and shall be complied with by such aircraft upon entering or departing from and while within the territory of the first contracting party."

It may be questioned whether the policy based requirement pertaining to "reciprocity" as formulated in the present version of Regulation 95/93 is in line with the international law based principle of "national treatment".

We believe that, depending on the circumstances under which the bilateral air agreement was concluded, and all other prevailing circumstances, non-EC states may invoke the clause on "fair and equal opportunity to compete" as laid down in such agreements when the Community imposes new – pricing and other - restrictions on slot allocation. This is especially true for developing countries, and countries which give foreign airlines preferential treatment in the process of slot allocation, such as the US.

B.2.3. The General Agreement on Trade in Services (GATS)

GATS applies to a limited number of measures affecting trade in air transport services only.[140] The "GATS 2000" round of negotiations does not foresee in inclusion of slot allocation in the GATS framework, so that we leave discussion of GATS outside the scope of this study.

B.2.4. ICAO

As stated above the Annexes to the Chicago Convention drawn up by ICAO do not contain standards on slot allocation. In 2000, ICAO conducted a study on the allocation of flight departure and arrival slots at international airports.[141] ICAO confirmed that its contracting states should adhere to the legal framework provided by the Chicago Convention, bilateral air agreements as well as regional and national slot allocation rules, and existing voluntary mechanisms for managing insufficient airport capacity. We refer to the sections above dealing with this framework.

B.3. The EC Framework

B.3.1. Introduction

The objective of this section is to:

- discuss the current legal framework regarding *slot allocation*, including proposals to amend these rules, and:

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[140] That is:

- aircraft repair and maintenance services;
- the selling and marketing of air transport services;
- computer reservation systems (CRS).

[141] ICAO Circular 283, and Recommendation 14, contained in ICAO Doc 9764.

- put the process of slot allocation in the *wider legal framework* of the EC in order to establish links between a regulation on slot allocation, and other EC rules included in the EC Treaty, and secondary legalisation. While establishing such links, due attention will be paid to the question whether a regulation of slot allocation:

  - complements,

  - overlaps with, or perhaps even

  - conflicts with

  EC secondary legislation.

B.3.2. The current framework

In the next sections, we will analyse the current legal framework on slot allocation, which consists of:

- Regulation 95/93 giving the rules on slot allocation;

- Council Regulation 894/2002 amending Regulation 95/93 on slot allocation, in order to maintain grandfather rights for air carriers which have not been able to use slots as a consequence of the terrorist attacks of 11 September 2001 on the US;

- *The proposal* for amending Regulation 95/93, made by the Commission in 2001 (COM(2001) 335 final of 20 June 2001) - henceforth: the Proposal of 2001; as well as:

- *The amended proposal* for amending Regulation 95/93, made by the Commission on 7 November 2002 (COM(2002) 623 final) - henceforth: the amended Proposal of 2002.

In addition, we will establish the relationship between the above rules and procedures on slot allocation with:

- the Regulation on market access (Regulation 2408/92);

- Council Directive 2002/30 on the establishment of rules and procedures with regard to the introduction of noise related operating restricting at Community airports, and:

- the competition law regime.

B.3.3. The legal framework on slot allocation

B.3.3.1.   Legal basis

Regulation 95/93 on slot allocation (as amended, as to which see below) forms the legal basis of the present process on slot allocation.

The legal basis of the Regulation 95/93 on the allocation of slots is Article 84(2), now 80(2) of the EC Treaty. The EC Council and Parliament confirmed this provision as the legal basis for Regulation 894/2002, amending Council Regulation 95/93.

All air transport legislation is based upon Article 80(2) EC; this legal basis has not been challenged.

B.3.3.2.   Definitions of slots

Under Regulation 95/93 (EEC):

A slot is defined as "the scheduled time of arrival or departure available or allocated to an aircraft movement on a specific date at an airport co-ordinated under the terms of this Regulation" (see Article 2(a)).

Under the Proposal of 2001:

A slot is defined as "the entitlement established under this Regulation, of an air carrier to use the airport infrastructure at a coordinated airport on a specific date and time for the purpose of landing and take-off as allocated by a coordinator in accordance with this Regulation" (see Article 1(2)).

Under IATA Scheduling Procedures:

A slot is defined as an aircraft movement within a set time frame (see Information presented by IATA to the ICAO World Air Transport Conference of 1994, AT Conf/4-WP/22 of 20/7/94 at 1.2).

We will proceed from the definition given under the Proposal of 2001 because we believe that this definition closely fits with the following discussion on title to slots (see Section B.4.2). A slot is an entitlement, or a right to use, airport capacity within a fixed period of time. The slot co-ordinator fixes said parameters (airport capacity and period of time), taking into account the requirements imposed by the applicable slot regulation.

B.3.3.3.   The rules on slot allocation

An EC Member State may - but is not obliged to do so - designate an airport as a co-ordinated airport or as fully co-ordinated airport in order to facilitate the operations of air carriers operating or intending to operate at an airport in its territory.

A *co-ordinated airport* is an airport where a slot co-ordinator has been appointed to facilitate operations from and to that airport.[142]

A *fully co-ordinated airport* is defined as an airport "where, in order to land or take off, during the periods for which it is fully co-ordinated, it is necessary for an air carrier to have a slot allocated by a co-ordinator".[143]

Hence, pursuant to Regulation 95/93, slots are allocated at fully co-ordinated Community airports. Designation as a fully co-ordinated airport takes place upon a thorough capacity analysis with respect to the airport in question.[144]

If a Member State designate an airport as co-ordinated or as fully co-ordinated, it must take into account the principles of:

- transparency;

- neutrality; and

- non-discrimination.

In addition to the above principles the following elements are to be taken into account:

- Council Regulation 894/2002 amending Regulation 95/93 on slot allocation, in order to maintain grandfather rights for air carriers which have not been able to use slots as a consequence of the terrorist attacks of 11 September 2001 on the US;

- *The proposal* for amending Regulation 95/93, made by the Commission in 2001 (COM(2001) 335 final of 20 June 2001) - henceforth: the Proposal of 2001, as well as:

- *The amended proposal* for amending Regulation 95/93, made by the Commission on 7 November 2002 (COM(2002) 623 final) - henceforth: the amended Proposal of 2002, fine tuning elements of the Proposal of 2001, and taking into account a number of amendments made by the European Parliament, with which the Commission agrees. However, the Commission has rejected a relatively small number of the changes suggested by the European Parliament. On the basis of the suggested and accepted changes, the Commission modified its Proposal of 2001, and incorporated them in the Proposal of 2002.

Especially the Proposal of 2001 and, to a lesser extent, the amended Proposal of 2002 contain a detailed analysis made by the Commission on the following elements, which are considered in the context of revising Regulation 95/93 on slot allocation:

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[142]   See Article 2(f) of Regulation 95/93

[143]   See Article 2(g) of Regulation 95/93

- the role of the slot co-ordinator;

- the legal nature of slots;

- allocation criteria;

- the environmental dimension;

- the role of alternative modes of transport;

- the application of the "use it or lose it" principle;

- the question of transfers and exchanges of slots;

- the definition of a new entrant; and

- enforcement and sanctions.

Since the Proposal of 2001 *explains* the above elements in the most detailed way, we will focus on this Proposal (of 2001) rather than on the amended Proposal of 2002 when referring to the explanations given by the Commission..

However, the Proposal of 2002 contains the draft regulation on slot allocation: henceforth: draft regulation on slot allocation, which is acceptable to both the Commission and the European Parliament, so that, when reference is made to the draft regulation on slot allocation, we refer to the *draft regulation on slot allocation* which is included in the Proposal of 2002.

B.3.4. The relationship between slot allocation and the wider Community framework

B.3.4.1.   Introduction

The following sections will examine the relationship between slot allocation in relation to:

- *The freedom of market access*, on which rules are laid down in Council Regulation 2408/92, providing for free access to the intra-EC market for Community air carriers, which freedom is, *inter alia*, subject to:

  - the imposition by EC Member States of Public Service Obligations (see Article 4 of Regulation 2408/92);

  - allocation of slots (see Article 8(2) of Regulation 2408/92); and

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[144]   See Article 3(3) of Regulation 95/93

- operational restrictions relating to the protection of the environment (see also Article 8(2) of Regulation 2408/92), which operational restrictions are now established by:

- Council Directive 2002/30 on the establishment of rules and procedures with regard to the introduction of noise related operating restricting at Community airports, which has as its objective to reduce noise nuisance from aircraft at Community airports.

- The application of the *competition rules* in the air transport sector may affect the allocation of slots. The Commission intervenes in the process of slot allocation under the competition law regime when it assesses requests for individual exemptions or negative clearance for eg alliances and in the context of merger control. The application of the competition law regime includes but is not limited to the following:

  - Commission Regulation 1617/93 (as amended), providing a block exemption from the EC competition rules (that is, Article 81(1) EC) on the basis of Article 81(3) EC with respect to arrangements on slot allocation at airports, and on scheduling at Community airports.

  - The application of Article 81 EC to the air transport sector in alliance cases, as a consequence of which the airlines engaged in the alliance agree upon, or the Commission imposes upon these airlines, measures pertaining to slots restrictions at certain Community airports.

  - Merger control rules (Council Regulation 4064/89, as amended by Council Regulation 1310/97) which may be applied in cases where two or more airlines merge, under which process the merging airlines may be required to surrender slots in order to restore the level playing field at one or more of the hub airports of the merged airlines.

  - Rules on the *abuse of a dominant position*. This will usually consist of favouring a national carrier. Such abuse may also be made by a national carrier (see below).

Questions concerning *state aid.* We will discuss these in Section B.4.3.6.

- The Commission's intervention in case of the assessment of requests for an exemption will fundamentally change with the coming into of force of Regulation 1/2003, as of May 1 2004. Under the new procedural regulation, the Commission is no longer obliged to take decisions on individual requests for a negative clearance or an exemption. Even though Article 10 of Regulation 1/2003 gives the Commission the power to take such decisions it will only do so if the public interest so requires. It is the Commission's stated intention to take such decisions in exceptional cases only.

Thus it is clear that the Commission will intervene to a lesser extent in the process of slot allocation.

B.3.4.2. Market access

Market access may be restricted as a consequence of congestion at Community airports, so that slot allocation becomes necessary. In order to establish the relationship between restrictions upon market access, and the process of slot allocation, the following sections briefly examine:

- the restrictions which congestion at airports and slot allocation impose upon the freedom of market access (which is the objective of Regulation 2408/92);

- slot allocation in the light of *environmental measures*; and

- the special place of *public service obligations* in the process of slot allocation.

Restrictions on market access as a result of congestion at airports and slot allocation

As stated above (see Section B.2.2.2), there is an operational link between the exercise of traffic rights and the availability of slots. Council Regulation 2408/92 and Council Regulation 95/93 acknowledge this relationship by cross-references which occur in the two regulations. See especially Article 8(2) of Regulation 2408/92, referring to the availability of slots (but not to Regulation 95/93 which did not yet exist in 1992) and Article 9(1)(b) of Council Regulation 95/93, referring to the matter of Public Services Obligations formulated in Regulation 2408/92.

We note that the Proposal for a new regulation on slot allocation, amending the present Regulation 95/93 - the Proposal of 2001, makes a number of references to Regulation 2408/92, in particular Articles 4, 8 and 9 thereof.

Moreover, market access can be limited through operational and environmental factors. We will examine whether the present Community framework on the limitation of intra-Community traffic rights is sufficiently clear on this point, by analysing the relationship between:

- Article 3 of Regulation 2408/92, providing for freedom of intra- Community operations for Community air carriers, *on the one hand*, and:

- Articles 8 and 9 of Regulation 2408/92, making room for restrictions on that freedom of market access *on the other hand*.

Whereas the present Regulation on market access (2408/92) refers to "the allocation of slots" (in Article 8(2)), Regulation 95/93 (on slot allocation) only refers to the reservation of slots

for domestic public service obligations (as to which see above), and not to Articles 8 and 9 of the Regulation 2408/92 on market access.

In the context of the present study, it is relevant to keep in mind that market access can also be restricted for environmental and operational reasons.

Restrictions on market access as a consequence of environmental measures

Both Articles 8 and 9 of the Regulation on market access deal with environmental restrictions. In its Decision regarding *access to Karlstad Airport*,[145] the Commission held that the Swedish authorities were not entitled to impose operational restorations at Karlstad airport going beyond those which are drawn up in Community law (see Directive 92/14 which has been repealed by Regulation 925/1999 - the "hushkit regulation" which has in turn been repealed by Directive 2002/30) as such restrictions hamper the freedom of market access. The Commission made it clear in its above decision that the difference between the two mentioned provisions is that, whereas Article 9 is concerned with measures of limited duration, Article 8 is related to measures of indefinite duration.

Member States may designate airports as co-ordinated or fully co-ordinated airports taking into account a *capacity analysis* of the airport(s) in question. The term "capacity" has not been defined in (Article 2 of) Regulation 95/93 but is usually understood to mean "physical" capacity.

In some Member States, in particular the Netherlands, the co-ordination of slots takes place on the basis of environmental constraints and not on the basis of shortage of physical capacity. The Commission is aware if the interpretation, and has tolerated it, perhaps while anticipating the entry into force of the draft regulation on slot allocation - as to which see the next paragraph.

In the Proposal of 2001, the Commission acknowledges the existence of environmental factors in the process of slot allocation in the following provisions:

- Article 2(n) (amending the present Article 2), giving co-ordination parameters, including "operational and environmental factors";

- Article 3(3) (amending the present Article 3), taking into account "environmental constraints" in the context of establishing a capacity analysis of the airport to be (fully) co-ordinated;

- Article 6(1), also identifying (operational and) environmental constraints as "coordination parameters"; and

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[145] See Commission Decision 98/523/EC of 22 July 1998.

- Article 8a(3), restricting or denying transfers or exchanges of slots in the light of "technical, operational and environmental constraints".

In conclusion, the environmental factor is considered as being an important element in a future slot allocation process. Another question is how the "environmental factor" should be determined, and by whom, absent a coherent Community framework on environmental planning of, including noise zoning around airports. Noise zoning is at present a competence of the Member States, who must "adopt a balanced approach in dealing with noise problems at airports in their territory" (see Article 4(1) of Directive 2002/30 on the *establishment of rules and procedures with regards to the introduction of noise related restrictions at Community airports*).

Another question is how the introduction of an environmental factor into the capacity analysis required for the determination of a co-ordinated airport pertains to other provisions of EC law designed to restrict market access and to impose operational restrictions on the basis of environmental conditions. We refer to the next section.

A revised Regulation on market access should make market access subject to Community legislation based on the availability of slots, as laid down in "Community legislation on the allocation of slots" in - what is now - Article 8(2), and also, Article 9(1), when mentioning the word "congestion", so as to make clear that such (future) Community legislation provides the exclusive source for slot allocation.

Public service obligations - PSOs

The present regulation on slot allocation (95/93, Article 9(1)(b)) provides that

> "a Member State may reserve slots at a fully coordinated airport for domestic scheduled services …. on routes where public service obligations have been imposed under Community legislation."

The applicable Community legislation is Article 4 of Council Regulation 2408/92 on market access. This provision gives rules on the imposition of Public Service obligations on intra Community routes.[146]

Under the present Regulation 95/93, the cited Article 9(1)(b) does not protect the operation of cross-border PSO routes. Thus, cross-border PSO routes are discriminated against when compared with PSO domestic routes. We wonder whether there is a justification of this different treatment of cross-border PSOs.

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[146] To date, EC Member States introduced around 200 PSO's, half of which are applied to routes in France. There has been relatively little cross-border operation of PSO routes. The only examples of which we are aware are an operation by the UK licensed airline Loganair in Ireland and Strasbourg-related routes.

The Commission wishes to ensure the efficient use of capacity at congested airports by taking into account alternative modes of transport, referring to the Council's conclusion of 6 October 1999 on the revitalisation of European railways and the Council's resolution of 10 December 1999 on the promotion of intermodality.[147]

We suggest that thought could be given to the question pertaining to the justification of the protection of domestic PSO slots in the light of the availability of alternative modes of transport. Since this question is most closely related to the preservation of PSOs under Regulation 2408/92, we assume that it will be discussed if and when this latter Regulation will be revised.

We believe that the *present* regime formed by (Article 4) of Regulation 2408/92, on the one hand, and (Article 9(1)(b) of) Regulation 95/93, on the other hand, does not enhance the creation of a level playing field for the operation of intra-Community services. In our view, the combined effect of these provisions is liable to create anti-competitive effects by promoting in law and in practice the operation of certain domestic operation, without sufficient Commission supervision and control.

On 5 December 2003, the Council reached political agreement forming the basis for a common position regarding slots which receive a protected status under a new Regulation on slot allocation when Community air carriers use those slots for the performance of "Public Service Obligations" as envisaged in Article 4 of Council Regulation 2408/92.[148] We believe that the provision which the Council of Ministers agreed upon in the context of the above common position meets our concern, that cross-border PSO routes are discriminated against when compared with domestic PSO routes. The text, which the Council adopted

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[147]   See paragraph 16 of the Proposal of 2001.

[148]   See Doc. 16257/03, Proposal for a Regulation of the European Parliament and of the Council amending Council Regulation 95/93 on common rules for the allocation of slots at Community airports (draft common position). The text which the Council agreed upon in December 2003 when reaching its draft common position is in line but not identical with Article 9 of the Proposal of 2001, covering the same subject. The differences between the two formulations - that is, Article 9 of the Proposal of 2001 on the one hand and Article 9 of the draft Common Position of 2003 on the other - are so small that it seems to us that those differences do not warrant a further analysis from our side. Article 9 on Public Service Obligations as agreed upon in the context of the draft common position of the Council reads as follows:

1.   Where public service obligations have been imposed on a route according to Article 4 of Council Regulation (EEC) No 2408/92, a Member State may reserve at a coordinated airport the slots required for the envisaged operations on that route. If the reserved slots on the route concerned are not used, these slots shall be made available to any other air carrier interested in operating the route according to the public service obligations subject to paragraph 2. If no other carrier is interested in operating the route and the Member State concerned does not issue a call for tender under Article 4 (1)(d) of Regulation (EEC) No 2408/92, the slots shall either be reserved for another route subject to public service obligations or be returned to the pool.

2.   The tender procedure established in Article 4 (1) (d) to (g) and 4(1) (i) of Regulation (EEC) No 2408/92 shall be applied for the use of the slots referred to in paragraph 1 above if more than one Community air carrier is interested in servicing the route and has not been able to obtain slots within one hour before or after the times requested from the coordinator.'

when reaching its common position, aligns the provision on the protection of slots for the purpose of operating PSO routes with Article 4 of Regulation 2408/92. We note that the above common position has yet to be finalised.

B.3.4.3. *Slot allocation as a consequence of operational measures*

According to the draft Regulation on slot allocation, slot co-ordinators shall take environmental restrictions into account when allocating slots (as to which see above). Obviously, in so far as those environmental restrictions are noise related, such restrictions must be in line with the Directive 2002/30. This section briefly discusses the relationship between a regulation on slot allocation and Directive 2002/30 *on the establishment of rules and procedures with regard to the introduction of noise related restrictions at Community airports* - henceforth: <u>Directive 2002/30</u>.

On the *one* hand, (Article 1(a) of) Directive 2002/30 sets as its objective to "facilitate the introduction of operating restrictions in a consistent manner" at Community airports.

On the *other* hand, (Article 6(1) of) the draft Regulation on slot allocation - as to which, see the Proposal of 2001 - identifies "operational and environmental constraints" as "co-ordination parameters" for slot allocation at co-ordinated Community airports, without cross-references between the Directive and the mentioned draft measure. Also, the explanatory memorandum made by the Commission in its Proposal of 2001 does not refer to this Directive.

An explanation of this omission could be that the Directive was drawn up rather quickly after the termination of the dispute between the US and EC Member States concerning the admission of "huskitted aircraft" at Community airports. The Directive was adopted on 26 March 2002, whereas the Proposal of 2001 was made on 20 June (2001). This said, it might be useful to take the Directive into account when drafting a final version of an amended Regulation on slot allocation, so that Member states know which operational and, especially "environmental constraints" as "co-ordination parameters", are permissible for the process of slot allocation.

B.3.4.4. *Conclusions on the relationship between market access, slot allocation, and the imposition of operational and environmental restrictions*

Sections B.3.4.1 to B.3.4.3 above show that a number of Community measures deal with closely related subjects. We identified those measures in these sections, as well as in Sections 2.4.4., 2.4.5, B.3.3 and B.3.4. Here follows a summary of Community legislation on in relation to slot allocation, with special reference to Community measures designed to the protect environmental standards

Legal measure	Provision	Condition
Regulation 2408/92 on market access	Article 8	Market access subject to slot allocation
Regulation 2408/92	Article 8	Restrictions on market access for the protection of the environment
Regulation 2408/92	Article 9	Restrictions on market access because of temporary environmental problems
Regulation 95/93	Article 6	Availability of "capacity" for slot allocation, including environmental capacity?
Directive 2002/30 on noise related restrictions	Article 4(2)	Introduction of "various measures" designed to protect the environment[149]
"Proposal of 2001"	Article 5(1)(a)	Recognition of "environmental concerns" as a guideline for slot allocation
"Proposal of 2001"	Article 6	Operational and environmental constraints as parameters for slot allocation
"Proposal of 2001"	Article 8(6)	Cross-reference to Article 9 of Regulation 2408/92, indicating a preference for the use of other means of transport
"Proposal of 2001"	Article 8a(3)	Refusal of transfer of slots because of environmental considerations

We believe that the relationship between the said measures is not always clear. Moreover, this relationship could be made more explicit by, for instance, the introduction of cross-references between the measures in question.

The draft regulation on slot allocation, included in the Proposal of 2001, makes cross references to Articles 4, 8 and 9 of Regulation 2408/92 on market access. However, we note that the draft regulation on slot allocation applies to *all* carriers, whereas Regulation 2408/92 only applies to *Community air carriers*. Depending on the relationship between Community law and international law, Community air carriers may be subject to a regime, which is different from that which applies to non-Community air carriers. This is especially relevant for the application of Articles 8 and 9 of Regulation 2408/92.

It seems to us that the application of the *national treatment* principle imposed by international air law (as to which see Section B.2.1.3) requires the establishment of a coherent and transparent framework for all carriers using Community airports.

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[149] It is not certain whether the measures to which this Directive refers include or exclude slot allocation. Article 2(g) defines a "balanced approach" towards noise problems in such a manner that Member States "shall consider the available measures to address noise problems". On the one hand, it could be argued that slot allocation is such an available measures. See also Article 4(2) of the same Directive, mentioning "the various measures available" to address noise problems. On the other hand, it could be argued that Regulation 95/93 and the future Regulation on slot allocation contain specific rules on slot allocation in the context of protecting the environment, which takes precedence over Directive 2002/30. Ultimately, national courts will have to decide on the question, whether or not Directive 2002/30 can be said to encompass slot allocation as a measure, which is available to Member State in order to address noise problems in the context of this Directive.

B.3.4.5. The competition law regime

From ex ante *to* ex post *regulation*

The above sections gave rules on *ex ante* regulation, addressing the question how slots can be best allocated. The present section will focus on the use of slots as a competitive tool, which is subject to *ex post*, that is, competition regulation.

We will briefly discuss the following:

- Commission Regulation 1617/93 (as amended), providing a block exemption from the EC competition rules (that is, Article 81(1) EC) on the basis of Article 81(3) EC with respect to arrangements on slot allocation at airports, and on scheduling at Community airports.

- *The application of Article 81 EC to the air transport sector to alliance cases*, as a consequence of which the airlines engaged in the alliance agree upon, or the Commission imposes upon these airlines, measures pertaining to slots restrictions at certain Community airports.

- *Merger control rules* (Council Regulation 4064/89, as amended by Council Regulation 1310/97) which may be applied in cases where two or more airlines merge, or in which an airline takes over another airline. Under this process the merging airlines, or the airlines engaged in the take over, may be required to surrender slots in order to restore the level playing field at one or more of the hub airports of the airlines in question (unless the parties, including the Commission, reach agreement on the disposal of slots).

- Rules on the *abuse of a dominant position* which may be held by an airport operator. This will usually consist of favouring a national carrier. Such abuse may also be made by a national carrier (see below).

- We will examine the question of *state aid* in the context of slot allocation in Section B.4.3.7.

Exemption of consultations on slot allocation from competition rules ex Article 81 EC

Commission Regulation 1617/93 exempts the consultations on slot allocation from Article 85(3) (now 81(3)) EC), as such consultations can improve the utilisation of the airport capacity and airspace, facilitate air traffic control and contribute to the spreading of air transport services at the airport in question (see Preamble no. 6).

Regulation 1083/1999 amended the above Commission Regulation, extending the exemption till 30 June 2001. Because no agreement had been reached on an amendment of Regulation 95/93, and the reasons for the exemption still apply to the present conditions

under which slots are allocated, it was necessary to extend the exemption once more, that is, until 30 June 2004.[150]

The application of Article 81 EC to the air transport sector to alliance cases

When approving an inter-airline alliance case under competition law provisions, the Commission has required parties to dispose of slots as one of the remedies.

For instance, the Commission has done so in the following cases:

- *Increase of frequencies on the route London* (*Heathrow*) - *Brussels* (Commission Decision 92/552 of 21 October 1992). In this case, Belgium asked the Commission to compel the UK to deny an increase in frequency to British Midland, on the route London (Heathrow)-Brussels, because the Belgian carrier Sabena could not obtain slots vat London (Heathrow) as reciprocity. The Commission held that the UK was entitled to authorise the increase in frequencies, but it should improve the offer of slots to Sabena as swiftly as possible.[151]

- *Lufthansa/SAS* (Commission decision 96/180 of 26 January 1996), in which the Commission granted an exemption to the alliance between the two airlines from Article 81(ex 85) EC on condition that the airlines in question ceded a substantial number of slots (as much as 225 slots per week). The Commission found that the alliance would have reduced or even eliminated competition on a large number of routes between Germany and Scandinavia. Hence, if a carrier would want to start services on one or more of such routes, Lufthansa and SAS would be required to give upon slots to that new entrant airline, if this new entrant airline would not be able to obtain slots in the normal procedure of slot allocation.[152]

- *BA/AA*, proposed Commission Decision,[153] under which BA and AA would be required to surrender slots on routes other than hub-to-hub routes, to a maximum of 267. In this decision, the Commission found that, in order to ensure that sufficient slots are available to permit effective competition, BA and AA would be required to dispose of slots at the relevant congested airports (London Heathrow and London Gatwick).

- *In Austrian Airlines/Lufthansa,* the two airlines agreed to make slots available to a new entrant for any particular Germany-Austria city pair, up to a maximum of 40 per cent

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[150] See Notice published (in OJ C 107 of 7 April 2001) pursuant to Article 5 of Council Regulation (EEC) 3976/87 on the application Article 81(3) EC to certain categories of agreements and concerted practices in the air transport sector. In 2002, the Commission has drawn up a Preliminary Draft Regulation amending Regulation (EEC) No 1617 as regards consultations on passenger tariffs and slot allocation at airports, in which the Commission proposes to extend the date of application of the regulation till 30 June 2005.

[151] Commission Decision 92/552 of 21 October 1992, OJ L 353/32 (1992)

[152] Commission Decision 96/180 of 26 January 1996, OJ L 54/28-42 (1996)

[153] See, Commission notice *concerning the alliance between British Airways and American Airlines*, OJ C239/10 (1998)

of the slots the parties operated on the city pair in question at the time of the notification of their co-operation agreement.[154]

Here are some general and preliminary conclusions, although it must be stressed that decisions are made on a case to case basis:

- the airlines in question must give slots up without compensation;

- slot remedies apply for the duration of the exempted alliance, as laid down in the Commission Decision;

- the exempted airlines are allowed to select carriers, which are new entrants on routes for which they give up slots;

- new entrant carriers must attempt to obtain slots through the normal slot allocation procedures, before requesting slots from the alliance partners;

- if alliance partners must give up slots, such slots may be specified in terms of timing, and other criteria; and

- new entrants may only use slots for the operation of routes, which are subject to competition concerns as a consequence of the alliance in question.

As to the relationship between the general competition law regime, on the *one* hand, and the special regime on slot allocation, provided by Regulation 95/93 (as amended) on the *other* hand, we refer to Preamble 15 of Regulation 95/93. Preamble 15 states that the provisions of this regulation shall be applied "without prejudice to the competition rules of the Treaty, in particular 85 and 86." We believe that 8b(2) of the Proposal of 2001 clarifies the role of competition authorities under a new slot regulation.[155]

Slot allocation measures in the context of mergers and take-overs

The Commission follows a similar pattern in regard to the use of slots as a competitive tool when applying the merger regulation. Here are some cases in which the Commission requested airlines to give up slots in the process of merging.[156]

- *KLM/Alitalia* (Case IV/M.0019), under which KLM and Alitalia were requested to surrender slots at specified airports on specified Holland-Italy routes, so as to allow

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[154] See also, Commission Decision COMP/37.730 of 5 July ()J L 242/25-42 (2002)

[155] "The present Regulation shall not affect the powers of public authorities to require the transfer of slots between air carriers pursuant to Articles 81 and 82 of the EC Treaty or Regulation 4064/89. These transfers can only take place without monetary compensation."

[156] On 19 September 2001, the German competition authorities required Lufthansa to give up three daily slots at Frankfurt airport as a condition of allowing its acquisition of a 24.9 per cent stake in the regional airline Eurowings, with an option to buy another 24.1 per cent. The low-cost competitor Germania has used the slots.

new entrants to enter those routes. The Commission held that the undertakings regarding the surrendering of slots by the two airlines remained valid until a new entrant carrier had operated 13 weekly frequencies for at least four consecutive traffic seasons on the contested routes.

- *United Airlines/US Airways* (Case M.2041) under which United Airlines agreed to give up slots for transatlantic flights at the airports of Frankfurt and Munich. This undertaking was also made subject to the proviso that the new entrant carrier had operated a new or additional competitive service for at least four traffic seasons.

The draft Regulation on slot allocation (see Article 8a(1)(b)) also provides for the transfer of slots between parent and subsidiary companies,[157] between subsidiaries of the same parent company, and between carriers engaged in mergers or acquisitions. We believe the terms related to transfer and exchange mentioned in these provisions are not be understood as "trade" so that the concerned transaction may not be accompanied by payment of money.

The application of Article 82 EC to the control of slots by an airport operator and an airline holding a dominant position at a Community airport

The abuse of a dominant position is liable to arise in cases where the operator of an airport seeks to alter slots to the benefit of its main customer-airline. Hence, the operator would infringe Article 82 EC. The fact that the allocation of a slot to the airline would involve the reorganisation of other slots would not constitute a valid justification of such a refusal because the operator of the airport as the operator of an "essential facility" is expected to go to provide market access, that is, airport access, on a fair and non-discriminatory basis.

The operator of the essential facility must carry the burden of proof that it provided equal access to all users of the facility. The operator of an essential facility is deemed to go far in order to accommodate the requests for access made by its users.

The above flows from cases, which have been decided upon in the context of access to ports. We mention the following:

- *Holyhead II* (OJ L55/52 (1994));[158]

- *Rodby-Puttgaarden*;[159]

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[157] A special case concerns the transfer of Sabena's slots after its bankruptcy in 2001 to its 100 per cent daughter company DAT. It was agreed with the liquidator that DAT would receive the use of all the slots held by Sabena. Slots were not sold, but DAT took over the use of all slots previously allotted to Sabena. This transaction caused some concern to the Commission/DG TREN, but the Commission has now approved the said transaction. DAT must progressively return the slots to the slot pool in the winter season 2001/2001. Moreover, DAT must give back all remaining slots it has not used.

[158] Commission's Report on Competition para. 219 (1992)

[159] OJ 1994, L 55/52

- *Elsinore;*[160]and

- *Roscoff;*[161]

We are not aware of case law concerning the abuse of a dominant position in the context of slot allocation in the aviation sector, but believe that the above decisions can be applied - *mutatis mutandis* - to the operation of airports, while taking into account the mentioned elements for the application of Article 82 EC.

Equally, a parallel can be drawn between airports favouring certain airlines (mostly the main customer-airline) in the matter of slot allocation, on the *one* hand, and in the matter of the imposition of charges, on the *other* hand.

We refer to the following cases:

- Commission Decision 1999/198 of 10 February 1999,[162] relating to a procedure pursuant to Article 8[2] of the EC Treaty, regarding *airport charges at Finnish airports.* At Finnish airports, domestic flights benefited from a discount of 60 per cent as compared with intra-Community flights, for no objective reason. The Commission held that Article 8[2] EC applied to airport operations through Regulation 17/62/EEC rather than through Regulation 3975/87 as amended. There is no justification for the imposition of differentiated landing charges because that would result in applying dissimilar conditions for equivalent landing and take-off services. The Finnish system is therefore discriminatory and distorts competition on the relevant markets, contrary to Article 8[2] EC.

- Commission Decision 95/364/EC of 28 June 1995 regarding *landing fees at Brussels airport.*[163] This airport applied a system of stepped discounts, which increases with a high volume of traffic. The charging system at Brussels airport favours airlines with high volume of traffic at Brussels Airport, and places small airlines at a competitive disadvantage. Hence, Brussels Airport abused its dominant position in the relevant market by introducing the above system of stepped discounts.

- Commission Decision 1999/199/EC of 10 February 1999 was also related to a system of discounts on *landing charges in use at Portuguese airports,*[164] and the differentiation of those charges according to the origin of flights. The Commission argued that the

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[160] Commission Press Release, IP 96/205 of 6 March 1996

[161] Commission Press Release, IP 95/492 of 16 May 1995

[162] OJ L 69/24-30 (1999)

[163] OJ L 216/8-14 (1995)

[164] OJ L 69/31-39 (1999). The ECJ dismissed an action brought by Portugal for annulment of this decision (see C-163/99; (2001) ECR I 2613).

Portuguese charging system is incompatible with Article [86](2) read in conjunction with Article 8[2] EC.

- See also: Commission Decision 98/513/EC of 11 June 1998 regarding the application of commercial fees at discriminatory rates at *Aéroports de Paris* to the supply of *ground handling services.* The Commission held that the fee system distorted completion on the relevant market, and was contrary to Article 8[2] EC.[165] France lodged an appeal against the decision. Both the Court of First Instance[166] and the Court of Justice[167] rejected the arguments of the French government.

- According to us, it is questionable whether Article 82 EC will apply to the conduct of airlines in relation to slots. It is, *first* of all, unlikely whether the incumbent airlines holding slots at their hub airports will have a dominant position. We believe that the market for air transport services is the relevant market, as there is not (yet) a market for slots which are not (yet) tradable. *Secondly*, it is debatable whether the incumbent airlines abuse their dominant positions at such airports by hampering transfer of slots, or refusing such transfers. The European Court of Justice never ruled on the question of essential facilities in the air transport sector. We base our views in this regard on the decision of the ECJ in the *Bronner* case of 1997.[168]

Conclusions with respect to slot allocation in the context of the competition law regime

The process of slot allocation, as a special regime of Community law, is subject to the general framework regarding competition law. The Commission has made this relationship clear in a number of decisions.

Slot disposal (by airlines engaged in an alliance, merger or take over) and slot allocation (to new entrants) are the most important remedies the Commission uses in the competition law related cases. Whether or not slot related measures are appropriate and efficient must be assessed on a case by case basis.

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[165] OJ L 230/10-27 (1998)

[166] Case T-128/98, [2000] ECR II-3929

[167] Case C-82/01 P, [2002] ECR-I-9297

[168] Case-7/97 [1998] ECR I-7791. In this case, the court held that the refusal by a press undertaking holding a very large share of the daily newspaper market in a Member State and operating the only nationwide newspaper home-delivery scheme in that Member State to allow the publisher of a rival newspaper, which by reason of its small circulation is unable either alone or in cooperation with other publishers to set up and operate its own home-delivery scheme in economically reasonable conditions, to have access to that scheme for appropriate remuneration does not constitute an abuse of a dominant position within the meaning of Article 86 of the Treaty. For the existence of an abuse within the meaning of that provision to be capable of being established in such circumstances, it would be necessary not only for that the refusal of the service comprised in home delivery to be likely to eliminate all competition in the daily newspaper market on the part of the person requesting the service and for such refusal to be incapable of being objectively justified, but also for the service in itself to be indispensable to carrying on that person's business, for lack of any actual or potential substitute for that home-delivery scheme.

Meanwhile, the Commission seems to adopt a more interventionist role with respect to the implementation of such remedies, inter alia, by requiring that the new entrants – to whom the airlines engaged in one of the above commercial ventures transfer slots – were unrelated to and independent from the airlines engaged in these ventures.

With respect to the abuse of a dominant position, we note that:

- Article 82 (ex 86) EC has not yet been used in the context of slot allocation, but that:

- interesting lessons can be learnt from the application of Article 82 (ex 86) to the system of airport charges/landing fees.

B.4. Primary and Secondary Trading of Slots

B.4.1. Introduction

This section examines primary and secondary trading of slots. Primary trading refers to the process under which governments transfer slots to users, that is, airlines, against payment of an amount of many which exceeds administrative costs, and which reflects the economic value of the slots. The government sells a slot, which the airline buys. Primary trading may include auctions of slots.

Secondary trading refers to transfers of slots as between airlines, which exchanges are accompanied by payment of a price reflecting the economic value of the slots.

We will examine primary and secondary trading taking into account:

- the current Regulation 95/93;

- the international legal framework governing allocation of slots; and

- the applicable EC rules.

B.4.2. Title with respect to slots

B.4.2.1.   Under Regulation 95/93 (EEC)

Airlines, and also airports have been inclined to consider slots as assets belonging to them. They argued that slots are their property, or at least that they are quasi owners.

Airlines did so because:

- slots were allocated to them; and,

- the application of the "grand father right" principle[169] allowed them to use slots for an indefinite period (subject to the use of those slots).

Operators of airports felt that slots belonged to them because they viewed them as an element of the infrastructure, which they provided as a service to their customers.

However, neither approach has been recognised in law. Slots may have been *allocated* to airlines, according to which airlines are entitled to use such slots, but that does not mean that airlines are entitled to consider slots as their property.

Regulation 95/93 does not stipulate that airlines can be viewed as owners of slots but that:

- slots are *allocated to* airlines (see for instance Article 10(3));

- slots may be exchanged between air carriers, or transferred from one air carrier to another (see Article 8(4));

- slots must be returned to the slot pool when unused (Article 10(2)); and

- air carriers "hold" slots (see Article 2(b)).

Hence, these provisions do not imply that air carriers *own* slots.

B.4.2.2. Under US law and policy

US Federal Law regulating slot allocation does not address the question of ownership of slots. Section 41714 of Title 49 of the US Code addresses the availability of slots.

The Department of Transportation authorises the use of slots. The Secretary of Transportation may grant exemptions to foreign air carriers (using Chapter 3 aircraft), from slot restrictions at so called High density Airports (other than Washington National Airport). Consequently, foreign air carriers may receive, and do receive,[170] preferential treatment vis a vis US carriers in the process of slot allocation.

The Federal Aviation Administration (FAA) stated that "slots do not represent a property right but represent an operating privilege subject to absolute FAA control."[171] This was, and we believe still is, the official standpoint in the US.

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[169] According to which an air carrier is entitled to claim the same slot in the scheduling period following the scheduling period during which that carrier used the slot; see Articles 8(1) and 10(1) and (2) of Regulation 95/93.

[170] See, for instance, Order 98-8-26 granting exemption to Scandinavian Airlines System, Docket OST-98-4021 from slot restrictions at Chicago O'Hare airport.

[171] See also, 14 C.F.R. (Code of Federal Regulations part 93, sub-part K (1968) as amended.

Consequently, the legal relationship between granter and holder of slots is similar to the regime, which is currently prevailing in the Community.

However, as the result of a number of bankruptcies and near bankruptcies among US airlines in the last two decades of the last century, slots at US airports governed by the High Density Rule were treated in practice as "assets". They were accepted as collateral by banks and as included in the estate of an airline by bankruptcy courts.

Title to slots is actually held by banks to this day, despite the proposition made by the US Department of Transportation that the economic value of slots held at US High density Airports could be extinguished from one moment to another by US authorities. Hence, this statement confirmed the public function of slots, putting private titles to slots at risk of private investors such as banks.

B.4.2.3. *Allocation and transferability of frequencies in the telecom sector*

The role of the International Telecommunications Union

If slots in aviation are defined as title to the use of a scarce resource, namely, space or infrastructure within an allocated period of time (allocated by the slot coordinator to an air carrier), slots in telecommunications can be viewed as a title to the use of another scarce resource – or medium, namely, frequencies with respect to satellites in the so called geostationary orbit for a limited period of time.

Through a coordination process, the International Telecommunications Union (ITU) grants title to the use of frequencies to its contracting states, requesting such title on behalf of and for operators established in their jurisdictions. If ITU has granted a frequency, it is entered into a register so that it is protected from – legal – inference. Operators use these frequencies for a limited period of time. The period of time is limited by the life time of the communication satellite, which is 10 to 15 years.

ITU allocates frequencies on the basis of the "first come first serve" principle to its contracting states, and not to users.

In most countries, governments allocate frequencies through licenses or authorisations. Governments award the licensee the right to provide a specific service using a particular frequency band. Under such an administrative system, governments protect the public interest against injuries competition among frequency users on the grounds that frequencies are a scarce medium.

A private law approach towards the use of frequencies

Three countries, namely, New Zealand, Guatemala and El Salvador, adopt a property rights approach to frequency allocation and use of frequencies. In 1989, New Zealand introduced

the concept of tradable rights as a substitute for administrative licensing schemes. In 1996, Guatemala and El Salvador introduced legislation expanding the idea of tradable rights. Differing from New Zealand, in both El Salvador and Guatemala all frequencies unassigned to users became subject to licensing under unrestricted tradable permits.[172]

In the Guatemala Civil Code the usufruct of a frequency includes the right to use and enjoy the property of another to the extent that such use and enjoyment does not diminish its essential substance. Since frequencies - on electromagnetic waves – are infinitely re-usable and are not destroyed or diminished when employed, the rights to use are considered as quasi property rights in the radio spectrum.

The 1996 code of Guatemala confirms that such rights may be:

* used;

* sold;

* subdivided, or

* consolidated

for a limited period of time, that is, fifteen years. Extensions are possible.

If there are more applicants applying for the same frequency, the competent governmental authority organises an auction.

The right to use (*usufruct*) frequencies under the code of Guatemala is not subject to an operating licence, but a right to use the radio spectrum. The users do not own the spectrum itself.[173] A right to use airwaves constitutes a *generic entitlement*. The governmental interest is to define the boundaries of that entitlement such that others may equally enjoy their rights. Enjoyment of entitlement may also be subject to certain limits on outputs, such as noise ratios. Interference and conflicts among frequency users could be handled through access to tort law, that is, in private law procedures.[174]

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[172] See, Pablo T. Spiller and Carlo Cardilli, *Towards a property rights approach to communications spectrum*, 16 Yale J. on Reg. 53.

[173] See, Article 121 of the Constitution of Guatemala, which assigns the property of the radio waves to the State (along the lines of water masses, air space, subsurface, including minerals.

[174] See, Thomas W. Hazlett and Giancarlo Ibarguen, *An Experiment in Airwave Ownership: Spectrum Liberalization in Guatemala*, (unpublished) paper delivered to the Association for Private Enterprise Education Annual Meetings, Cancun, Mexico (April 9, 2002)

Allocation and transferability of frequencies under EU law

<u>Expansion of telecommunication systems</u>

In the context of the expansion of Universal Mobile Telecommunications Systems (UMTS) across Europe, the European Commission pointed out that some of the major technical and economic, that is, cost-related, difficulties result from legal and regulatory problems. Of particular relevance was the relatively wide discretion left to EC Member States regarding license conditions, as well as conditions for deploying networks. In relation to the present study, the two following questions are relevant:

- can licences be transferred;

- can frequencies be traded?

<u>Transfer of licenses</u>

Under the current EU Licensing Directive (97/13), which Directive 2002/21, mentioned below, will repeal by the 25th of July 2003, some EU Member States expressly prohibit license transfers, while others allow licenses to be transferred, subject to certain conditions that vary from Member State to Member State. Under Directive 2002/21, users of frequencies must always notify to the national regulatory authority its intention to transfer rights to use of radio frequencies.[175]

National authorities must remedy harmful interference between users of frequencies.[176] We point at the difference with the private law approach towards the resolution of harmful interference adopted by the countries mentioned above.

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[175] See Article 9(1) of Directive 2002/21

[176] See Article 9(5) of Directive 97/13

Frequency trading

Under EU Directive 2002/20 (to be implemented before the 25th of July 2003), Member States "may" make provision for undertakings to transfer rights to use radio frequencies with other undertakings. However, Member States must ensure that such transfers are notified to the competent national authority, and that undertakings respect applicable procedures.[177] Directive 2002/20 refers to "the rights of use for radio frequencies". Said rights of use are subject to a grant, and an "authorisation" made by a Member State.[178] No mention is made of whether transfers of rights may be accompanied by monetary payments.

Directive 2002/20 appears to leave the door open for auctions. The Preamble (consideration 22) states that, where the demand for radio frequencies in a specific range exceeds their availability, "appropriate and transparent procedures should be followed for the assignment of such frequencies in order to avoid discrimination and optimise use of those scare resources."[179] However, Directive 2002/20 does not include the term "auction". Said procedures are to be conducted on the basis of selection criteria, which must be objective, transparent, non-discriminatory and proportionate.[180]

Meanwhile, almost all Member States are using auction systems to award licences.

Imposition of fees and charges

Member States may recover administrative costs from users for the costs of granting authorisations. Moreover, Member States may allow the imposition to users of fees for the rights of use of frequencies. Such charges and fees shall be objective, transparent, non-discriminatory and propionate to their intended purpose.[181]

B.4.3. Primary and secondary trading of slots

B.4.3.1. *The distinction between primary and secondary trading*

Airlines hold "slots" which we defined as "entitlements" or "rights to use". National law must identify the legal meaning of the terms "entitlements" and "rights to use".

This section will examine the question of title to slots in the context of slot allocation, which may be made under a future regulation on slot allocation as "primary trading". Once slot

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[177] See Article 9(3) and (4) of Directive 2002/21

[178] See Articles 4 and 5 of Directive 2002/20

[179] See also Article 7 of Directive 2002/20, on the *Procedure for limiting the number of rights of use to be granted for radio frequencies.*

[180] See Article 7(3) of Directive 2002/20

[181] See Articles 12 and 13 of Directive 2002/20

co-ordinators have allocated slots, we will discuss the question of exchange of slots, including the permissibility of slot trading.

B.4.3.2.   Primary trading

Rights to use slots as opposed to ownership slots

We concluded above that Community law and policy - and US law and policy - do not consider airlines as owners of slots. Governments authorise the use of slots, as "public goods". This conclusion results from the following provisions:

- EC Member States are responsible for the organisation of slot allocation at airports located in their territories (see Articles 3, 4 and 5 of Regulation 95/93), and that:

- A Member State may reserve slots for certain purposes (see Article 9 of Regulation 95/93).

The Proposal of 2001 proceeds from the same point of departure, namely, that Member States are responsible for the organisation of slot allocation at airports in their territories, and contains provisions which are similar to these mentioned above.[182]

The concept of primary trading

The present system of slot allocation, including the respect for grandfather rights and the "use it or loose it rule", contains inherent barriers to entry into and exit from the aviation market. Hence, the present rules do not contribute to the creation of a level playing field for the carriers.   According to Article 4(2) EC the policy of the Community shall be in accordance with the principle of an open market economy with free competition. Furthermore, Article 3(1)(g) dictates that the Community shall establish a system ensuring that competition in the internal market is not distorted. These principles imply that the Community legislator has a duty to eliminate anti competitive effects of the present slot allocation mechanism, as indicated above.

Allowing secondary trading without restrictions would have the effect of reinforcing the unequal conditions. This effect is further amplified because, as we shall argue below, Article 1 of the First Protocol to the European Convention on Human Rights (the "ECHR") mandate compensation. For this reason, a discussion of the rules relating to primary trading of slots has to precede a discussion of the rules on secondary trading.

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[182] See, for instance, Article 8(2), last sentence "Member States may limit such entitlement of slots operated with a minimum aircraft size." , and Article 9(1): … "a Member State may reserve at a coordinated airport the slots for the envisaged operations …"

Neither EC law, nor international or national law, define the concept of "primary trading" in the context of slot allocation. We understand that the Commission envisages that the EC Member States "sell" the entitlements, or the rights to use airport capacity during a defined period of time, to airlines. We proceed from the point of view, that the term "selling" and "trading" imply that the government is not merely recovering administrative fees, as they do when granting authorisations for the use of frequencies in the telecom sector (as to which see above). "Trading" implies that governments use the pricing mechanism in order to allocate a scare resource.

Governments would receive money for the grant of such entitlements. The justification for such payment is that governments are granting a scarce resource, which has an economic value.

It would seem to us that the following options are available:

- The government *sells* for the entitlement for a certain price, to be fixed by the government, taking into account all circumstances, including the value of the slot;

- The government organises an *auction* (see telecom sector); or

- The government organises a *lottery*, under which the government does not requirement payment of a price so that this mechanism would not seem to fall under the heading of "trading" (see US practice).

Under primary trading, the airlines will be required to pay a certain amount of money to the government in whose territory the co-ordinated airport is located, in exchange for the reception of a slot. The imposition of a payment deviates from the present system under which all airlines receive slots for free from the concerned governments.

If and when the Community envisages to introduce the above concept of primary trading, we feel that the following legal parameters should be taken into account:

- *International air law related conditions.* International air law would, inter alia, require that such a measure:

  - Be *cost-related* as non-EC Governments, acting on behalf of their airlines, could argue that the application of a price to the grant of a slot by an EC government would constitute an element of the *airport charge*, which must be cost-related. The question then becomes how the application of a price for the grant of a slot can be justified as a recovery of costs made by the government. As to the legal requirements of cost-relatedness of airport charges, we refer to our discussion in Sections 2.4.2.3, B.2.1.3, and in particular, 8.3.2.

  - Be *non-discriminatory* as to the nationality of the aircraft (as to which, see Section B.2.1.3).

- Be in conformity with the principle on "*fair and equal opportunity to compete*" which is a standard clause in bilateral air agreements (see Section B.2.2.5). Non-EC governments might argue that such a measure would subject their (non-EC) airlines to a less favourable treatment in the territory of the EC Member State than the treatment provided to EC carriers in their own territory, as the non-EC government could put forward that such a payment is not due at its own airports. According to this view, the introduction of "primary slot trading" is liable to affect the balance of opportunities for the designated airlines operating services under the bilateral air agreement. Said balance is arguably covered by this clause.

- Be in conformity with ICAO policies making a distinction between *charges and taxes*. This standpoint is line with the above point of departure that levies must be cost related. According to ICAO's interpretation, charges are levies which are cost-related. Charges should be designed to remedy costs or damages, which the airlines incur. If at all, ICAO prefers charges to taxes.[183]

- Be in conformity with provisions of bilateral air agreements, which reflect, and refer to, the above measures.[184]

On the other hand, the government of the EC Member State could try to resist the above arguments by invoking:

- *Article 15 of the Chicago Convention*, stating that the EC Member States do not discriminate between EC and non-EC airlines (see Section B.2.1.3), and

- *Article 11 of the Chicago Convention*, concerning the applicability of national and local air regulations.[185] Hence, the EC Member State might argue that the introduction of primary trading falls under the application of national regulations, which is justified by this provision (Article 11 of the Chicago Convention). However, the non-EC Member state could argue that this provision starts with the words "Subject to the provisions of this Convention" which includes the requirements of Article 15 (as to which see Section B.2.1.3 above). Moreover, it is questionable whether Article 11 can be applied to the above measure, because Article 11 is designed to regulate safety of navigation in contracting states of the Chicago Convention rather than economic conditions pertaining to access to airports.

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[183] See, for instance, ICAO Doc 9579 (1991)

[184] See also Section B.2.2.2

[185] See Section B.2.1.5 and footnote 129

Furthermore, the EC Member States could, if a high degree of certainty that the mechanism will be acceptable to the main third country governments is considered desirable, raise the matter in ICAO and seek accommodation through negotiations.

If the EC would adopt a regulation establishing airport charges that are not cost related as required under the ICAO rules, such rules could be challenged according to the following procedures:

- Member States could lodge an appeal against such legislation on the basis of article 230 EC. It is not necessary for Member States to have standing that they voted against such a measure during the deliberations in the Council of Ministers.

- Private parties have two avenues for challenging such measures:

    1. They can bring an action under article 230, paragraph 4, EC, if they are directly and individually concerned. This will most probably be difficult to prove. The case law of the ECJ on standing for private parties is quite restrictive.

    2. Private parties could provoke a legal dispute and then ask the national court to ask preliminary question about the legality of the relevant regulation. Such a dispute can be easily provoked if airlines refuse to pay the charges. Member States will bring suit against these companies.

It is important to note that the ECJ in assessing whether or not the regulation is in conformity with EC law must also apply the prevailing international law obligations of the fifteen Member States. Cf. Case 21-24/72, International Fruit Company, [1972] ECR 1219.

It should be noted that such a procedure, including the preliminary ruling, may take a considerable time, likely to be three years or more.

- *EC air law related conditions.* If the Community would proceed to "primary slot trading", the following EC law related issues have to be considered:

    - the *fiscal neutrality* of the proposed measures, that is, the operation of domestic services may not enjoy a preferential treatment as a consequence of the introduction of "primary trading";

    - the principle of *free movement of services*;

    - the rules on *state aid* (see Section B.4.3.6 below);

- the prohibition of *distortion of competition*;[186]

- the strict observance of the *non-discrimination* principle;[187]

- the *proportionality* principle, under which the measure in question must be proportional with the aim to be achieved.[188]

It is, in this context, interesting to note that the Court of Justice ruled in a case unrelated to air transport but related to road transport that users on Austrian toll ways must be treated in a non-discriminatory fashion. Moreover, charges (in this case tolls) imposed for the use of the infrastructure, that is, high ways, must be related to the costs of infrastructure, and may not be used to cater for external costs, such as environmental costs.[189] The difference between road and air transport however is that the conditions pertaining to cost-relatedness in road transport is based on EC law (Directive 93/89/EEC), whereas there is no such EC based measure in air transport.[190] Nevertheless, the decision can be linked to the above-mentioned principles of the Chicago Convention and ICAO polices on the matter of cost relatedness of a charge.

The above mentioned EC rules and policy measures may allow for exemptions, which are established by law. For instance, the right of EC Member States to impose Public Service Obligations in accordance with Regulation 2408/92 (see Section B.3.4.2) is such an exemption.

B.4.3.3. Lottery

Airlines would receive slots, which are allocated by a lottery. Introduction of a lottery would be a form of "primary allocation" rather than "primary trading". Since a lottery does not involve imposition of (extra) airport charges or taxes, we limit our remarks to the following.

If non-EC airlines are required to participate to the lottery, and are not exempted therefrom because of international policy requirements (as the US government does, see Section B.2.1.3), such non-EC airlines, or their governments, might invoke the following provisions:

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[186] See Article 81 and 82 of the EC Treaty, as discussed in Section B.3.4.4.

[187] See, for instance, *Commission* versus *Portuguese Republic*, Judgement of 26 June 2001, Case C-70/99; [2001] ECR I-4845 , and Case C-447/99, *Commission* versus *Italy*, [2001] ECR I-5203

[188] See the decisions of the ECJ mentioned in footnote 187.

[189] Judgement of the ECJ of 26 September 2000, in the case of the *Commission* versus *Austria*, Case C-205/98, [2000] ECR I-7367

[190] There has been a draft Directive on airport charges, but the Council has not adopted this measure.

- *national treatment* this would practically mean complete *non-discriminatory access* to EC airports, provided by Article 15 of the Chicago Convention (see Section B.2.1.3) and confirmed by bilateral air agreements (see Section B.2.2); and

- the clause on "*fair and equal opportunity to compete*" as laid down in bilateral air agreements (as to which see Section B.2.2.5).

B.4.3.4.   Compensation to airlines for loss of grandfather rights under primary trading

If slots which incumbent airlines currently hold are made subject to "primary trading", they may - gradually - loose their "grandfather" status. Airlines may claim that they will loose entitlements under the current regulation, and that they may loose "grand fathered" slots which gained economic value due to their investments when operating such slots. Hence, they may claim compensation for loss of value, loss of entitlement and loss of possession.

Article 6(2) of the EU Treaty mandates the respect for fundamental rights as guaranteed by the European Convention on Human Rights (1950). This article of the Treaty on European Union confirms and consolidates the case law of the Court of Justice that rules that the Community and its Member States are bound to respect the principles of the ECHR. Thus, even though Article 6(2) of the EU Treaty does not have direct effect in the Community legal order the case law of the Court has created this effect.

Article 1 of First Protocol of the ECHR protects every natural and legal person against loss of possession. No one shall be deprived of his possessions except in the public interest and subject to the conditions provided for by law and by the general principles of international law.

It is established case law of both the European Commission of Human Rights and the European Court of Human Rights that, in principle, compensation must be paid in case of expropriation.[191]

There is also considerable case law indicating that the revocation of exclusive or special rights may come under the protection of Article 1 of the First Protocol of the ECHR and can thus give rise to claims for compensation.[192]

Article 8b of the Proposed Regulation of 2001 states in unambiguous terms that entitlement to slots based on grandfather rights shall not give rise to any claims for compensation in respect of any limitation, restriction or elimination thereof imposed under Community law.

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[191]   See the *James* and *Lithgow* cases, 1986, ECHR 98, 66 et seq. and ECHR 102, 89 et seq.

[192]   See the *Fredin* case judgement of 18 February 1991, ECHR 192 as well as the *Pine Valley* case, judgement of 29 November 1991, ECHR 222.

The question is whether such entitlements, based on the possession of - current- grandfather rights, can be considered as "possessions" Article 1 of Protocol No 1.

It is likely that airlines, especially incumbent airlines, will argue that their holding of grandfather rights constitute possessions in the sense of Article 1 of the First Protocol of the ECHR. Moreover, they will claim that they enhanced the economic value of such possessions by operating the air services linked to the possession of "grandfathered" slots. Hence, such incumbent airlines may put forward that they are entitled to compensation for loss of such possessions on the basis of the above provisions, the moment the Community modifies the present regime by the introduction of a more market oriented regime based on trading.

B.4.3.5.   Secondary trading

Permissibility of slot trading

In the present section we will focus on the permissibility of slot trading by private parties such as airlines, although other parties such as banks cannot be excluded.

Regulation 95/93 opened the door for private transactions between air carriers. This is in no small part due to the somewhat cryptic formulation of Article 8(4). It is clear from the wording of Article 8(4) that one carrier with another may only exchange a slot if it receives a slot in return. There has been much debate as to whether it is allowed to exchange a slot for another one involving payment of money.

Law and case law concerning slot exchanges in EC Member States

The UK High Court[193] interpreted Article 8(4) of Regulation 95/93. This court held that an airline is entitled to be allocated slots pursuant to the system of grandfather rights regardless of whether that airline intends to use them, and that the provisions allowing airlines to exchange slots permit exchanges regardless whether an airline party to the exchange intends to use them or whether financial considerations accompany the exchange.

A Dutch court adopted a less liberal view on Article 8(4) of Regulation 95/93. The President of the court (in summary proceedings) esteemed that this provision is designed to limit transfer and exchanges of slots among air carriers. The term "transfer" includes "tender" and "give use of" slots. According to the President, the private exchange of slots would

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[193]   *R* versus *Airport Coordination Ltd*, ex parte *States of Guernsey Transport Board*, judgement of High Court (Queens Bench Division) of 25 November 1999

undermine the objectives of Regulation 95/93 as well as the position of new entrant carriers.[194]

Under the present regime, it has therefore to be decided on a case-by-case basis whether the parties involved with the exchange have satisfied the requirement pertaining to exchange. A French judge may take a different view than the UK court did, and so may the ECJ, who, by the way, has not been confronted with the question.

In Spain, forbidden transfers and exchanges of slots between carriers may be punished by imposing fines.

Neither Regulation 95/93 nor the future regulation on slot allocation provide for the imposition of fines in such cases. Article 14(5) of the draft regulation on slot allocation requires Member states to impose fines if carriers do not use slots at the agreed times. It might be advisable to draw up an EC law based condition on the imposition of fines in case of non-compliance with the provision on the transfer and exchange of slots between air carriers.

Slot trading in the context of international regimes

The OECD found that secondary slot trading is liable to infringe Article 15 of the Chicago Convention (as to which see Section B.2.1.3 above), requiring national treatment and access to airports under uniform conditions for all air carriers.[195] Moreover, it could be said that slot trading affects the principle of "fair and equal opportunity to compete" which we discussed above (see Section B.2.2.5).

These points are certainly very interesting, and merit more consideration if and when the Commission will advocate slot trading.

The draft Regulation on slot allocation on slot trading

It seems to us that the draft regulation on slot allocation is designed to put an und to the uncertainty with respect to slot trading. Indeed, Article 8a entitled "slot mobility" provides the following:

> "(1)   Slots may be
>   …..
>
>   (c) Exchanged, one for one, between two air carriers where both air
>   carriers involved undertake to use the slots received in exchange."

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[194]   *Dutch Bird* versus *Transavia Airlines*, Decision of 17 July 2001, District Court of Haarlem (Number 75723/KG ZA 01-362)

[195]   OECD, *The Future of International Air Transport Policy, Responding to Global Change* 128 (1997)

Paragraph 2 provides that paragraph 1 one forms the exclusive basis for the transfer of slots. However, paragraph 1 does not say in so many words that payment of money, accompanying the exchange referred to in sub-paragraph c, above, is not permitted.

The Explanatory Memorandum does not explain this point. It does make clear, however, that any other form of transfer, including slot leases, are not allowed (see paragraph 19).

B.4.3.6.   *Limiting primary and/or secondary trading to intra-EU flights only*

Another option would be to limit any primary and/or secondary trading to intra-EU flights only. There are precedents for such an approach in the US, where international slots are excluded from slot trading at the High Density airports (see Appendix C).

In our view, limiting primary and/or secondary trading to intra-EU carriers would be possible as long as non-EU carriers are not discriminated *against*. The position of non-EU carriers should not be affected in a negative fashion as a consequence of such a measure as they could rely on the non-discrimination clauses as well as bilateral clauses pertaining to "fair and equal opportunity to compete" (as to which see Section B.2.2.5). We mentioned that "positive discrimination" (as to which see Section B.2.1.3) is allowed, and examined the situation prevailing in the US in that context.

Hence, from a legal point of view it would be helpful, but perhaps not necessary (as to which see next sentence), if primary and secondary trading would be limited to EU *carriers* operating intra-EU flights. However, the number of non-EU carriers operating intra-EU flights is fairly limited, so that the practical relevance of limiting this device to EU carriers only is equally limited.

B.4.3.7.   *Application of rules on state aid*

Under the present regime (Regulation 95/93), the airlines receive slots for free. As a consequence of the application of the principle on protecting "grandfather rights", the main beneficiaries of this regime are the so-called incumbent airlines. If a new Regulation allows for secondary trading, the incumbent airline sells something, which it received for free from its government. Hence, the question arises whether incumbent airlines benefit from state aid when the new regime, allowing for secondary trading, replaces the current regime which is based on the protection of grand father rights.

Article 1 of Council Regulation (EC) No 659/1999 of 22 March 1999, laying down detailed rules for the application of Article 93 of the EC Treaty, states that existing aid shall mean, *inter alia*:

v) aid which is deemed to be an existing aid because it can be established that at the time it was put into effect it did not constitute an aid, and subsequently became an aid due to the evolution of the common market and without having been altered by the Member State.

Where certain measures become aid following the liberalisation of an activity by Community law, such measures shall not be considered as existing aid after the date fixed for liberalisation;

This provision has been discussed in the context of the liberalisation of the telecom sector where it was argued that the granting of licences prior to the liberalisation constituted state aid. The argument was that before liberalisation licences were handed out for free whereas thereafter companies had to pay a stiff price for them. The argument has been brought to the attention of the Commission which seems not to have pursued the matter.[196]

It may also be argued that compensation for the loss of property rights in case airlines would succeed in claiming such compensation, see above, would constitute aid.

The payment of compensation can not constitute state aid under the EC state aid, because it follows from the relevant jurisprudence of the Strasbourg Court that contractual rights have to be protected and that proper compensation in case of the abrogation of such rights are mandatory. This principle is, as we discussed above, part of the Community legal order as the ECJ held in its judgement *International Fruit Company*.[197]

The grant of state aid may place the recipient airlines in a more favourable position vis a vis competitors as such subsidised airlines could outbid the non-subsidised airlines competing for slots. To the extent that state aid would cause infringement of the EC competition rules, making the grant of the aid subject to stringent conditions can solve such infringement. Hence, the decision approving the aid could condition the aid to the requirement that it will not be used in the bidding for slots. It is common practice for the Commission to attach conditions to the decision allowing a government to grant the aid so that the recipient airline will not use the aid in order to distort competition. We refer to the conditions in the Commission's decisions regarding Air France[198] and Olympic Airways[199] in 1994.

Concluding remarks as to primary and secondary trading

Public law does not recognise property rights in slots.

The definition of the term "entitlement" (see the draft regulation on slot allocation), the question of "grandfather rights" and the eventual disposal thereof, may be addressed by drawing parallels with law and practices in the telecommunication sectors, where similar issues arise.

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[196]   See Report on Competition Policy 1999

[197]   Joint cases 21-24/72, *International Fruit Company* III, [1972] ECR 1219

[198]   OJ L 254/73-89 (1994)

[199]   OJ L 273/22-37 (1994)

Interesting lessons can be learned from the telecom sector. The EU regime leaves wide discretionary powers to Member States with respect to the allocation and transferability of frequencies. Three non-EU states have adopted a more private law oriented approach to these issues than the EU regime would seem to allow.

A definition of "entitlement" may also be examined by referring to national law, including case law.

If the Community introduces trading into the process of slot allocation, a number of international and EC law related conditions, including but not limited to those pertaining to cost relatedness and the non-discrimination, must be taken into account. Moreover, such a measure may raise repercussions in the trade balance agreed upon in existing bilateral air agreements.

Slot transactions may have private elements, that is, when they are transferred among or exchanged between air carriers, but such transactions are subject to the scrutiny of public law. At present, national jurisdictions may have diverging views on the permissibility of the "trade element" in slot exchanges.

Incumbent airlines may claim compensation for loss of possession if the Community introduces a more market oriented regime, affecting the status of grandfather slots.

National law, and the future regulation on slot allocation, provide for the imposition of fines upon air carriers engaging into unlawful transactions pertaining to slots.

The draft regulation on slot allocation does not permit slot trading. Another question is whether this regulation forbids such trading.

APPENDIX C.   US EXPERIENCE OF SLOT TRADING

In the United States, for antitrust reasons, the IATA based system involving grandfathered slots and scheduling conferences does not apply. Access to most airports in the country is unconstrained. Airlines' demand for slots at airports is accommodated according to the "first come first served" principle and airlines schedule their flights taking expected delays into account.

By the end of the 1960s, however, a number of particularly busy airports were prone to excess demand and noise problems. At these airports (so-called "high-density airports), in 1969, a measure was therefore introduced limiting the number of authorised slots.[200] Airlines were granted antitrust immunity to discuss the allocation of the slots and to schedule them. Initially, this system worked well until airline deregulation brought about a large increase in the demand for slots. In the mid 1980s, this resulted in a deadlock and a new approach was needed.

This resulted in the promulgation of the "buy/sell" rule (the "Rule"). Under the Rule, the initial allocation of slots was grandfathered to the airlines that were using them, and a relatively unrestricted aftermarket in slots was permitted. From 1 April 1986, slots used for *domestic* purposes could be bought and sold by any party. Five per cent of total slots in 1986 were retained and distributed to new entrants by means of a lottery. Surrendered slots are assigned to a pool and reallocated using a lottery, but with 25 per cent initially offered to new entrants. It was emphasised by the DOT that it still "owned" the slots and that it reserved the right to withdraw the slots at any time. [201]

International slots were ringfenced and excluded from the trading system, though they are allowed to be exchanged on a one-for-one basis for other international slots (and any domestic slot may also be used for international flights). Certain other categories of slots (mainly for general aviation) were also ringfenced and excluded from the trading system. For commuter slots, the restriction was imposed that these could not be bought by the larger carriers.

Slots currently have to be used for 80 per cent of the time in a two-month period. However, they can subject to this use-it-or-lose-it rule be owned by any party, including non-airline entities. For example, regional communities have acquired slots to enhance services to their region's airports.   In addition, some airlines have mortgaged their slots to financial institutions.

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[200]   These were JFK and La Guardia in New York City; O'Hare in Chicago; Ronald Reagan National; and Newark International Airport. The restrictions at Newark were lifted in the early 1970s.

[201]   General Accounting Office (1998) *Airline Competition – Barriers to Entry Continue in Some Domestic Markets.* Washington, D.C.: GAO.

Slots are assigned a withdrawal number; slots with the lowest withdrawal numbers may be withdrawn by the FAA if, for example, more slots are needed for international flights. It is noteworthy that this possibility does not prevent, for example, the mortgaging of slots to financial institutions.

The US slot market operates principally by bilateral negotiations between airlines. In part, these are facilitated by the Air Transport Association (the trade association of US airlines), which is reported by Langner[202] to organise five to six meetings per year for all airlines to organise and facilitate slot trades. Only one-for-one exchanges are allowed at these meetings and as a result, only slot holders benefit from them. There is also an informal network between air carriers.

In addition, there are airline slot brokers who know the market and trade by telephone. However, no institutionalised broker's market has developed. Langner attributes this to the fact that the turnover volume is relatively low so that brokerage fees have to be large. In addition, the value that brokers add, for example by bringing together the transaction partners or by possessing superior information, is limited since the industry has set up its own institutional framework.

During the first six to nine months after the Rule was introduced, trading volumes were substantial. Following this initial sorting out, the market stabilised. Starkie[203] reports that by 1988, total *annual* trading of slots (including one-for-one trades accompanied by a compensation) was equivalent to more than 50 per cent of the *daily* total of slots available at the four airports.[204]

The US system has attracted much attention and a debate has taken place in recent years on the question whether it has allowed incumbent airlines to reduce competition by hoarding slots and increasing barriers to entry. It has been suggested, particularly by the General Accounting Office (GAO) that the system has failed to secure new entry into congested airports; outright sales (as opposed to exchanges) have been few in number and new entrant air carriers negligible.

In 1999, the GAO published its most recent analysis in which it indicated that at the slot-constrained airports, established airlines have expanded their slot holdings whereas the share held by airlines established after deregulation at these airports remains low.[205] The

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[202] Langner, S J (1995) "Contractual aspects of transacting in slots in the United States" Journal of Air Transport Management, Vol 2, No ¾, p151-161.

[203] Starkie, D (1994) "The US market in airport slots" *Journal of Transport Economics and Policy*, Vol 28, No 3, p325-329.

[204] Emphasis added.

[205] General Accounting Office (1999) *Airline Deregulation – Changes in Airfares, Service Quality, and Barriers to Entry.* Washington, D.C.: GAO.

share of slots held by the major established airlines at these airports between 1986 and 1999 is shown in Table C.1.

Table C.1

Percentage of Domestic Air Carriers held by Major Airlines at US High Density Airports

Airport	Holding entities	1986	1991	1996	1999
Chicago O'Hare	American and United	66	83	87	84
New York JFK	Shawmut Bank, American and Delta	43	60	75	84
La Guardia	American, Delta and US Airways	27	43	64	70
Washington National	American, Delta and US Airways	25	43	59	65

Source: GAO (1999)

In addition, fares at three of the four slot-constrained airports (O'Hare, La Guardia and Washington National) were found to be between 29 and 55 per cent higher than at non-constrained airports that serve similar communities, with the greatest differences found in short-haul markets. However, higher fares at constrained airports are not necessarily a sign of inefficiency if these higher fares ration passenger demand to the available airport capacity. No difference was found between fares at the other slot-constrained airport (New York JFK) and the comparator airports.

Others have noted that high slots holdings by incumbent airlines and little entry by new entrants may not be evidence of anti-competitive behaviour on behalf of incumbents but rather suggest the efficient use of hub airports. Kleit and Kobayashi[206] analysed slot usage at the US's most concentrated airport, Chicago O'Hare, and concluded that the evidence was more consistent with the observed concentration being the result of efficiency considerations rather than with anti-competitive behaviour.

Morrison and Winston[207] suggest that there is in fact no evidence that new entrants have fewer slots at controlled airports than at other airports once the impact of Southwest Airlines (with its strategy of avoiding congested airports) is corrected for. Their calculations show that new entrants airlines provide 8 per cent of passenger miles at slot-constrained airports and 20 per cent at airports that were not subject to slot coordination. When excluding Southwest Airlines, the share of new entrants at non-slot constrained airports falls to 10 per cent, roughly comparable with their share at slot-controlled airports.

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[206] Kleit, A N, Kobayashi, B H (1996) "Market failure or market efficiency? Evidence on airport slot usage" *Research in Transportation Economics.* Vol 4, p 1-32.

[207] Morrison, S A, Winston, C (1997) "The fare skies – air transportation and middle America" *The Brookings Review,* Fall, p42-45.

Starkie[208] notes that the apparent failure of the system to secure new entry may have been the result of any of the following arguments:

- entrants need more than just a "slot", as for significant entry onto one route, six to ten slots, allowing three to five rotations, are needed;

- entry into US airports is difficult anyway as unlike in Europe, gates at US airports are often leased to airlines, sometimes for long periods of time;[209]

- no new aggressive entry into the US airline industry has occurred anyway;[210] and/or

- the small volume of slot trades may reflect the fact that the market has reached an equilibrium.

On the basis of these points and of the Chicago experience reviewed by Klein and Kobayashi (*op. cit*), Starkie suggests that a secondary market in slots is likely to increase the efficient use of slots at congested airports. Czerny and Tegner[211] also discuss the GAO findings that incumbent airlines have increased their slot holdings at slot-constrained airports, and that prices at such airports are higher than at other airports. They too suggest that they may not be a result of market failure but of market efficiency; hub networks create positive network effects and the high prices at constrained airports may be an efficient way of allocating scarce capacity.

Among other things, the concerns about the competitiveness of the US airline industry have resulted in the Aviation Investment and Reform Act for the 21st Century (AIR-21). The Act was enacted in April 2000 and its specific objectives included improving services to small communities; and fostering entry into the airline market. To stimulate airline competition, the Act provides for the gradual phasing out of slot restrictions.[212] A number of new slots were granted immediately by means of special exemptions from the slot rules. The new exemptions granted under the Act are not allowed to be traded or transferred to other carriers. Restrictions for new entrants and additional services to small communities have also been removed. To mitigate the environmental impact from the new services, only Stage 3 aircraft are entitled to use the new slots to mitigate the environmental impacts from the new services.

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[208] Starkie, D (1998) "Allocating airport slots: a role for the market?" *Journal of Air Transport Management*, Vol 4, p111-116. See also Starkie (1994), *op.cit.*

[209] Starkie notes that more entry has been observed in the separate market for commuter slots, where requirements for facilities are minimal.

[210] Except Southwest's expansion into California and the Northeast of the US

[211] Czerny, A I, Tegner, H (2002) "Secondary markets for runway capacity" Essay prepared for the second seminar of the IMPRINT-EUROPE Thematic Network.

[212] Under the Act, slot restrictions at Chicago O'Hare airport had to be abolished by July 1, 2002, and at La Guardia and John F Kennedy airports by January 1, 2007.

The relaxation of the slot constraints without the introduction of congestion charges has however resulted in severe problems as a result of increased delays. Over 600 exemption requests were submitted and approved for new flights to LaGuardia airports (where prior to the implementation of the AIR-21 exemptions, just over 1,000 daily operations had been scheduled). By November 2000, around 300 new flights had started operating and average daily delays increased by over 230 per cent.

As a result, it was decided to limit the number of new slots that would be made available. In November 2000, the number of new AIR-21 slots was fixed at 159, and these slots were reallocated by means of a lottery.

However, it was recognised that this would not be a long-term solution and in 2001, the FAA consulted on five long-term approaches for allocating capacity at La Guardia.[213] The long-term options that the FAA consulted on were the following:

- **Congestion based landing fees.** Traditional landing fees would be supplemented or replaced entirely with a system of market-based landing fees per hour.

- **Auctioning of landing and take-off slots.** The airport or the FAA would hold an auction for a specified number of slots, and the auction would be phased in over a number of years. An example is given whereby 25 per cent of the available slots are auctioned each year, with each right valid for a period of four years. It is noted that with such a system, airport revenues at congested airports are likely to increase their traditional rate bases. A number of options are suggested to solve this problem, including scaling back bids proportionately to the ratio of airport cost to the aggregate of winning bids; offering rebates to new entrants and limited incumbents; offering discounts according to passenger volumes carried; and investment in airport capacity or environmental projects.

- **Encouraging the use of larger aircraft.** The FAA would administratively determine a minimum aircraft size requirement, and only allocate non-excluded slots to flights that meet the minimum size. To the extent that spare capacity still exists after the initial allocation, further slots can be allocated to slightly smaller planes. To establish the minimum size that would balance supply and demand, the measure would be implemented in phases, for example in four years

- **Establish a pool of slots for small community service and withdraw slots at regular intervals for reallocation to new entrants.** Under this option, a limited number (around 3 per cent of slots every year, or every two years) would be withdrawn and reallocated by means of a lottery to new entrants, in order to avoid the current

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[213] Federal Aviation Administration (2001) *Notice of Alternative Policy Options for Managing Capacity at LaGuardia Airport and Proposed Extension of the Lottery Allocation.* Published in the Federal Register of 12 June 2001, accessible via http://api.hq.faa.gov/lga/June%2012%20notice(1).pdf

"virtual denial of new access" under the buy-sell rule. It is noted that one variant of this option could be to eliminate one-way trades under the buy-sell rule, ie a prohibition on the buying or leasing of slots. It is suggested that this would prevent a carrier or other entity from retaining the long-term allocation of a slot that it does not operate.

- **Reallocation of slots under a replacement rule**. This option would establish a new rule, whereby slots would have expiration dates. Upon expiration (it is mentioned that this could be every two years), the FAA would reallocate most slots (in the order of 95-98 per cent) to incumbent carriers, and some to new entrants by means of a lottery.

The consultation period was extended after the September 11 attacks to June 22, 2002. By then, around 120 responses had been submitted.[214] Among the key ones are:

- The **Department of Justice** strongly favours slot auctions. It argues that the current trading does not function properly because airlines with market power have an incentive to outbid an equally efficient (or even more efficient) entrant for any slots offered. It suggests that slot auctions should be simultaneous (bidders should be allowed to make bids on multiple slots at once) and anonymous (to make it more difficult and expensive for an incumbent with market power to exclude a rival by outbidding it). On congestion pricing, the Department notes that it may be very hard to implement due to the difficulty of setting the correct fee.

- The **Air Transport Association of America** argues that the proposals are (i) unnecessary and (ii) flawed, unwise and unworkable. The Association argues that after the limitation of the number of AIR-21 exemptions (as described above), delays at LaGuardia have already fallen to normal levels. Furthermore, the Association submits a testimony by economic consulting firm LECG that argues that all options identified by the FAA use administrative criteria to allocate a significant portion of the available slots, and do not pay attention to the role of the secondary market. As a result, it is claimed that none of the options will result in an efficient resource allocation. In addition, it is noted that access to LaGuardia is already subject to a market-based allocation system as carriers can trade slots. It is suggested that the slot market is reasonably active and does not impose unfair or disproportionate burdens on new entrants.

- Large airlines such as **American Airlines, United Airlines, Delta Airlines and US Airways** also submitted their own responses in addition to the ATA. Each of these large airlines is opposed to each of the measures proposed by the FAA. It is claimed that the proposals are unlawful, unnecessary and will harm the public interest by

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[214] The responses can be accessed via http://dms.dot.gov/search/searchFormSimple.cfm; docket number 9854.

imposing a tax on airlines and consumers, by constantly disrupting service patterns, by discouraging investment etc.

- The **Airports Council International – North America** (ACI-NA) argues that local airport operators should have a major role in determining how allocate capacity at their airports, subject to nationally determined policy parameters. It argues that market-based mechanisms should be used to allocate capacity, supplemented by administrative measures where appropriate. It supports both slot auctions and congestion pricing, though expects that auctions will be administratively easier than congestion pricing, and will produce more predictable results since the total number of allowable operations is fixed. It is recognised that market-based mechanisms will generate new revenue streams and it is used that these be used (i) to increase capacity at the New York airports; (ii) to pay for noise mitigation projects and (iii) to use some of the proceeds for rebates to airlines based on the number of passenger enplanements.

APPENDIX D.   THEORY AND PRACTICE OF AUCTION DESIGN

D.1. Introduction

This Appendix discusses the theory and practice of auction design. It describes the complex auctions that have been carried out by the US Federal Communications Commission and others in recent years, primarily for radio spectrum.   It also provides the theoretical background to these developments, and discusses a number of issues that can arise when implementing auctions in practice.

We focus on these auctions as they may have the potential to resolve some of the difficulties (such as demand interdependencies and a large number of lots) that have previously ruled out the use of auctions to allocate airport slots. Following a brief summary of some of the relevant questions addressed by auction design theory, we provide a chronological description of the development of ascending auctions for multiple lots. This illustrates the difficulties encountered in moving from the theoretical concept of an auction design to the practical implementation of such a design. There are many steps involved in constructing a successful auction.   Finding the right design is only one such step.   It needs to be supplemented by decisions on contractual issues, informational issues and a deep understanding of the context of the auction. The chronological description illustrates how "imperfect" solutions were found and developed over time to deal with the issues arising in one particular context.

D.2. Auction Design

D.2.1. Auction Types

The auction literature[215] distinguishes between four basic types of auction for the sale of one unit:

- a first price sealed bid auction;

- a second price sealed bid auction;

- an ascending auction; and

- a descending auction.

There are different terminologies used to describe these in practice. In energy markets, a sealed bid auction is also sometimes called a "Request for Proposal" or "RfP". Sometimes these auctions are also called "one shot". Investment banking auctions are usually first price

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[215]   A standard introduction is Klemperer P, (2000), "Auction Theory: A Guide To the Literature", in *The Economic Theory of Auctions,* Elgar Reference Collection.

sealed bid auctions. Ascending auctions are often called English auctions, and descending auctions are also called Dutch auctions. Both are called multiple round auctions. A variation of a multiple round auction is a "clock" or "Japanese" auction, in which the auctioneer posts the price and the bidders say "yes" or "no". Finally, there is a so-called Anglo-Dutch auction, that is a hybrid between an ascending auction and a sealed bid auction - at some point during the ascending auction, the sealed bid phase is triggered and participants are asked to submit offers.

The introduction of multiple units requires a modification of the basic auction formats. Table D.1 below gives an overview of the main auction formats that are possible.

Table D.1
Multiple Lot Auctions

Simple sealed bid auctions	Pay your bid sealed bid auctions
	Pay bid of lowest winning bidder sealed bid auctions
	Pay bid of highest losing bidder auctions
Combinatorial sealed bid auctions	Combinatorial single bid pay your bid auctions
	Single bid generalised Vickrey auctions (combinatorial pay opportunity cost auctions)
Demand/supply schedule auctions	Demand/supply schedule auctions with payment of lowest winning bid
	Demand/supply schedule auctions with payment of highest losing bid
Simultaneous auctions	Simultaneous ascending auctions
	Simultaneous descending auctions
	Anglo-Dutch hybrid auctions
Combinatorial simultaneous auctions	Simultaneous ascending auctions with package bidding
Sequential auctions	Sequential auctions

A combinatorial auction allows bidders to bid on combinations of units instead of single units. Combinatorial auctions can be run as pay-your-bid, pay the opportunity cost of the bid and as ascending auctions.

A "demand/supply schedule" auction is one in which bidders submit demands (numbers of units) they would like to purchase over many different price points. When aggregated over all bidders, the collection of points can be interpreted as a demand schedule. The seller may have a corresponding supply schedule. The transaction would occur at the point at which demand just exceeds supply. The price paid could be the price at that point or the price at which demand is just less than supply.

Sequential auctions are auctions in which multiple units are sold over time. For each of the individual auctions, different designs are possible.

As can be seen from the table, the number of possible auction formats increases significantly when multiple units are being sold. In a similar way, the implementation problems of auctions with multiple units increase. We address these issues further below.

D.2.2. Theoretical Analysis of Different Auction Types

D.2.2.1. Optimality and efficiency

In principle, auction theory is concerned with the evaluation of auction types according to two criteria:

- efficiency - an efficient auction is, in the most basic form of the definition, a mechanism that assigns objects to the bidders who value them most;

- optimality - in contrast, optimality is concerned with the maximisation of revenues for the seller.

Even in a simple setting, the two concepts may not be the same, as the example below demonstrates.

Example: Efficiency and Optimality

Suppose that there are two bidders that bid over one object. Each of the bidders knows the range of values in which the other bidder's value falls (say they lie between 0 and 10 with equal probability for the first bidder, and between 0 and 11 with equal probability for the second bidder). Before the auction, each of the bidders gets a 'draw' from its own probability distribution. On the basis of their own draws and the knowledge they have of the probability distribution of the other bidder, the two bidders submit bids in a sealed bid first price auction.

In this setting, it can be shown that a Nash equilibrium for the weaker bidder is to bid more aggressively (a higher proportion of his value) than the bidder who has the more favourable probability distribution.[216] This behaviour will sometimes lead to an allocation of the object to the weaker bidder and is therefore ex ante inefficient in the way that we have defined efficiency. However, since the aggressive bidding shifts some of the surplus from the bidders to the auctioneer, a first price sealed bid auction has good optimality properties.[217]

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[216] See E. Maskin, J. Riley, *Equilibrium in Sealed High Bid Auctions*, Review of Economic Studies (2000), 67, 439-454 and *Asymmetric Auctions*, Review of Economic Studies (1999).

[217] However, P Klemperer, among others ('What really matters in Auction Design?', working paper, (2002)) argues that due to the possibility that a lower value bidder can win in a sealed bid auction in a Nash equilibrium, new entrants are more attracted to this type of auction.

A large part of auction theory is concerned with optimality. It draws on the theory of auction design to find mechanisms that yield the largest surplus for the seller. In the sense of revenue maximisation, one of the most celebrated auction results is the 'Revenue Equivalence Theorem'. In its simplest form, this states that under conditions of (i) no collusion; (ii) identical support for bidders; (iii) one unit for sale; (iv) risk neutrality; and (v) symmetry of beliefs, all auction mechanisms yield the same revenues for the seller. Various authors have analysed what happens when these conditions are relaxed - in general the results become much less clear-cut.[218] When the revenue equivalence conditions do not hold, the optimal auction type usually depends on the particular market structure, the cost structure, the observed strategic behaviour of bidders, and so on. In this way, auction theory provides a tool that allows the design decision to be more structured, it allows the designer to ask the right questions and gives guidance on some of the right answers.

D.2.2.2.   Secondary markets

In general, secondary markets help to make the objectives of efficiency and optimality more consistent. If bidders can trade after an auction, they can reallocate any misassigned goods to the bidder with the highest value. The consequence for an auctioneer is that it does not pay him to use a mechanism that does not allocate the good efficiently, since otherwise the bidder who wins the good in the auction and then sells it to the bidder with the highest value would extract value that the auctioneer could extract for himself. Therefore it pays the auctioneer to use mechanisms that are efficient.[219]

For this reason, the establishment of secondary markets should allay fears by airlines that an auction mechanism would be designed to be optimal but inefficient, and therefore would "exploit" airlines.

D.2.2.3.   Uncertainty and information

Uncertainty over a bidder's own values, and over other bidders' values, are elements of bidding that an auction design needs to address. The most important information-related theorem in auction theory is the so-called linkage principle. In broad terms, it states that if an auctioneer manages to reduce uncertainty for bidders, then they will bid a higher proportion of their value.

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[218]   See, for example, Holt, *Competitive Bidding for Contracts under Alternative Auction Procedures*, Journal of Political Economy, (1980), 88, 433-445, Riley and Samuelson, *Optimal Auctions*, American Economic Review (1981), 71, Milgrom and Weber, *A Theory of Auctions and Competitive Bidding*, Econometrica (1982), 50, 1089-122, Graham and Marshall, *Collusive Bidder Behaviour at a Single Object Second Price and English Auction*, Journal of Political Economy (1989), 95, 1217-1239, and McAfee and McMillan, *Bidding Rings*, American Economic Review (1992), 82, 579-599.

[219]   A good treatment of the issue can be found in L. M. Ausubel and P. Cramton, (1998), 'The Optimality of Being Efficient', working paper.

Another concern is whether the value of an object is 'common' to all the bidders (such as a good that can be resold in a liquid market), 'private' to each bidder (such as a painting by an undiscovered artist), or 'affiliated' (that a higher value by one particular bidder means that other bidders also have higher values). Again, these informational issues need to be taken into account when designing or participating in an auction.

An interesting example of an effect that could be interpreted as signs of "affiliation" occurred in the UK auction of third generation spectrum rights. A total of 13 bidders initially participated in the auction. More than 90 rounds into the auction, five bidders dropped out within a short space of time (seven rounds). The auction then continued for a considerable time after this first group dropped out. One interpretation of such behaviour would be to argue that the first group of bidders' values were affiliated. They reinterpreted their value of a third generation licence when other companies that they considered comparable decided to exit the auction.

If values are strongly affiliated, arguments exist in favour of ascending auctions, since these auctions give bidders additional information that might be termed "the comfort of others".

D.2.2.4. *Other concerns*

Other concerns of auction theory are the risk of collusion, equity, the appearance and credibility of the result, risk for bidders and several others. These concerns will be illustrated in our discussion of simultaneous ascending auctions.

As can be seen from the brief introduction above, the design of an auction, and the market for which a particular auction is intended, become significant once the simple assumptions of the revenue equivalence theorem become invalid. In the following sections, we briefly summarise auction design for single bid auctions, and then describe the development of multiple round ascending auctions.

D.3. Single Bid Auction Designs

At first sight, single bid auction designs seem attractive for a number of reasons: they are easy to administer, relatively simple to understand, very fast and bidders will find it difficult to collude.

More recently, several auction proponents, notably Paul Klemperer,[220] have argued that ascending auctions suffer from the problem that it is "obvious" who the winner is before the auction begins. Ascending auctions may therefore suffer from the problem of not attracting enough participants, with a resulting danger of low revenues due to a lack of competition.

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[220] Paul Klemperer, 'What Really Matters in Auction Design', Working Paper, 2002.

However, the main alternative - sealed bid auctions - have unappealing properties. In particular, if they are pay-your-bid (or first price) auctions, it is exceedingly difficult to compute good bidding strategies. In a sense, the simplicity of the design shifts the burden of complexity onto the bidders and their bidding strategy. Bidders need to estimate the value of the highest bidding loser in order to submit a bid that just allows them to win their desired lots.[221] A second negative property of first price auctions is that, empirically, bids often vary by extremely large amounts. Famous examples are the licences that Telefonica acquired in Brazil, where they bid several billion US$ more than the second highest bidder.

However, it appears to be the case that with (a) many units and (b) regular repetition of auctions, the problems of high uncertainty and the weak auction entry properties are ameliorated. Suppose, for example, that a sealed bid auction is repeated over regular intervals, so that the auction becomes more like a trading market. Then bidders will have the chance to learn about other bidders' valuations, they will be able to formulate more precise expectations about the winning bid, and they will have a chance to come back if they do not win the object.

Such properties apply when the same items are auctioned each time, for example because each lot confers usage rights for only a short duration. But the same properties do not apply to sequential auctions, where separate lots are sold in a series of single unit auctions. Sequential auctions have very different properties from repeated auctions - they suffer from the additional uncertainty that bidders need to decide whether they should bid early or late. The literature describes two different effects, a so-called "afternoon effect" (prices go down over time) and a "morning effect" (prices go up over time). Bidders need to consider the trade off between entering the auction late, as there may be fewer competitors, against the greater risk that they will fail to win a lot.

Several spectrum auctions have been run as sequential auctions. In particular, in Switzerland a wireless local loop auction was run in Spring 2000. Three national licences were on sale, followed by five regional licences in each of nine regions of Switzerland. Bidders who did not bid for the national licences, but waited to accumulate regional licences, fared significantly better than bidders who won national licences. And the first of the national licences was significantly cheaper than the second national licence.

When goods are complements, it can be shown that the first good sells for a higher proportion of its value than the second.[222] While the second good has additional value for

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[221] Indeed, arguably modern auction theory started with the seminal article by Vickrey ('Counterspeculation, Auctions and Competitive Sealed Tenders', in *Recent Advances in Game Theory*, Princeton University Press, 1962), who argued that there should be no difference in revenues between a first and a second price auction for a single good, but that the bidding strategies that bidders would need to compute for the first price auction would be so difficult that a second price auction is preferable. In contrast, under the conditions of the revenue equivalence theorem, second price auctions have the property that bidding one's value is a weakly dominating strategy.

[222] R Preston McAfee and Daniel Vincent, 'The Declining Price Anomaly', Journal of Economic Theory (60), 1993.

the bidder who won the first good, it has less value for other bidders and therefore competition for the second good is reduced. Holding sequential auctions can also lead to "all-pay" problems, where everyone pays but not everyone wins.[223]

An alternative approach, when there are demand complementarities between lots, is to allow conditional or "package" bidding. In sealed bid auctions with package bidding, a bidder may decide to bid different amounts for a combination of items than for the sum of these items individually. By bidding zero for individual items, but positive sums for combinations of items, bidders can ensure that they win either none or all of a particular package of lots.

There are several problems with this type of package bidding: one issue is complexity. Even with just five items, there are 31 possible packages on offer.[224] The possible number of combinations grows exponentially as the number of lots increases. Therefore the first challenge for a combinatorial sealed bid auction design is to devise an appropriate 'bidding language'. This would allow bidders to express bids in a more concise way.[225] However, with a large number of combinations, even a concise bidding language may not allow a bidder conveniently to express values for all possible combinations.

Two potential problems may arise if bidders do not express values for all combinations:

• the winning combination of bids may leave some lots unsold – not because they have zero value, but because of the complexity of submitting a bid for all possible combinations;

• the second price auction will lose its property that bidding one's true valuation is a weakly dominating strategy. Bidders would need to start thinking about the bids that others might submit, in which case participation in the auction (and formulation of a bidding strategy) becomes more complex.

The difficulty of carrying out single bid auctions where there are demand complementarities, even with package bidding, has led to the adoption of an alternative approach, using simultaneous ascending auctions (with or without package bidding).

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[223] For example, the auction held by the Italian Ministry of Communications for third generation mobile phone licences faced regulations that included a potential all-pay element. New entrants could bid for additional spectrum in an auction after the main auction – but there were only two additional spectrum blocks available. If three of the winners of the main auction had been new entrants, the regulation would have imposed elements of an all-pay auction on them. Therefore the auction design had to address this potential problem.

[224] If the items are labelled ABCDE, then the possible packages are A, B, C, D, E, AB, AC, AD, AE, BC, BD, BE, CD, CE, DE, ABC, ABD, ABE, ACD, ACE, ADE, BCD, BCE, BDE, CDE, ABCD, ABCE, ABDE, ACDE, BCDE and ABCDE.

[225] For example 'A or B or C' may be designed as a concise way of saying 'A or B or C or AB or AC or BC or ABC', which would be written as 'A xor B xor C xor AB xor AC xor BC xor ABC'. A computer program would be introduced that would 'translate' the bidder's concise bid into exclusive or (xor) bids that would be entered into the auction solver.

D.4. Simultaneous Ascending Auctions

The most significant recent advance in the implementation of auctions has been the use and development of simultaneous ascending auctions.   The US Federal Communications Commission (FCC) first used a simultaneous ascending auction for the allocation of radio spectrum in 1994, and has carried out about 40 subsequent auctions since then, during which time the design of the auction has developed significantly. Radio spectrum auctions in Austria, Germany, Greece, Hong Kong, Italy, Latvia, the Netherlands, Singapore, Switzerland, Taiwan and the UK have also used variations of simultaneous ascending auctions.

Due to this body of experience, it is possible to trace the complexities that were faced by the auction designers, and how the auction design developed over time in order to deal with those complexities. Additionally, sometimes innovations in interface design or computer communications make new auction formats feasible that had previously been regarded as too complex for bidders or for the auctioneer. This is particularly the case for simultaneous ascending auctions with package bidding (see Section D.5 below).

The basic features of a simultaneous ascending auction are usually that:

- the auction does not close until all bidding stops on all lots;

- some form of switching and substitution is allowed between lots;

- the highest bids on each lot at the each of a round (sometimes called the "provisional winners") are to some extent binding (ie there are restrictions on a bidders' ability to withdraw such bids);

- otherwise, bidders are allowed to leave the auction if the prices become too expensive.

The fundamental innovation underlying the simultaneous ascending auction is that bidders are allowed to "manage" their portfolio of desired lots. Subject to the detailed rules governing each auction, bidders can achieve this either by switching their bids between lots, or by bidding for a higher or lower number of lots than previously.

In practice, the design of a simultaneous ascending auction also needs to address a number of detailed issues. In relation to bidders' ability to change their bids between rounds, a set of detailed rules needs to state, among other things:

- whether bidders should be allowed to bid on more than one object;

- whether there are any restrictions on a bidder's ability to switch bids between rounds (including the case where all bidders switch from one lot to another);

- whether, from one round to the next, bidders should be allowed to increase the number of lots they bid for. This also covers the question of whether bidders are allowed to enter the auction in subsequent rounds if they fail to submit any bids at all in one round;

- whether there are restrictions on a bidder's ability to drop out of the auction at any stage (including the question of whether the "winning" bids in one round can be withdrawn in the next);

- what information should be revealed – both to bidders and also to non-participants - at the end of each round, including whether the identity of the current set of provisional winners (as well as the size of their bids) should be revealed.

How these questions ought to be answered depends to a large extent on the context of the auction, in particular the underlying market structure, valuation uncertainty and market player behaviour in the market that is targeted.

D.4.1. FCC #1: The first simultaneous multiple round auction for spectrum

The simplest case of a simultaneous ascending auction concerns the sale of homogeneous objects. In the auction FCC #1, 10 nationwide paging licences, that were considered to be reasonably good substitutes, were offered for sale. With these objects regarded as homogeneous, switching or substitution was allowed on quite generous terms for the bidders. Two phases of the auction were defined:

- in the first phase, bidders could switch their bids between different sets of licences, including switching to a smaller or larger set than they had previously bid for;

- in the second phase, switches were only allowed between sets that consisted of the same number of licences.

D.4.1.1.   Activity rule in FCC #1

The rule governing the switches allowed in auction is called an "activity rule". The activity rule with two phases of activity requirements, as introduced in FCC #1, follows a suggestion by Milgrom-Wilson. Activity rules may also address problems of complementarities, and also the risk that bidders will have an incentive to adopt a "wait and see" approach.[226]

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[226] Simultaneous ascending auctions may suffer from the problem that bidders would like to wait to see what prices emerge and how other participants bid before they submit their own bids. In some circumstances, bidders can benefit from hiding their intentions. Therefore, all bidders have an incentive to wait and the auction design needs to encourage bidders to bid. In a setting where it is difficult to impose an activity rule, such as in the context of internet auctions like those run by e-bay, it can often be observed that most bidding activity takes place in the last period of time before the auction closes. On e-bay, the closing time therefore represents a mechanism analogous to the activity rule of the FCC. In contrast, the FCC auctions do not impose a time of closure for the auction.

Activity rules have been used in all the simultaneous ascending auctions that have been taken place so far, and have been very successful in the context in which they were applied. However, activity rules may also introduce new problems of their own. For example, particular activity rules might prolong auctions, make (implicit) collusion between bidders easier, encourage insincere and inflated bids at the beginning of an auction, or require the closure rule of an auction to be revised. These points will be discussed in later sections.

D.4.1.2. *Bidding credits in FCC #1*

Another innovation in the FCC #1 auction was the introduction of "bidding credits". Certain entities could get bidding credits of 25 per cent, equivalent to a discount of 25 per cent on their bids (so, if successful, they would only pay 75 per cent of the amount that they bid for an item).

Bidding credits have been used throughout the FCC spectrum auctions. They have generally been given to three types of bidder: those related to "tribal land" (to encourage communications services in territories inhabited by Native Americans); for "technology pioneers"; and also for "designated entities", which are small companies that fall below a certain threshold set by reference to asset value or turnover.

The FCC's handling of bidding credits is not without its critics. In particular, in auction FCC #35 it has been widely acknowledged that large companies set up designated entities and paid indirectly for their licences. This allowed companies both to benefit from bidding credits and also to violate competition constraints on the number of licences that could be held by any bidder in a particular region (so-called spectrum caps).

D.4.1.3. *Bid withdrawal in FCC #1*

Already in FCC #1, bidders were allowed to withdraw provisional winning bids This was subject to a penalty, defined as the difference between the value of the withdrawn bid and the value of the winning bid on the licence. Such withdrawals could have an unravelling effect that could change the course of the auction, and such rules have a mixed record of success in the FCC auctions.

D.4.1.4. *Demand Reduction on FCC #1*

In the FCC # 1 auction, bidders were allowed to accumulate more than one nationwide licence, and these items were regarded by bidders as substitutes.[227] This led to the

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[227]   Ausubel and Cramton report that the winning bids for these licences were very close and this is evidence that price differences were smoothed out by bidders, since they were allowed to switch from licences with higher prices to licences with lower prices. See Lawrence Ausubel and Peter Cramton, 'Demand Reduction and Inefficiency in Multi-Unit Auctions, Working Paper, University of Maryland, March 1998.

phenomenon known as "demand reduction".[228] One of the bidders, PageNet, decided to switch from bidding on three large licences to two large licences and one small licence. PageNet thought that, if it continued to bid for a third large licence, it would increase the prices of all the large licences. Therefore, even if the price had not reached its incremental valuation for a third unit, PageNet reduced its demand for the large licences.[229]

In general, this effect is related to the nature of the auction (ie a uniform price auction for multiple homogeneous items where bidders can demand more than one unit). When bidders wish to acquire multiple units, there is a positive probability that their bid on any additional unit is going to determine the price that they will have to pay. Therefore, bidders have an incentive to bid less than their true value on subsequent units in order to reduce the price they will pay for each unit.

Therefore, despite the apparent analogy between this type of auction and a second price auction for a single item, the results obtained for the single item case do not hold for FCC #1. As the example of PageNet indicates, the property that participants should bid up to their true valuation is not valid in the more complex form of FCC #1.

D.4.1.5. Complementarities

A complementarity exists in spectrum auctions when a set of objects is worth more to a bidder than the sum of the individual objects in the set. Complementarity problems are inherent in simultaneous multiple round auctions when the objects are not homogeneous, and lead to a so-called "exposure risk" for bidders.

The natural way to address a complementarity is to allow package (or combinatorial) bids. However, as discussed in Section D.5, combinatorial ascending auctions introduce problems of their own.

For the auction FCC #1, an activity rule of "less than full activity" was introduced in order to deal with complementarities. This means that if a bidder bids on n objects in round t and the required activity percentage is r, then it will be allowed to bid on n/r objects in round $t+1$.[230] The provides bidders with a limited ability to adopt a "wait and see" approach, for example to discover how relative prices develop. Such a rule is especially useful if there are "core" and "peripheral" objects, as bidders can wait until they are reasonably certain of obtaining a core object before starting to bid on peripheral objects.

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[228] See Lawrence Ausubel and Peter Cramton, 'Demand Reduction and Inefficiency in Multi-Unit Auctions, Working Paper, University of Maryland, March 1998.

[229] Evidence that this was the reason for the reduction was provided by Peter Cramton, who was a member of the PageNet bidding team. Ausubel and Cramton quote other examples of demand reduction in other auctions.

[230] So, for example, if a bidder bids on 2 objects in round 5 and the required activity percentage is 50%, then it is allowed to bid on up to 4 objects in round 6.

While an activity rule was used in FCC #1, it becomes more important when an auction has a regional dimension. Therefore, the bidding rules were refined for FCC #3

D.4.2. FCC #3: Introducing regional elements

In FCC #3, spectrum licences in five regions were on offer (see Figure D.1). These regional licences could not be considered as being homogeneous. Therefore, in order to allow for substitutability and complementarities between lots, the auction rules needed to be amended.

Figure D.1
Regional Licences in FCC #3

PCS Auction #3 - Regional Narrowband
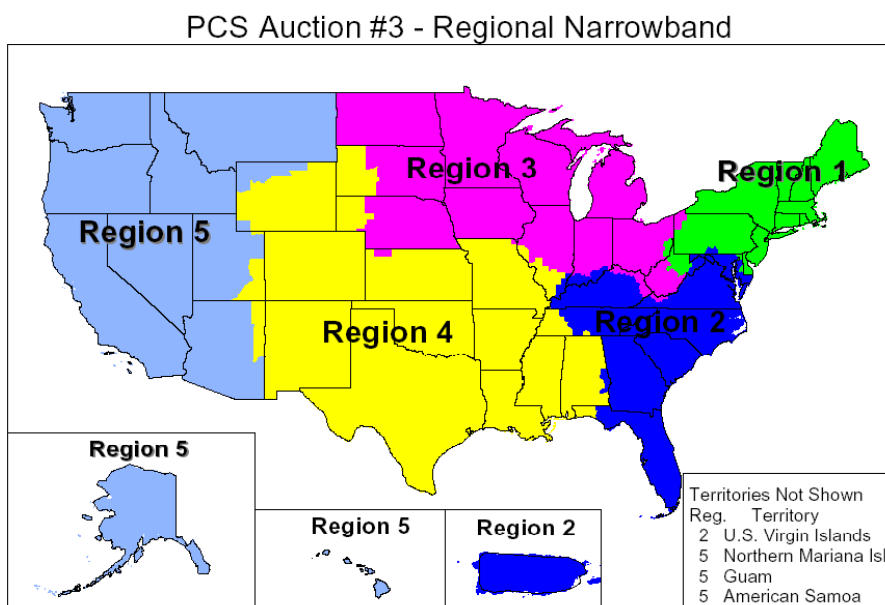
One option would have been to move to a combinatorial auction design. Instead, the auction design tried to capture the increased importance of complementarity issues by moving to an activity rule that was based on coverage and licence size (so-called MHz POPs). Before the auction, all licences were assigned POPs (or population under coverage), and the licences in each region (six per region) were assigned MHz POPs by multiplying the population under coverage by the spectrum size of the licence. The activity rule then stated that, in the three phases of the auction, bidders needed to be active on an increasing percentage of their eligibility (ie how much they were eligible to bid for in a round).

The results of this auction are presented in Table D.2.

Table D.2
Results of FCC #3

Region	Winning Bidder
Northeast	Pagemart II
Northeast	PCS Development
Northeast	Mobilemedia Pcs
Northeast	Advanced Wireless Messaging
Northeast	Air Touch Paging
Northeast	Lisa-Gaye Shearing
Southern	PageMart II
Southern	PCS Development
Southern	Mobilemedia Pcs
Southern	Advanced Wireless Messaging
Southern	Insta-Check Systems
Southern	Lisa-Gaye Shearing
Midwest	PageMart II
Midwest	PCS Development
Midwest	Mobilemedia Pcs
Midwest	Advanced Wireless Messaging
Midwest	Ameritech Mobile Services
Midwest	Lisa-Gaye Shearing
Central	Pagemart II
Central	PCS Development
Central	Mobilemedia Pcs
Central	Advanced Wireless Messaging
Central	Air Touch Paging
Central	Benbow PCS Ventures
Western	Pagemart II
Western	PCS Development
Western	Mobilemedia Pcs
Western	Advanced Wireless Messaging
Western	Air Touch Paging
Western	Benbow PCS Ventures

Source: http://wireless.fcc.gov/auctions/03/

From the results shown in Table D.2, it appears that bidders that intended to build national licences from the regional licences on offer were able to do so. In particular, the first four licences in each region went to the same companies nationwide.[231]

D.4.2.1. *Low activity requirements can prolong an auction*

One observation that emerged from the FCC #3 auction is that, if bidders are allowed to wait until the allocation of core licences has been (provisionally) decided before they bid on peripheral licences, there may be a long "tail" and the duration of the auction may become a problem in itself. This is illustrated by the pattern of bidding, as reproduced in aggregate in Figure D.2 below.

Figure D.2
Aggregate Revenue by Round for FCC #3

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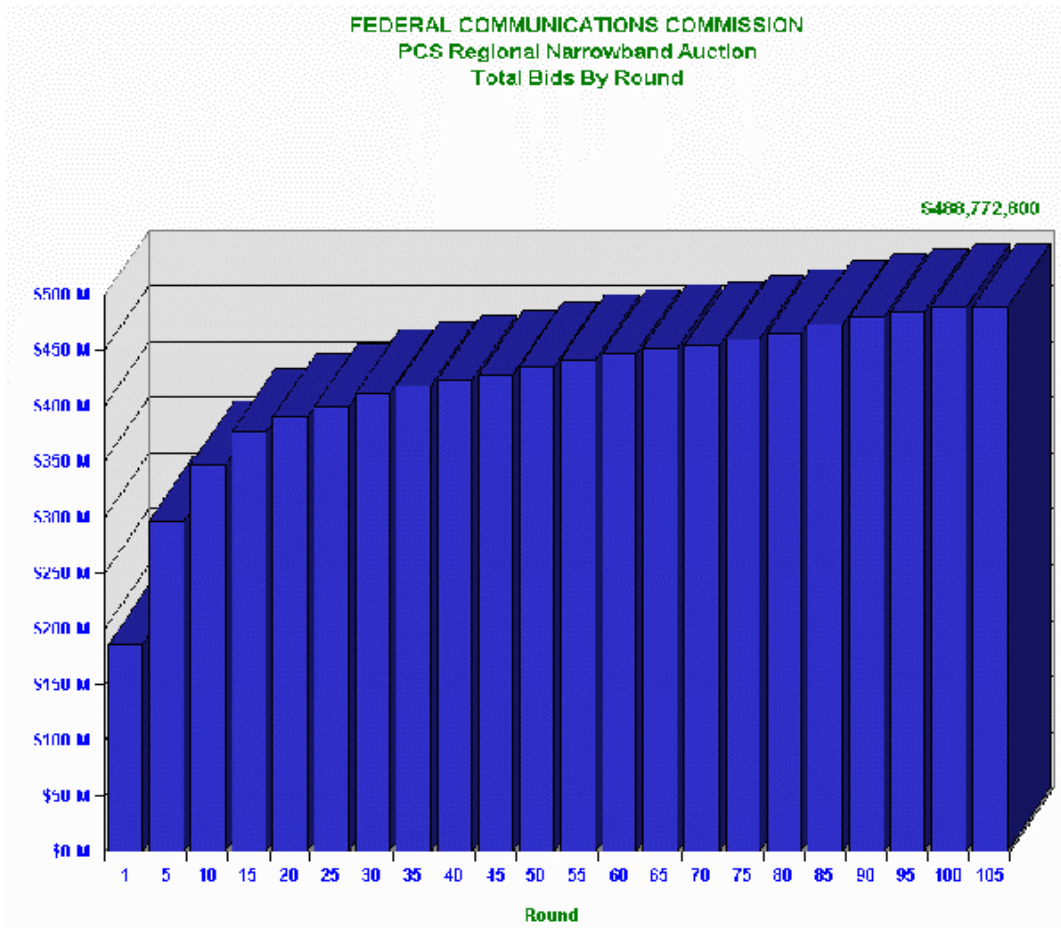
[231] However, caution is needed when evaluating the result, given the scope for strategic behaviour such as the demand reduction described in Section D.4.1.4.

As noted in Section D.4.1, activity rules that are too generous may allow bidders to wait with their bids, and also to "park" bids at the beginning of an auction on licences that they consider a low priority. This behaviour can lead to a long tail and long duration of auctions. The introduction of phases with increasing activity requirements is designed to counter the problem of prolonging auctions. However, increasing activity requirements in turn reduce the effectiveness of an activity rule to deal with exposure risks. Later additions to the design of simultaneous ascending auctions have provided additional safeguards against auctions that continue for an unreasonable amount of time (see Section D.4.5.3).

D.4.3. FCC #4: increasing the number of objects

FCC #4 could be regarded as the first experiment in expanding the number of objects on sale with essentially the same auction design. In FCC #4, 99 licences in a total of 51 MTA regions were offered for sale. This meant that the potential complementarities multiplied and that bidding became significantly more complex.

In this auction, so-called eligibility waivers were introduced. Instead of bidding in a round, bidders could take a form of "time-out" that would still leave them with the same eligibility for the following round. In each of the three phases of FCC #4, bidders were given one such waiver.

Another significant innovation in FCC #4 was the introduction of a "tracking tool" for bidders. From a implementational point of view, it is probably not feasible to run an auction for 99 objects with 30 bidders without the support of a suitable computer program that allows bidders to analyse the progression of the auction. Therefore, the FCC developed its own auction database and database analysis tool, first in Microsoft Excel format and subsequently in Microsoft Access format (from auction #20 onwards). This allowed bidders either to produce their own bid reports or to rely on the information provided by the FCC.

FCC #4 was the first multi-billion dollar auction, and it was generally felt that it was feasible to run such an auction at a large scale as long as the computing infrastructure was in place. Subsequently, the FCC also introduced a Geographical Information System for licences.

D.4.4. Later innovations: check-box bidding and exponential smoothing

It can be argued that the main elements of simultaneous ascending auction design were in place for FCC #4, and this design had been shown to "work" for hundreds of objects (FCC #35 had 420 objects) and dozens of bidders.

Innovations and adjustments made after FCC #4 included:

- the introduction of "'check box bidding"; and

- a more refined minimum increment methodology called "exponential smoothing".

Check-box bidding was meant to address the problem that bidders attempted to collude by signalling their priorities to other bidders, for example through the use of the last digits of their bids. Check-box bidding, in contrast, only allows participants to bid in discrete multiples of the minimum bid increment (for example, one minimum bid increment, two minimum bid increments, three minimum bid increments, etc). However, the advantage of check-box bidding may be doubtful, as it allows bidders to signal relatively easily whether or not they intend to bid aggressively on a particular licence, for example by bidding two minimum increments rather than one minimum increment. Previously, it may have been more difficult to ensure that a signal of aggressive bidding would be picked up as such by other bidders.

D.4.5. SAA innovations in other countries and contexts

D.4.5.1. *Clock auctions*

Perhaps one of the more interesting innovations has been the recent move to so-called clock auctions. Clock auctions have been used in the design of the Singapore supplemental 2G spectrum auction, the Latvian 2G/3G spectrum auction, the New Jersey Basic Generation Service electricity procurement auctions, an auction for virtual power plants for EDF in France and the Hong Kong 3G auction. In a clock auction, prices are posted by the auctioneer and bidders decide how many lots to bid for at the posted prices. Bidders therefore do not submit a price/bid pair, but only indicate the number of lots that they are bidding for.

The advantage of clock auctions is that it reduces strategic complexities and signalling issues by bidders. However, in order to make a clock auction work for multiple objects, relatively complex rules that govern the switching from one object to another object need to be implemented. In a simultaneous ascending auction, switching is implemented by an activity rule and the principle that high bids cannot be withdrawn. The latter ensures that once a product is "subscribed" (ie bid on), the provisional winner at each stage of the auction will always be identifiable. However, a clock auction does not have "highest" bids (there is no monetary measure to distinguish different bids) and therefore explicit rules need to be developed that still retain the ability of the auctioneer to keep objects subscribed. These rules make the elegant idea of a clock auction more difficult to implement in practice.

D.4.5.2. *Protective measures for entrants*

Apart from bidding credits, other protective measure for entrants or weaker bidders were introduced in several simultaneous ascending-type auctions. Two examples are the UK and Italian 3G auctions. In the UK auction, one of the five licences on offer was reserved for an entrant. In the Italian auction, all bidders bid on a 'basic licence', and winners of these basic licences who were also new entrants were then allowed to bid for additional spectrum in a subsequent phase.

D.4.5.3.   *Sealed bid cut-offs*

Many recent simultaneous ascending auction designs had sealed bid cut-offs that the auctioneer could invoke when bidding extended over too many rounds. For example such a rule might say that if the auction lasts longer than 50 rounds, the auctioneer has the ability to ask all remaining bidders to submit sealed bids, with the proviso that a bid cannot be lower than either the minimum required price at that point in time or that bidder's previous highest bid. However, we are not aware that this facility has been used in practice.

D.4.5.4.   *Payment terms*

Several attempts have been made to address the constraints on payment terms. Due to the anonymity of an auction, payment terms need to be standardised for all bidders, which represents a significant constraint on the flexibility that bilateral trade provides. In some FCC auctions, bidders were allowed to choose to pay the whole sum upfront, or to use a deferred payment option. However, the deferred payment option led to a significant problem with strategic default, most notoriously by the company NextWave. A lot of US spectrum remains unused while much spectrum is congested due to the fact that NextWave defaulted on deferred payments and that the licences affected by the default have been held in court for almost five years.

D.5. Simultaneous Ascending Auctions with Package Bidding (SAAPB)

It is important to regard the introduction of package (or combinatorial) bidding into simultaneous ascending auctions as a natural evolution of the standard design. As described above, simultaneous ascending auctions have provided a flexible framework that has been refined to deal with problems of substitution and complementarity in a way that seemed satisfactory for the application of spectrum auctions. However, it is also clear that the innovations necessary to accommodate complementary bids into the simultaneous ascending auction format opened up problems such as collusion, parking, exaggerated demands in early rounds, etc. These problems in turn had to be addressed by changes to the rules, in terms of the information provided to bidders and the way that bids can be placed. In addition, the approach to the complementarity problem is not a clean solution and leaves bidders with an exposure risk that may not allow them to win their preferred set of objects.

Following a series of experiments[232] and a long consultation process, the FCC decided to run a simultaneous ascending auction with package bidding. Auction #31 was scheduled to be held in 2000, but has since been delayed indefinitely due to reasons unrelated to the auction

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[232] Experiments carried out by 'Cybernomics Inc.' for the FCC. Also, several consultants' papers were published and conferences held, see http://www.fcc.gov/wtb/auctions/combin/papers.html.

format.[233] This left the FCC with the opportunity to develop a revised auction format, which is described below.

Independently, Milgrom and Ausubel[234] have written an influential paper on the theoretical properties of a particular type of combinatorial auction.

D.5.1. FCC #31

FCC #31 is an auction designed for the sale of two licences in each of six US Economic Area Groupings (EAGs). Winning one licence in each of the six EAGs would give a bidder national coverage in the spectrum band. Bidders can win up to 12 licences, and the following rules apply:[235]

- bidders are allowed to construct up to 12 packages of licences over the course of the auction. They need not construct all the packages at the beginning of the auction, and the packages are allowed to overlap;

- singletons are not considered a package, so that, strictly speaking, bidders are allowed to assemble 12 + 6 = 18 packages including singletons;

- once a bid is made, it remains binding until the end of the auction. It may happen that a bid becomes part of a provisionally winning set after the bid was made;

- every round is solved for the set of revenue maximising bids that is a feasible allocation of licences, taking into account all bids made by all bidders in all rounds;

- there is an activity rule that bidders need to be active on a percentage of their eligible coverage (ie the activity rule carries over from the standard simultaneous ascending auction). Bidders may win a total set of licences in excess of their eligibility if a licence that they bid on in an earlier round becomes part of the final winning set;

- different sets of bids in the same round are mutually exclusive, but bids across rounds are not. If bids from different rounds end up in the provisionally winning set then the old bids can be "renewed", in effect allowing bidders to construct a new package;

- minimum bids are dependent on the bidders, though a variation of the Vickrey pricing rule (the opportunity cost) applies to objects that have not been bid on.

The auction design seems a logical extension of the simultaneous ascending auctions described above. For bidders, the extensions do not necessarily seem completely to break

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[233] The spectrum that is to be sold in FCC #31 is encumbered by analogue television broadcasters.

[234] L. Ausubel and P. Milgrom, 'Ascending Auctions with Package Bidding', (2001), Working Paper.

[235] See http://wireless.fcc.gov/auctions/31.

with their experience, though it should be noted that the number of lots on offer is much smaller than in the largest of the previous FCC auctions without package bidding. We might expect a similar process of development to that which occurred after FCC #1 to be repeated after FCC #31. A similar body of experience would need to be built up before attempting a combinatorial auction with a large number of objects.

The new design allows bidders to express many bids that were hitherto not possible. Most importantly, bidders can bid on a package of licences (for example a package that aggregates to a national licence) and need not be concerned with the risk of winning only a subset of those licences. As a result, bidders are more able to express the value of complementarity in monetary terms. Since the exposure risk is reduced, bidders should also be able to focus more on winning their most valuable lot, instead of needing to make difficult judgements about the set of licences they would like to win. It may also reduce the incidence of "parking" bids at the beginning of the auction on licences that bidders would not wish to buy.

D.6. Auctions for Airport Slots

D.6.1. Auction formats

Auction theory distinguishes between multiple round ascending or descending auctions (also sometimes called 'open' auctions) and single sealed bid auctions. In addition, auctions can be for single objects, multiple objects or combinations of objects. A third criterion is the price that is paid by winning bidders. Bidders may be asked to pay the price that they bid, or to pay the price of the lowest winning bid or the price at which the highest losing bid exited the auction.

D.6.1.1.   Open vs. sealed auction format

There are several reasons to believe that an open ascending auction would perform better than a sealed bid auction in the context of airport slot allocation. The main reason is that many European airports are dominated by a single airline, which implies that bidders' valuations may be asymmetric. As explained below, asymmetries may lead to inefficient outcomes for some auction formats. Another reason to prefer an open ascending auction is that bidders' valuations of slots may not be independent, in which case an open auction format facilitates a gradual 'discovery' of valuations through bidding rounds. Finally, bidding strategies are arguably less complex in an open ascending auction.

D.6.1.2.   Asymmetric bidders

Bidder asymmetry is the main reason to prefer an open ascending auction format. Many European airports are dominated by a single airline, which implies that bidders' valuations may be asymmetric. For example, British Airways has established Heathrow as its base.

Therefore, British Airways may be willing to pay more on average for a Heathrow slot than other airlines in order to realise economies of scale.

To illustrate the intuition behind the potential inefficiency due to asymmetric valuations, consider a simple example where bidders are asymmetric in the sense that one bidder has on average a larger valuation than the other bidders. Valuations are private information but all bidders know that one bidder is a 'strong' bidder.

In an open ascending auction every bidder will bid his true valuation as in the case of symmetric bidders. The outcome of the auction is efficient since the winner of the auction is the bidder with the highest valuation.

In contrast, in a sealed-bid first-price auction a bidder will generally bid less than his true valuation. The reason is that the bid is equal to the price paid, should he win the auction. The optimal bid depends on 'beliefs' about rival bids and it cannot be ruled out that the bidder with the highest valuation does not win the auction.[236] This inefficiency will occur when a bidder turns out to have a higher valuation than the winner of the auction, but lost the auction because he 'shaded' his bid more than the winner.[237] In an open ascending auction this inefficiency cannot occur, since the bidder with the highest valuation can always top the current highest bid.[238]

D.6.1.3. *Interdependent valuations*

Another reason to prefer open ascending auctions to sealed bid auctions is that valuations may not be independent. There may both be common value elements to airport slots as well as an affiliation of values.

Bidders' values may have a 'common value' element, which is common *across all bidders*. For example, a slot on a Saturday morning may have a lower value for all bidders than a slot on a Friday evening. Or a slot at an airport that has excellent transport links and is close to a major city may provide a common value to bidders.

'Affiliated values' mean that values are linked in the sense that information about one bidder's values contains information about other bidders' values. Hence, higher bidding by a particular bidder leads to a re-evaluation of value of another bidder. For example, it may be thought that the values of slots at Heathrow airport are affiliated for Alitalia and Iberia.

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[236] See, for example, E. Maskin and J. Riley (1996), *Asymmetric Auctions*, Review of Economic Studies pp. 1-39.

[237] Note that the inefficiency would not occur with symmetric bidders. Although bidders would still have to form beliefs about rival bids, the ranking of bids and valuations are identical since every bidder 'shades' his bid by the same amount.

[238] Also note that a Vickrey auction is efficient regardless of asymmetries. It is not the sealed bid format per se that causes the inefficiency.

In this case of common and affiliated values, an open auction format provides valuable information to bidders, which can be used to revise valuations during the auction. As argued by Milgrom and Weber in a seminal article[239], when values are affiliated, an open auction often performs better than a sealed-bid auction in terms of both revenue and efficiency.

D.6.1.4.   Complexity and computational burden

Finally, the complexity of bidding strategies is less demanding in an open auction. In an open ascending auction a bidder can simply stay in the auction until the price reaches his valuation. Under a sealed bid format, bidders must anticipate rival bidders' strategies and compute optimal bids in one go. Therefore a sealed bid auction transfers most of the complexity from the mechanism to the bidders. While a sealed bid auction may appear simple to the outside observer and can be implemented quickly, it is significantly more complex for bidders than an open ascending auction.

The complexity increases manifold in auctions that assign multiple objects and again for auctions of combinations of objects. In particular, for these types of auctions, it is a strongly misleading argument to suggest that sealed bid auctions are 'simple'. On the contrary, such auction formats are highly burdensome and extremely difficult for bidders to act in. In large scale sealed bid auctions, bids often vary by extremely large amounts, which is an indication that bidders did not have sufficient information about other market participants in order to form an informed bid.

With a bid for combinations, this argument even holds for Vickrey type second price auctions. The burden of bidding on all possible combinations that could be of interest to bidders is extremely large. In contrast, with an open auction, an auction on combinations appears to be a more appropriate proposition.

The problem of complexity illustrates a fundamental issue with the introduction of auctions for airport slots. Naturally it is possible to introduce a type of auction for airport slots. However, such an auction should present a significant improvement over current allocation mechanisms. Such a stringent requirement on an auction mechanism implies that the auction mechanism itself needs to be flexible enough to capture the complexities of the market.

The following section develops rules for an auction. As a starting point, rules for a standard multiple round ascending clock auction are formulated. Given the importance of combinations for hub carriers and for scheduling purposes, this is not our preferred

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[239]   P. R. Milgrom and R. J. Weber (1982), *A Theory of Auctions and Competitive Bidding,* Econometrica, 50 (5), pp. 1089-1122

benchmark design. Instead, the design is subsequently developed further to a design of a 'combinatorial ascending clock auction'.

D.6.2. Introduction to benchmark rules for slot auctions

This section describes auction rules that could be used to allocate airport slots at a single airport. The rules are 'indicative' in the sense that they are written to afford airport operators and airlines an opportunity to understand how an airport slot-auction could function.

Since an auction would essentially provide a substitute (or, if only a subset of airport slots are auctioned off, a complement) for scheduling conferences, the auction procedure should also be a mechanism that is based as much as possible on the negotiating process of a scheduling conference. The auction rules should be designed to feel natural for airlines and airport operators and should allow airlines to achieve their desired slot allocation at least as well as would be possible through scheduling conferences.

The auction rules are not complete in the sense that some of the details would need to be addressed in order to make the rules work in a real auction. Ideally, these details should be determined through a consultation process with all interested parties involved at the airport at which the auction would be held.

D.6.2.1.   Two auction types

We describe two auction types. Both auction types are variants of ascending multiple round auctions used by the US national telecommunications regulator (FCC) for spectrum auctions.[240] The difference between the two sets of rules lies in restrictions placed on bidders' possibilities of expressing their preferences in the auction. Auction Type I restricts bidders to placing bids on individual slots. With Auction Type II we present a more general auction format where package bidding is allowed, ie bids for combinations of slots.

While Auction Type I is an amended version of the FCC rules, the proposed rules for Auction Type II are fundamentally new, although they draw on recent developments in the auction literature. In particular, we refer to papers by Milgrom and Ausubel[241], Plott and Salmon[242], and two proposed variants of rules for the planned Federal Communications Commission Auction #31[243] for spectrum rights in the United States.

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[240]   P. Milgrom (1999) *Putting Auction Theory to Work: The Simultaneous Ascending Auction*, working paper

[241]   *Ascending Auctions with Package Bidding, P. Milgrom and L. Ausubel (2002)*, working paper

[242]   *Comments on FCC Public Notice DA 00-1075,* C. Plott and T.Salmon, California Institute of Technology, June 2000

[243]   Federal Communications Commission, Public Notices on Auction of Licenses in the 747-762 and 777-792 MHz Bands, www.fcc.gov/auctions

In both auction designs, bidders bid on 'slots' of runway capacity. Our working assumption is that slots are defined by three criteria: (i) a 10 minute time window, (ii) the weekday of operation and (iii) a specification whether the runway will be used for landing or a take-off.

In Auction Type I, bidders can only bid on individual slots. In Auction Type II, bidders are allowed to submit bids on combinations of slots. For example, a bidder may want to combine a landing slot with a take-off slot within a particular amount of time. In order to ensure this, the bidder can submit a bid for a combination of two slots. In a more complex way, the bidder can also submit bids for schedules. Suppose that a bidder wants to run a twice-daily service, then the bidder can submit one bid for a combination of two take-off and two landing slots.

Both auction types run over multiple rounds. Each round consists of a bidding phase and a reporting phase. In the bidding phase bidders submit bids. In the reporting phase all bids are processed, the provisional winning bids are computed, and the results are reported back to the bidders. Provisionally winning bids in a round are those bids that would end up as the winning bids if the auction closed after that round. In the subsequent round, bids can be improved and the auction closes when no new improved bids are received.

To make the auction design more concrete, the auction designs presented in the following sections are illustrated with data from London's Heathrow airport of the summer of 2002.

D.6.3. Auction Design Type I: Bids on Individual Slots

D.6.3.1.   Terminology

The auction is a *simultaneous ascending clock-auction.* It is *simultaneous* in the sense that all slots are auctioned off at the same time, that bidders can switch between the slots in the auction and that the auction finishes for all slots at the same time. It is *ascending* in the sense that the auction is run over multiple rounds and that prices increase from one round to the next. It is a *clock-auction* in the sense that the auctioneer lets prices 'tick-up' and bidders say 'yes' or 'no' to each price.

D.6.3.2.   Slots

Bidders in the auction are bidding on slots. A slot is a defined as a right to use runway for landing or take-off in a particular time interval on a particular weekday throughout the season. Each slot is thus defined by

- a specification whether the runway will be used for landing or take-off;

- a time window of a duration of 10 minutes;

- a weekday of operation.

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The following sections describe each of the criteria that define a slot.[244]

D.6.3.2.1.   Take-off or Landing

Any particular slot constitutes either a take-off or a landing-slot, but not both. Take-off and landing-slots are treated separately. In order to assemble a combination of a landing-slot and a subsequent take-off slot, bidders need to submit separate bids.

D.6.3.2.2.   Time window

Depending on opening hours and night-flight restrictions, each airport has a number of time-windows with an associated number of slots available.

Figure D.3 London Heathrow Slot Distribution 30 minute intervals

For the summer of 2002, Heathrow had a total number of 9181 slots allocated.

Heathrow Airport Runway Slots Summer Season '02, Mondays
(times are the end times of a half-hour window)

The Table shows the slot distribution across half hour windows on a Monday for the summer season of 2002. There are between 1 and 47 slots allocated in each of these windows and spread evenly throughout the day, with the exception of a trough in traffic at around 2pm. For less congested airports the data follows much more a bimodal distribution with peaks around the morning and evening hours. The even spread at Heathrow is a good indication that Heathrow is substantially congested and that therefore there is likely to be an unsatisfied demand for slots.

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[244] Note that a selection of landing/take-off, time window and weekday may not uniquely identify a particular slot in the auction. There may be several identical slots available.

Suppose, for example, that it is decided to make 10% of the total number of peak half-hour airport slots, rounded down to the next integer, available in every half hour of operation. This means that for the summer season of 2002 at Heathrow, four slots would be auctioned off in every half hour window throughout every Monday of the season. Every day at Heathrow has a number of peak half-hour airport slots that exceed 40. Therefore, the total number of slots in the auction would be 4 slots per half hour time window x 18 hours of operation x 2 time windows per hour x 7 days per week = 1152 slots.

D.6.3.2.3. Weekday of operation

Slots in the auction are available on a daily basis throughout the season. In the type I auction design weekly schedules are not available. Instead, for example, for a daily schedule, the bidders need to assemble slots on every day of the week. Those slots are treated separately in the auction.

D.6.3.3. Eligibility and Activity

'Eligibility' and 'Activity' are used to pace bidding during the auction. Eligibility is a term used for defining an upper bound on the number of slots a bidder can bid on during the auction. Each slot is associated with one unit of eligibility and a bidder can never exceed his eligibility.

A bidder's 'initial eligibility' is determined by an application for eligibility points prior to the auction. In subsequent rounds eligibility is determined by a bidder's activity as explained below.

In the auction, a bidder's eligibility can never increase. A bidder needs to maintain its eligibility by staying active in a round. In order to be eligible to bid on n slots in round k+1, a bidder needs to be active on a number of slots equal to n multiplied by the activity ratio. The activity ratio is a percentage between 50% and 100% and will be increased during the course of the auction. A bidder is active on a slot if he accepts the posted price of the slot or if the bidder has a bid on the slot from previous round that is part of the provisionally winning set.

In the first round of the auction, a bidder's required activity is equal to the initial eligibility multiplied by the activity ratio of the first round.

Suppose the auctioneer sets the activity ratio for the first round at 50%. Then, if British Airways has eligibility of 450 for the first round of the auction, it only needs to bid on 450 * 50% = 225 slots to maintain its eligibility for the second round.

The use of an activity rule is a standard tool employed in simultaneous ascending auctions that intends to provide incentives for bidders to bid. An activity rule with an activity ratio of less than one attempts to address issues of 'complementarities'. For example, suppose a bidder wants to bid on a mid-afternoon slot only if he can be reasonably sure to win a morning and an evening slot. Then a low activity ratio allows the bidder to first bid on morning and evening slots and, once he is confident that he has won those slots, to start bidding on the afternoon slot.

If, for a particular airport, there are concerns regarding the viability of competition at the airport, then the airport slot auction mechanism allows use of eligibility as a tool to address these competition issues. For example, bidders could be restricted to an eligibility-cap, which could be the percentage of total available slots, or bidders could, for example, be restricted to only bid on a particular number of morning slots on a particular day of the week.

D.6.3.4.   Rounds

The auction proceeds in rounds. A round consists of two phases, a bidding phase and a reporting phase.

In the bidding phase bidders

- can accept the posted price of a slot the bidder bid on in the previous round;

- can switch from one slot to another slot;

- can submit exit bids on slots.

In the reporting phase, the auctioneer

- calculates round results;

  - accepts or denies switch bids

  - calculates excess demand for each slot

- publishes round results to bidders;

- posts prices for the next round.

All of these actions are described in more detail in the following sections.

D.6.3.5. *Information provided to Bidders during the auction*

Bidders receive information about the number of bids, exit bids and switches for all slots. Bidders do not receive information as to the identity of the bidders. Bidders receive information about the aggregate eligibility, but not individual bidders' eligibility.

> *There might be some information that bidders would like to conceal from other bidders during a slot auction. For example, suppose a large bidder with a small presence would like to expand at the airport where the slot auction is held. If the bidder is not successful, then it would prefer that the incumbent does not find out about its attempts to expand. Information revelation during the auction may thus act to deter entrants to bid in the auction.*

D.6.3.6. *Price Posting by Auctioneer*

The auctioneer posts prices for every slot.

> In a traditional simultaneous ascending auction, bidders determine both the price and the quantity of their bids. Prices are usually required to lie between an interval of a minimum required bid and a maximum allowed bid. The bidders who submit the highest bids for a particular object are called the 'standing high bidders' and are prevented from moving to another object as long as they have the standing high bids. In effect, bidders leapfrog each other. In contrast, in the proposed format, the prices are posted by the auctioneer and, while there are provisionally winning bidders, those bidders are still required to bid again in the following round as long as there are more provisionally winning bidders than objects. Under most scenarios, such a mechanism increases the speed of an auction. The format also makes collusion more difficult by eliminating the possibility of signalling through 'jump-bids' or 'trailing digits'[245]. Also, 'dividing the market' strategies where bidders agree to refrain from bidding on each other's objects can be more difficult to implement.

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[245] In an early spectrum auction by the US's Federal Communications Commission, the last digits of a bid were used to send signals to other bidders in the auction.

D.6.3.7. *Bids*

D.6.3.7.1. Bids in the first round

In the first round of the auction bids are constrained by eligibility. Each bidder's eligibility is reduced if his bidding activity is less than his eligibility. In the first round, exit bids and switch bids are not allowed.

D.6.3.7.2. Bids at the posted price

A bid by a bidder at the Posted Price is a confirmation and binding commitment that the bidder would purchase the slot at the Posted Price if the auction finished at the end of the round. When there is more than one slot available in a time-window, a bid consists of a positive number and a specification of the slot that the bidder would want to purchase. A bidder cannot bid on more slots in a time-window than the available number of slots in the time-window.

D.6.3.7.3. Exit bids

A bidder can cancel the eligibility associated with a bid by submitting an Exit Bid. An Exit Bid is a bid that the bidder places on a particular slot, which is weakly higher than the previous round's Posted Price and strictly lower than the Posted Price in the current round.

The intention behind exit bids is that bidders should be allowed to express their precise valuations in the auction. If exit bids were not allowed, a situation where there is excess demand in one round and excess supply in the following round may occur.

> Suppose, for example, that a bidder has a valuation of 10 for a particular slot and the posted price of the slot has increased from 9 to 11. In this case, the bidder will submit an exit bid of 10.

D.6.3.7.4. Switch bids

A switch bid is a bid that the bidder moves from one slot to another slot. Switch bids may need to be retained in order to always ensure that slots that have at least once been bid on do not become slots without bids at a later stage in the auction. The auctioneer would deny a switch if the slot of which the bidder requests to switch from would be left without a sufficient number of bids on it. The switch is denied until that slot receives enough bids. Then a denied switch is released and the bidder is free to either switch or submit a new bid on any other slot in the auction. The bidder does not have the obligation to carry out a switch bid that is first denied and then released in a later round.

> An example for a switch bid is the following tuple: (1500h → 1530h, Mondays, take-off slot). This bid indicates that the bidder wants to switch from the time-window ending at 1500h to the time-window ending at 1530h.

D.6.3.8. *Provisionally winning set*

The provisionally winning set after a round of bidding contains all the bidders that accepted the posted price of that round plus any bids from previous round's provisionally winning set needed to balance supply and demand, ie denied switch bids and retained exit bids.

Excess supply: There is said to be 'excess supply' in the provisionally winning set if there are less bids on identical slots belonging to the provisionally winning set than there are available slots. If there is excess supply at the posted price, the provisionally winning set contains a number of bids from the previous round needed to balance supply and demand.

Excess demand: There is said to be 'excess demand' in the provisionally winning set if there are more bids on identical slots belonging to the provisionally winning set than there are available slots. If there is excess demand at the posted price, all the bidders who accepted the posted price are in the provisionally winning set.

> Suppose that there are 8 bids on the following slot (1000h, Tuesday, take-off slot), and there are no other slots defined in that time-window. Suppose also that there are four runway-slots available in the time-window. Then the provisionally winning set consists of all 8 bids and there is said to be excess demand in the provisionally winning set.

D.6.3.9. *Bid increments and minimum bids*

In the reporting phase of a round, the auctioneer will increase the posted price on a slot in the following round if there is excess demand for the slot.

Bid increments will be determined by the auctioneer and are used to manage the speed of the auction. They are expected to be in the region of between 2% and 5%.

D.6.3.10. *Closure*

The Auction closes when no bidder accepts the posted price of any slot and no exit bids are submitted.

D.6.4. Combinatorial Ascending Auctions: Rationale, Efficiency and Complications

In this section we describe the rationale for introducing combinatorial bid elements into the auction for airport slots. We use the terms 'package bidding' and 'combinatorial' interchangeably.

The main argument for allowing package bidding when items are complements is to minimize the so-called 'Exposure Problem'. A bidder is said to face an exposure problem if he risks being left with objects that he does not wish to purchase individually, but that he bid on during the auction since they were part of a larger package that the bidder desired. Package bidding addresses the problem of assembling packages by allowing bids directly on the packages instead of only on the individual objects that make up a package.

The combinatorial elements of an auction design are beneficial if there is a hub carrier at an airport. For the hub carrier, the network itself represents a benefit over and above the value that each route to the airport would have on a stand-alone basis. The hub protects, for example, regional routes that may not be viable on a stand-alone basis but have value conferred to them due to the large number of connections available from the hub airport.

Hubs are not the only characteristics of airport access that give rise to complementarities. A further complementarity lies in scheduling, even for point-to-point traffic. For example, airlines may only wish to fly to a destination if they can offer at least a daily service. Or airlines may want to have the same departure times for their daily services throughout a week of operation.

There are also more immediate operational complementarities. For example, an airline may only wish to have a landing slot if it can also acquire a take-off slot within a reasonable time of the landing slot.

Not allowing bidders to express these complementarities would in some sense make auctions a less significant improvement over current more informal allocation mechanisms. Therefore, there are strong reasons to consider combinatorial auction mechanisms. For reasons of complexity we would recommend to keep the multi-round format but extend it to allow bidders to bid on packages. Such a modification gives rise to a number of other changes that would need to be introduced into the auction rules. The revised combinatorial auction rules are presented in Section D.6.5.

D.6.4.1.   Complications introduced by ascending combinatorial auctions

While combinatorial auctions allow bidders to express value complementarities between the objects in the auction, package bidding may introduce a 'Threshold Problem'. The 'Threshold Problem' refers to the difficulty that bidders demanding a single unit may have in outbidding a bidder who demands a package. Minimizing both the exposure problem and the threshold problem are often conflicting aims, hence trade-offs needs to be made. This section outlines the logic of both problems, followed by an illustration of how practical

auction rules can be shaped in order to trade-off the conflicting aims. The development of the auction rules for 'FCC auction 31' provides such an example.

Generally, package bidding allows bidders to make a single bid for a package of objects. The main motivation for using an auction with package bidding lies in its potential to eliminate the exposure problem. The exposure problem refers to the situation where a bidder seeking to acquire a package of complementary objects may find himself the high bidder on some objects, at prices above their individual values, and then see the prices of other objects needed to form the package rise to a level that brings the total package price above its value to the bidder.

The exposure problem can be avoided entirely when bidders are free to place as many mutually exclusive bids for different packages as they wish. In principle, a bidder can bid a different amount for every possible package, thus eliminating the exposure problem. However, this implies that bidders need to calculate valuations for a large number of packages, which in practice may be infeasible. By applying a simultaneous ascending auction format, bidders can restrict attention to bidding on a few selected packages in each round, thus reducing the complexity considerable.

In a simultaneous ascending auction with package bidding, a set of provisionally winning bids is calculated after each round of bids. The set of provisionally winning bids contains those bids that would be winning bids if the auction closed after the current round. The difficulty with package bidding is that currently non-provisionally winning bids may become provisionally winning bids at a later stage. Details on how the auction treats non-provisionally winning bids, activity and eligibility, bid increments and closure rules are thus key design issues in relation to overcoming potential problems due to package bidding. One such problem is the threshold problem.

The threshold problem in auctions with package bidding refers to the difficulty that multiple bidders desiring objects that constitute a larger package may have in outbidding a single bidder bidding for that larger package. Consider an example where bidder A seeks only object X, and bidder B seeks only object Y. Both bidders are willing to pay 14 for the objects. Furthermore, bidder C is willing to pay 20 for the package XY. Also, note that efficiency requires that object X is allocated to bidder A and object Y is allocated to bidder B.

Table D.3

Example: Bidder valuations

	Object X	Object Y	Package XY
Bidder A	14	0	14
Bidder B	0	14	14
Bidder C	0	0	20

Assume bidder A and bidder B have bid 5 for objects X and Y respectively and that bidder C has bid 20 for the package XY. The provisionally winning bid is thus 20 for the package XY, which goes to bidder C. Neither bidder A nor bidder B can single-handedly overcome the difference (the threshold) between the current provisionally bid and a bid that would change the provisionally winning bid. However, coordinated bid increases would allow bidder A and B to bid 10 plus one bid increment each and win. Thus, the threshold problem cannot be overcome without allowing for bid increases that are insufficient to win in their own.

This example shows that there is a trade-off between overcoming threshold problems and ensuring a reasonable pace of the auction. In general, the rules ought to allow enough flexibility to bidders facing a threshold problem so that they can submit improved but possibly non-competitive bids in the hope that other bidders interested in complementary combinations will help overcome the threshold problem by increasing their bids. In other words, the auctioneer has to allow some signalling in order to address possible threshold problems.

Another design issue that deals with the threshold problem is activity rules. Ideally an auctioneer wants to allow bids that do not replace the provisionally winning set in order to address threshold problems. Therefore, activity rules can be specified such that they give full credit to non-provisionally winning bids as well as provisionally winning bids. Again, this involves a trade-off between addressing the threshold problem and assuring pace of the auction.

Finally, since the threshold problem is inherently a free-rider problem, there is a danger that even with appropriately designed activity rules and bid increments, bidders hold back bidding. Closing rules that allow two rounds of no new provisionally winning bids may be considered. Essentially, one round of no new provisionally winning bids gives bidders a warning that there is only round left to "coordinate" bidding that overcomes the threshold problem.

D.6.5. Auction Design Type II: Bids on Combinations of Slots

D.6.5.1. Terminology

The auction is a *combinatorial simultaneous ascending clock-auction*. It is a *combinatorial* or package bidding auction in the sense that bidders can bid on combinations of slots. It is *simultaneous* in the sense that all slots are auctioned off at the same time, that bidders can switch between the slots in the auction and that the auction finishes for all slots at the same time. It is *ascending* in the sense that the auction is run over multiple rounds and that prices increase from one round to the next. It is a *clock-auction* in the sense that the auctioneer lets prices 'tick-up' and bidders say 'yes' or 'no' to each posted price. The fundamental change to auction Type I is that bidders may bid on combinations of slots.

D.6.5.2. *Definition of the bidding item*

D.6.5.2.1. Slots

As in Auction Type I, a slot is a defined as a right to use runway for landing or take-off in a particular time interval on a particular weekday throughout the season. Each slot is thus defined by

- a specification whether the runway will be used for landing or take-off;

- a time window of a duration of 10 minutes;

- a weekday of operation.

D.6.5.2.2. Bidding language

An addition to the auction of Type I is the use of a 'bidding language'. The use of a 'bidding language' in a combinatorial auction simplifies the auction for bidders. In fact, with as many as hundreds of slots in the auction, a concise bidding language may make the combinatorial auction simpler for the bidders than a standard ascending auction without package bidding. Much of the complexity of the bids is hidden from the bidders by the bidding language. However, the generality of the bidding language needs to be restricted to take into account constraints on computability. As can be seen in the following paragraphs, the bidding language serves two purposes: it allows bidders to express a large number of bids in a concise way and it clarifies the exclusivity of combinations.

Bidders can bid on more than one combination in every round. However, only one of the combinations can win. Combinations are separated by the bidding term 'XOR', which means 'exclusive or', ie either or but not both.[246]

Bidders can also link existing combinations with the word 'AND'. By linking existing combinations, those combinations cease to be mutually exclusive.

Additional terms in the bidding language, such as 'daily' or 'turn-around', as described in the following paragraphs, are translated into 'XOR' and 'AND' bids by the auctioneer.

D.6.5.2.3. Combinations of slots

In contrast to Auction Type I, bidders bid on combinations of slots. A combination of slots is either:

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[246] The bidding language could also be extended to include an 'inclusive or', 'OR', which would allow an even more concise representation of a bid.

- one single slot; or,

- the combination of slots in the same or different time-windows; or,

- a combination defined by a pre-defined bidding term as described in D.6.5.2.4 or,

- a mixture of the above points linked by the word 'AND'.

For clarification, the first item implies that a single slot is also regarded as a "combination". This terminology is used for simplicity.

A bidder can submit up to 5[247] new combinations in a round, where combinations that employ the pre-defined terms of the bidding language count as one combination. All combinations are treated as mutually exclusive, which means that only one of the combinations can be in the provisionally winning set of the bidder.

Suppose, for the summer of '02 at Heathrow, a bidder wants to submits the combination [(1500h, Monday, landing slot), (1500h, Wednesday, landing slot), (1500h, Friday, landing slot)] and the combination [(1500h, Tuesday, landing slot), (1500h, Wednesday, landing slot), (1500h, Thursday, landing slot)]. The bidder is allowed to submit both combinations as bids in a round, but both combinations are mutually exclusive. Only one of the combinations can become a member of the provisionally winning bids. The bid is entered into the auction as [[(1500h, Monday, landing slot) AND (1500h, Wednesday, landing slot) AND (1500h, Friday, landing slot)] XOR [(1500h, Tuesday, landing slot) AND (1500h, Wednesday, landing slot) AND (1500h, Thursday, landing slot)]].

D.6.5.2.4.   Pre-defined combinations

The bidding terms 'daily', 'Mon-Fri' and 'Turn-around' allow airlines to easily build schedules. The terms are described in paragraphs (D.6.5.2.6 and D.6.5.2.7). They are pre-defined combinations that are effectively slots linked together by the word 'AND'.

The bidding terms 'weekly', 'Morning', 'Afternoon', and 'Evening', in contrast, are pre-defined combinations that are effectively 'XOR' combinations. The terms are described in paragraphs (D.6.5.2.5 and D.6.5.2.6).

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[247]   This number needs to be restricted due to the computational burden. Finding the winners of a combinatorial auction is an integer programming problem of the 'NP-class'. In practical terms it means that the number of computations needed to find the solution to a combinatorial auction can quickly become so large that a round of bidding cannot be solved in a reasonable amount of time.

For the purpose of bidding restrictions, pre-defined combinations count as one combination only.

D.6.5.2.5. Time window

Depending on opening hours and night-flight restrictions, each airport has a number of time-windows with an associated number of slots available for bidding. In the auction, in addition to forming their own combinations, bidders can submit bids using the following terms:[248]

Term in Bidding Language	Meaning
Morning	Between 7am and 1030am
Afternoon	Between 2pm and 5pm
Evening	Between 5pm and 10pm

> Suppose a bidder submits the following bid: [Morning, Monday, landing slot]. The use of the word 'Morning' means that this bid is treated as equivalent to the following bids on combinations of slots: [(7am, Monday, landing slot) XOR (730am, Monday, landing slot) XOR (8am, Monday, landing slot) XOR (830am, Monday, landing slot) XOR (9am, Monday, landing slot) XOR (10am, Monday, landing slot) XOR (1030am, Monday, landing slot)] where according to the definition of 'XOR' bids all the bids in square brackets are treated as mutually exclusive. For the purposes of restrictions on the number of combinations, the bid counts as one combination.

D.6.5.2.6. Weekday

The following pre-defined combinations permit bidders to introduce the frequency of service into their bids:

Term in Bidding Language	Meaning
Daily	Repeats the selected slot for every day of the week
Mon-Fri	Repeats the selected slot for Mon-Fri
Weekly	Produces an 'XOR' bid for a weekly service (one day per week on any day of the week)

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[248] The particular time intervals chosen here are arbitrary.

D.6.5.2.7.   Take-off or landing

Bidders need to specify whether they require the runway slot as a take-off or a landing slot. Bidders can, however, also form combinations of landing and take-off slots. The bidding language introduces the word 'turn-around' for this purpose.

Term in Bidding Language	Meaning
Turn-around	The bid produces an 'AND'-bid of a landing and a take-off slot, separated by the specified stand-time.

It should be noted that for this construction, bidders need to define a stand-time. The auctioneer translates the stand-time into spaces between slots.

> Suppose a bidder submits the bid [7am, Monday, turn-around], and specifies a stand-time of 30 minutes, then this bid is treated by the auctioneer as equivalent to [(7am, Monday, landing slot) AND (730am, Monday, take-off slot)]

D.6.5.3.   Eligibility

Eligibility is the term used for defining how many slots a bidder can bid on. A bidder's 'initial eligibility' is determined by an application for eligibility points prior to the auction. In subsequent rounds eligibility is determined by a bidder's activity as explained below.

Each slot gives the same amount of eligibility equal to one unit of eligibility regardless of the choice of time window.

From round one the eligibility of the bidder is determined by the combination with the maximum number of slots that the bidder submits. If the bidder submits several combinations separated by 'XOR', the corresponding eligibility is the maximum number of slots that the bidder would be awarded if the 'XOR' bid were part of the winning set.

In the auction, a bidder's eligibility can never increase. A bidder needs to maintain its eligibility by staying active in a round. In order to be eligible to bid on combinations with a maximum of n slots in round k+1, a bidder needs to be active on at least one combination with n slots in round k.

In contrast to the more restrictive auction of Type I, the concept of 'activity ratio' is not employed in the more general combinatorial auction of Type II. Since the auction design allows for a large variety of combinations and mutually exclusive bids, the use of an activity ratio is deemed to be unnecessary.

D.6.5.4.   Rounds

The auction proceeds in rounds in a similar way as for auction type I. A round consists of two phases, a bidding phase and a reporting phase.

In the bidding phase bidders

- can create new combinations of slots;

- can accept the posted price of a combination of slots the bidder bid on in the previous round;

- can switch from one combination of slots to another combination of slots;

- can submit exit bids on combinations of slots.

In the reporting phase, the auctioneer

- calculates round results;

    - accepts or denies switch bids

    - calculates excess demand for each slot

- publishes round results to bidders;

- posts prices for the next round.

All of these actions are described in more detail in the following sections.

D.6.5.5.   Information provided to bidders during the auction

Bidders receive information about the number of bids, exit bids and switches for all slots and combinations of slots that are relevant to them. Bidders do not receive information as to the identity of the bidders. Bidders receive information about the aggregate eligibility, but not individual bidders' eligibility.

An additional concern is that with the introduction of combinations, the amount of information that is generated by the auction becomes very large. In order to limit complexity, we propose only to publish information that is useful to bidders and to produce additional information on bidder's requests. Such a mechanism will reduce the informational and computational burden for bidders. For example, a bidder would be presented with all bids relevant to the bids on his own combinations (without the identity of the other bidders), but not with other bidder's bids on combinations that do not overlap with any of the bidder's combinations. The bidder could however request that additional information from the auctioneer.

D.6.5.6.   *Price posting by auctioneer*

The auctioneer posts prices for every combination of slots that has been bid into the system. The price that the auctioneer posts in the reporting phase of a round is called the Posted Price for the subsequent round.

D.6.5.7.   *Bids*

D.6.5.7.1.   Bids at the posted price

A bid by a bidder at the Posted Price is a confirmation and binding commitment that the bidder would purchase the slot combination at the Posted Price if the auction finished at the end of the round.

Example: In a given round, the posted price of combination 1 is 10 and the current price of combination 2 is 15. A bidder can bid on combination 1, for example, by accepting the posted price of that combination.

If a bidder submits more than one combination separated by the bidding term 'XOR' then he needs to accept the Posted Price for all the combinations that constitute the bid. Each of the combinations that are the result of a Pre-defined Combination will be bid into the system at the same price.

D.6.5.7.2.   New combinations of slots

A bidder can create a new combination of slots during a round. The creation of a combination of slots consists of three steps:

- the bidder submits the created combination of slots to the auctioneer;

- the auctioneer computes the Posted Price for the combination;

- the bidder confirms that he would purchase the combination at the Posted Price.

Since a bidder can never increase his eligibility in the auction, new combinations of slots can only be bid on by switching from existing slots, except for round 1.

Example: A bidder creates a new combination of slots, for example combining combination 1 and 4. Denote this new combination by 15. The auctioneer computes the posted price of this new combination and reports it to the bidder. The bidder can now accept the posted price of combination 15.

In every round, combinations are considered mutually exclusive. A bidder cannot end up with more than one combination in the provisionally winning set. In order to facilitate the construction of combinations of slots, bidders can use the word 'AND' to link existing combinations.

D.6.5.7.3. Retained bids

A bidder's bids are retained by the auctioneer if they are in the provisionally winning set and there is no excess demand in the provisionally winning set.

The retaining of bids is a tool that can be employed to address the threshold problem (see Section D.6.4). Many different specifications could be implemented. Ideally, one would want to retain all bids that at some later stage could still become part of the provisionally winning set, but not retain those that will never become part of the provisionally winning set. Such a bidding rule would allow small bidders to coordinate their bids in order to efficiently overcome the bid on a larger package by a single bidder. However, such a rule may stall the auction, since bidders may not have an incentive to submit bids when the posted price increases. The illustration used here is relatively close to the FCC #31 implementation. In that auction (see also the appendix), bids are retained but lost the eligibility associated with them. This is similar to placing exit bids.

D.6.5.7.4. Bid cancellation

A bidder can cancel the eligibility associated with a bid by submitting an Exit Bid. An Exit Bid is a bid that the bidder places on a particular combination of slots and that is weakly higher than the previous round's Posted Price and strictly lower than the Posted Price of the current round.

D.6.5.7.5. Switch bids

A switch bid is a bid that the bidder moves from one slot to another slot. Switch bids may be denied by the auctioneer. If a switch bid is necessary to fill the demand of a particular

slot, then the switch bid will be denied. This occurs if the switch bid is part of the provisionally winning set and there is no excess demand in the provisional winning set.

D.6.5.8. Provisionally winning set

The Provisionally Winning Set is the feasible allocation of slots that is revenue maximising in the reporting phase of a round.

> There is said to be 'excess demand' in the provisionally winning set if there are more bids on identical slots belonging to the provisionally winning set than there are available slots.

D.6.5.9. Bid increments

In the reporting phase of a round, the auctioneer will report new Posted Prices for all combinations of slots. The calculation of Posted Prices for the example shown below is based on the concept of 'current prices', which are essentially the shadow prices of slots, emerging from the winner determination problem.

If there is excess demand for a particular slot, then the Posted Price of a combination containing the slot is the maximum of:

- the opening Posted Price set by the auctioneer; and

- the Current Price estimate of the combination plus x%, where x, will be determined by the auctioneer and is used to manage the speed of the auction.

If there is no excess demand for a slot, the Posted Price from the current round is carried over to the next round.

D.6.5.10. Closure

The Auction closes after the second round where no bidder accepts the posted price of any combination of slots and no exit bids are submitted.

D.6.6. Stylised example for an auction according to the rules of Type II: Combinatorial Ascending Clock Auction

Assume 4 airlines are interested in bidding on 3 daily take-off slots:

- Morning slot: Take-off, daily, 9:00-9:10

- Afternoon slot: Take-off, daily, 13:00-13:10

- Evening slot: Take-off, daily, 19:00-19:10

Airline A wants either a morning slot or an evening slot, Airline B wants either an afternoon slot or an evening slot, Airline C only wants an evening slot and Airline D wants either a package of morning/afternoon slots or a package of morning/evening slots. Valuations are given in table 1.1.

Table D.4
Valuations

	Morning	Afternoon	Evening	Morning/afternoon	Morning/evening
Airline A	150	0	200	150	150
Airline B	0	150	200	150	200
Airline C	0	0	300	0	300
Airline D	0	0	0	275	300

This example is constructed such that bidding involves switching, package creation, exit bids and a potential threshold problem. Note that the efficient allocation of slots is a morning slot to Airline A, an afternoon slot to Airline B and an evening slot to Airline C.

We assume that airlines follow a simple bidding rule that maximises round by round surplus. For example, if airlines will accept the posted price(s) in each round that yields the highest surplus (valuation – posted price). Once all posted prices exceed valuations the airline submits an exit bid.

When there is excess demand for a slot, prices are increased by 20%. This bid increment could be made more flexible, by making it dependent on the amount of excess demand. Furthermore, 20% is probably higher than we would expect to see in a real auction, but it allows us to illustrate the mechanism in few rounds.

The calculation of posted prices in the example in this section is based on a method suggested in FCC's rules for Auction 31.[249] This method is not the only possible one to compute current prices. The current price estimate of each slot is based on the concept that every linear optimisation problem has a dual problem that provides information on the value of relaxing the constraints, ie shadow prices. The dual to the winner determination problem thus provides information on the value individual slots, ie the current price estimate.

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[249] A more detailed description of the calculation of current prices can be found at
http://wireless.fcc.gov/auctions/31/releases/da020659.pdf

D.6.6.1. Round 1

In round 1 posted prices for each slot are set by the auctioneer. Posted prices for packages are equal to the sum of posted prices for slots contained in each package, but only prices for packages that have been created by airlines will be posted. Initially, Airline D creates a package containing a morning and an evening slot. Posted prices and bids for round 1 are given in table 1.2.

Table D.5
Round 1 Posted Prices and Bids

	Morning	Afternoon	Evening	Morning/evening
Airline A	80	120	100 Accept	180
Airline B	80	120	100 Accept	180
Airline C	80	120	100 Accept	180
Airline D	**80**	**120**	**100**	**180 Accept**

Airline A accepts the posted price of 100 for the evening slot since this yields the highest surplus. Similarly, Airline B and C accept the price of the evening slot. Airline D accepts the price of the package containing morning/evening slots.

At this stage, airline D is the provisionally winner of the morning and evening slots since this yields the highest revenue. There is currently excess demand for the evening slot. Round results are summarised in table 1.3.

Table D.6
Round 1 Current Prices, Revenue and Demand

	Morning	Afternoon	Evening
Current prices	80	120	100
Demand	1	0	4
Revenue		180	
Winning set	Airline D		Airline D

D.6.6.2. Round 2

In this round the posted prices of the evening slot and the package containing an evening slot are increased. The new posted prices are the current prices plus 20%.

Table D.7
Round 2 Posted Prices and Bids

	Morning	Afternoon	Evening	Morning/evening
Airline A	80	120	120 Accept	216
Airline B	80	120	120 Accept	216
Airline C	80	120	120 Accept	216
Airline D	80	120	120	216 (180 retained)

Airlines A, B and D still accept the posted price of the evening slot. Airline D, which is the provisionally winner of the morning/evening package does not accept the posted price, and the bid of 180 is retained.

Table D.8
Round 2 current prices, revenue and demand

	Morning	Afternoon	Evening
Current prices	80	120	120
Demand	1	0	4
Revenue		180	
Winning set	Airline D		Airline D

D.6.6.3.   *Round 3*

In this round the posted price of the evening slot increased.

Table D.9
Round 3 Posted Prices and Bids

	Morning	Afternoon	Evening	Morning/evening
Airline A	80 Accept	120	144	240
Airline B	80	120	144 Accept	240
Airline C	80	120	144 Accept	240
Airline D	80	120	144	240 (180 retained)

Airline A wants to switch to the morning slot since this yields a higher surplus. The switch is accepted since airlines B and C accept the posted price of the evening slot.

Table D.10
Round 3 Current Prices, Revenue and Demand

	Morning	Afternoon	Evening
Current prices	80	120	144
Demand	2	0	3
Revenue		224	
Winning set	Airline A		Airline B,C

D.6.6.4. Round 4

Airline D creates a new package containing morning and afternoon slots since the price of the morning/evening slots has increased.

Table D.11
Round 4 Posted Prices and Bids

	Morning	Afternoon	Evening	Morning/afternoon	Morning/evening
Airline A	96 Accept	120	172.8	240	268.8
Airline B	96	120 Accept	172.8	240	268.8
Airline C	96	120	172.8 Accept	240	268.8
Airline D	96	120	172.8	240 Accept	268.8

Airline B wants to switch to an afternoon slot, which is accepted since airline C accepts the posted price of the evening slot. Airline D's request for a switch to the morning/afternoon package is also accepted.

Table D.12
Round 4 Current Prices, Revenue and Demand

	Morning	Afternoon	Evening
Current prices	100	140	172.8
Demand	2	2	1
Revenue		412.8	
Winning set	**Airline D**	**Airline D**	**Airline C**

D.6.6.5. Round 5

Posted prices of morning and afternoon slots are increased.

Table D.13
Round 5 Posted Prices and Bids

	Morning	Afternoon	Evening	Morning/afternoon	Morning/evening
Airline A	120	168	172.8 Accept	288	327.36
Airline B	120	168	172.8 Accept	288	327.36
Airline C	120	168	172.8 Accept	288	327.36
Airline D	120	168	172.8	250 Exit	327.36

Airlines A and B want to switch to the evening slot. Both requests are accepted. Airline D is denied a switch to the morning/evening package and submits an exit bid of 250 for the morning/afternoon package.[250]

Table D.14
Round 5 Current Prices, Revenue and Demand

	Morning	Afternoon	Evening
Current prices	105	145	172.8
Demand	1	1	3
Revenue		422.8	
Winning set	Airline D	Airline D	Airline A,B,C

D.6.6.6.   *Round 6*

Table D.15
Round 6 posted prices and bids

	Morning	Afternoon	Evening	Morning/afternoon	Morning/evening
Airline A	120 Accept	168	207.36	288	333.36
Airline B	120	150 Exit	207.36	288	333.36
Airline C	120	168	207.36 Accept	288	333.36
Airline D	**120**	**168**	**207.36**	**288 (Exit 250)**	**333.36**

Airline A wants to switch to the morning slot, which is accepted. Also, airline B is allowed to switch to the afternoon slot and submits an exit bid of 150. Airline D has already submitted an exit bid and is not allowed a bid in this round.

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[250] The determination of an optimal exit bid is essentially the same as determining an optimal bid in a first-price sealed-bid auction. When the exit is submitted, airline D does not know the other bids in that round. An exit bid of less than 250 may therefore be considered by airline D in order to increase the surplus. This decision involves a trade-off between winning at a low price and not winning the slot. For simplicity, we assume in this example that airline D submits an exit bid of the true valuation, 250 (a lower exit bid would not change the allocation).

Table D.16
Round 6 Current Prices, Revenue and Demand

	Morning	Afternoon	Evening
Current prices	120	150	207.36
Demand	1	1	1
Revenue		477.36	
Winning set	Airline A	Airline B	Airline C

There is no excess demand for any slot. The morning slot is sold to Airline A, the afternoon slot is sold to airline B and the evening slot is sold to airline C. Hence, the allocation is efficient and the potential threshold problem is overcome.

From round 5 to 6 airlines A and B manage to outbid airline D on the morning and afternoon slots. Airline D has an exit bid of 250 for the package, which implies that airlines A and B need bids of at least 250 jointly to outbid airline D. In the example above this is accomplished by assuming that airlines accept posted prices whenever this is profitable. However, in practice airlines may employ more sophisticated strategies. For example, in round 6 airline A may choose not to accept the posted price of 120 for the morning slot and submit an exit bid of 100 instead, anticipating that airline B will submit a bid of at least 150 (thereby reaching a joint bid of 250). If Airline B is following the same line of reasoning, and submits an exit bid below 150, then airline D is still the winner of the morning and afternoon slots. Furthermore, airlines A and B have submitted exit bids and are not allowed to bid again, hence they cannot overcome the threshold problem.

D.6.7. Usage factors and slot-packages

A slot is defined as a right to use runway for landing or take-off in a particular time interval on a particular weekday throughout the season. This definition is reasonable if runway is the only capacity constraint and all types of aircrafts use the same amount of runway capacity. However, larger aircrafts generally require more runway capacity and some airports may also be constrained by terminal and stand capacity. This implies that the effective capacity of an airport is endogenous in the sense that capacity is determined by the mix of aircraft types, required stand time etc.

DotEcon has suggested that this additional complexity can be handled by extending the definition of slots to include 'usage factors'. Usage factors would capture the different dimensions of capacity utilisation and could be specified as follows:

- The size category of the aircraft

- The routing direction for taking-off aircrafts, which affects runway capacity.

- Preference for terminal

- Maximum passenger load, which affects terminal capacity

Bids would then have to be supplemented by specifications of usage factors. There are several ways in which the auctions rules could be extended to accommodate such usage factors. We provide 2 different alternatives below. The difference lies in the way 'identical' slots with different usage factors are treated.

D.6.7.1. Alternative 1: DotEcon's proposal

One option, proposed by DotEcon, is to let usage factors enter the problem of winner determination and otherwise keep auction rules unchanged. Bidders would specify usage factors, which would enter as additional constraints in the problem of determining the provisionally winning set. This option implies that the price of a particular slot is independent of the specified usage factors. Two carriers who win the right to use the same time window with different aircrafts and stand-time requirements will pay the same price.

The main problem with this option is that excess demand in one round may be followed by excess supply in subsequent rounds. This situation arises if new bids with lower capacity requirements are submitted.

Example: Suppose there is excess demand for a particular slot and a new higher price is announced by the auctioneer. Some bidders may leave the auction at this stage, and some bidders may accept the price-tick and change the specification of usage factors. If bidders who accept the price tick reduce their usage factors, excess supply cannot be ruled out.

The problem identified above is to a large extent due to the lack of details in DotEcon's proposed auctions rules. Foe example, it is not clear how bid increments for identical slots with different usage factors would be determined.

D.6.7.2. Alternative 2: Modify the definition of slots

E second option is to expand the number of slots by treating each of the possible specifications of usage factors as separate slots. For example, if bidders can specify one of 5 different types of aircrafts, the number of slots increases with a factor 5. Each of the original slots would exist in 5 different versions, one for each type of aircraft. This alternative is a particularly simple form of combinatorial bidding since bidders specify a package of runway, stand and terminal capacity.

By treating bids with different usage factors as bids on different slots the problem identified above is avoided. If a bidder wants to submit a new bid with lower usage factors, the bid is treated as switch bid, which will be rejected in case excess supply would result. The main

disadvantage of this alternative is that it is computationally demanding. With several dimensions of usage factors the number of slots increases rapidly.

This alternative to dealing with more complex capacity constraints (usage factors) is similar to the analysis of Brewer and Plott[251] who devise an auction procedure for selling rights of passage to trains. Feasibility and safety constraints limit, for example, the use of fast trains too soon after slow ones. Brewer and Plott suggest a Binary Conflict Ascending Price Auction (BICAP) that deals with such constraints, essentially by treating each possible specification of usage factors as different objects. The analysis by Brewer and Plott suggests that the number of objects in the auction increases with the number of additional constraints. Therefore these auction designs become similar to ascending combinatorial auctions.

D.6.8. Conclusions

The introduction of slot-auctions for the allocation of airport capacity would change the current allocation format significantly. Such a step needs to be carefully considered; its benefits, effects and possible complications need to be understood.

The current paper is intended to provide several steps towards the implementation of airport slot auctions. It attempts to provide an exposition of how airport slot auctions would fit into the current airport access charge system; and it sets out a possible design framework for an auction.

When considering airport slot auctions, we would want to stress that those auctions are more likely to be successful if their goal and their remit are clarified well in advance of an auction. In particular, if an auction is used to replace the current system of grandfathering rights, then the future of airport usage charges need to be sufficiently clear over the term of the contract. Also, the contractual terms in the event of unused slots ('no-shows') may need to be clarified and modified from the current 80/20 usage rule.

Introducing an airport slot auction will have an effect not only on airports and airlines, but will also impact on airlines' finances and the financial structure and industry supporting airlines. As has been the experience in the US, property rights to auction slots may end up in the hands of financial companies, as airlines attempt to use those rights for financing purposes. More discussions and investigations may be needed to understand the financial impact of airport slot auctions and how the financial markets and institutions would deal with it.

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[251] Brewer, P. and C. Plott (1996) "A Binary Conflict Ascending Price Mechanism for Dealing with Decentralised Allocation of the Right to Use Railroad Tracks", International Journal of Industrial Organization, 14, 857-886.

For a successful auction it is vital that the process not be developed behind closed doors. Rather, we would recommend that, in case an auction is introduced, all interested parties be invited to comment and voice their concerns, especially on the contract that would be auctioned. The terms of the contract, in particular its risk characteristics for airport operators and airlines, are very likely to be areas of concern.

In contrast, the auction design itself would need to be developed by auction experts. Those experts would need to be able to explain their design to the interested parties and should incorporate any feedback.

It is vital that the individual auction design be tailored very closely to the particular airport that they cover. The market conditions at each airport, in particular the role of the hub carrier and the mixture of regional/short-haul and intercontinental flights, will influence how bidders will bid in an auction. Further design issues that need to be tackled for each market are the size of the time windows, the restrictions on combinations and the need for including terminal and stand constraints as well as runway constraints.

We have developed and presented rules for a combinatorial ascending auction. Due to the nature of the markets, we believe that such an auction type would be the most appropriate. However, these auction are complex for the auctioneer. Workable specifications will need to be developed. In particular, innovations in user interface design, bidding language and distributed computing technologies will be necessary in order to address the complexity of the design. We believe that with a successful implementation of these necessary innovations, combinatorial ascending auctions have the potential to become simpler, clearer and less risky for bidders than either sealed bid or standard multiple round ascending auctions.

D.7. References

Ausubel, L. M and Cramton, P. (1998) "The Optimality of Being Efficient", working paper

Ausubel, L. M and Milgrom, P. R. (2002) "Ascending Auctions with Package Bidding", Frontiers of Theoretical Economics, Vol 1.1, 1-44

Civil Aviation Authority (UK), (2001) "Heathrow, Gatwick and Stansted Airports price caps, 2003-2008: CAA recommendations to the Competition Commission", www.caa.co.uk

Carlin, A. and Park, R. E. (1970) "Marginal Cost Pricing of Airport Runway Capacity", American Economic Review, 60, pp. 310-319

Charles River Associates (2001) "Reductions in flight operations as an alternative to runway reconfiguration at San Francisco International Airport", Report prepared for San Francisco International Airport.

Coase, R. H. (1960) "The Problem of Social Cost", Journal of Law and Economics, 3, 1-44

Coase, R. H. (1972) "Durability and Monopoly", Journal of Law and Economics, 15, 143-140

Cramton, P. (2001), *Spectrum Auctions*, Handbook of Telecommunications Economics, Martin Cave, Sumit Majumdar, and Ingo Vogelsang, eds., Amsterdam: Elsevier Science B.V.

Daniel, J. (1991) "Peak-Load-Congestion Pricing of Hub Airport Operation with Endogenous Scheduling and Traffic-Flow Adjustments at Minneapolis-St. Paul Airport, Transportation Research Record, 1298

Daniel, J. (1995) "Congestion pricing and capacity of large hub airports: A Bottleneck model with stochastic queues", Econometrica 63, 2, 327-370.

Robyn, D. (2001) "Ending runway gridlock", available at www.ndol.org/blueprint

Van Ryzin, G. (2000) "Airline Revenue Management and e-Markets", Columbia University, www.ima.umn.edu/talks/workshops/12-3-5.2000/van-ryzin/rm.pdf

DotEcon (2001) "Auctioning airport slots", A report for HM Treasury and the Department of the Environment, Transport and the Regions.

Fischer, D. (2000) "SEABIRD investigates the future of regional aviation in the Baltic Sea region", BMT Transport Solutions.

Helm, M. (2003) "Auctions and energy networks", Utilities Policy 11, 21-25.

Levine, M. (1969) "Landing fees and the airport congestion problem", The Journal of Law and Economics 12, 1, 79-108.

Lijesen, M. G., Rietveld, P. and Nijkamp, P. (2000) "Do European Carriers dominate their Hubs?", Tinbergen Institute Discussion Paper TI 2000-071/3

Madden, M. and White, N. F. (2003) "The long-term capacity auctions: A review of the UK gas entry capacity regime", The Energy Publishing Network, Oxford OX4 6EN, United Kingdom

Maldoom, D. (2003) "Auctioning capacity at airports", Utilities Policy 11, 47-51.

McDaniel, T. (2003) "Auctioning access to networks: evidence and expectations", Utilities policy 11, 33-38.

McDaniel, T. and Neuhoff, K. (2002) "Auction to gas transmission access: The British Experience", Cambridge University Department of Applied Economics Working Paper

McDaniel, T. and Neuhoff, K. (2002) "Use of long-term auctions for network investment"

Morrison, S. A. (1987) "The equity and efficiency of runway pricing", Journal of Public Economics 34, 45-60.

Newbery, D. (2003) "Network capacity auctions: Promise and problems", Utilities Policy 11, 27-32.

Perkins, E. and D. Jenkins (2001) "Market-based solutions to airport congestion", OST-2001-9849.

Rassenti, S. J., V. L. Smith and R. L. Bulfin (1982) "A combinatorial auction mechanism for airport time slot allocation", The Bell Journal of Economics 13, 402-417.

Sentence, A. (2003) "Airport slot auctions: desirable or feasible?", Utilities Policy 11, 53-57.

Stern and Turvey (2003) "Auctions of capacity in network industries", Utilities Policy 11, 1-8.

Stirland, R. T. and K. Kwong (1991) « The new airport and aviation in Hong Kong – A new perspective : Comment and Reply, HKCER Letters, Vol.6.

U.S. Department of Transportation, Federal Aviation Administration (2001) "Comments on airports control, international – north America", FAA-2001-9854.

Walters, A. A. (1973) "Investment in airports and the economist's role. JFK International Airport: An example and some comparisons", in Cost Benefit and Cost Effectiveness, Wolfe (ed.).

Wolfe, J. (1973) "Cost Benefit and Cost Effectiveness"

Yarrow, G (2003) "Capacity auctions in the UK energy sector", Utilities Policy 11, 9-20.

APPENDIX E.   APPROACH TO QUANTITATIVE ASSESSMENT OF IMPACTS

E.1.   Overview of Modelling Approach

Any market-based slot allocation mechanism will work by confronting airlines with an effective cost that reflects the scarcity value of each slot at congested airports (ie how much another airline would be willing to pay for it). This effective cost may be a direct cash cost that the airline must pay to continue using the slot, or it may be an opportunity cost that reflects the income the airline might earn by selling the slot to another airline. But in each case, the airline's decisions in relation to slot usage will depend on whether it is willing (and able) to bear the higher cost necessary to continue using peak slots at congested airports.

To carry out a quantitative assessment of the impact of market-based allocation mechanisms, therefore, requires an analysis of how different types of airlines are likely to respond to these new cost signals. Unfortunately, there is very little practical experience of the application of market mechanisms that can be used to inform such a quantitative analysis. There is no experience at all of primary trading mechanisms (such as higher posted prices or auctions) being used to allocate slots at congested airports.[252] And the experience to date of secondary trading is of relatively little value because of factors such as the uncertain legal status of the existing grey market in the UK,[253] or the very limited extent of slot trading in the US.[254]

Instead, therefore, our quantitative analysis is based on industry data describing the current and future extent of excess demand, and an assessment (based, among other things, on information collected during our interview programme, but also compared with other studies which identify the importance of airport charges in relation to total airline costs) of the likely price sensitivity of different types of service. We have identified eight different categories of service, reflecting differences in cost and revenue structures that we believe will influence their likely responses to market mechanisms:

- hub alliance short-haul;

- hub alliance long-haul;

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[252]   A peak pricing structure has been applied at the London airports in various forms from the late 1970s onwards, but peak prices have not been set at market-clearing levels.

[253]   This status means that there is unlikely to be as much pressure (from shareholders, financiers or others) as might be placed on airlines to sell their slot holdings in a legitimised and well-functioning market. The fact that the current market is very "thin" also means that slot holders may have little confidence that they will achieve the maximum price in any sale, and both the low number of transactions and the uncertain legal status will act to limit the scope for independent agents to act as slot brokers or trade facilitators.

[254]   Trading occurs only at four airports and, even more importantly, is restricted only to domestic services. There is no scope, for example, for airlines wishing to operate transatlantic services to acquire slots that are currently used for short haul services.

- other alliances short-haul;

- other alliances long-haul;

- low cost;

- charter;

- other short-haul; and

- other long-haul.

Having estimated how each type of airline would respond to the introduction of market mechanisms, we then use data on plane size, load factors and slot utilisation rates to estimate the overall impact of these airlines' responses.

Because of the lack of evidence in relation to specific market mechanisms, our overall approach has been:

- first, to estimate the impact of a theoretical "frictionless" or "ideal" market mechanism. This indicates the potential impact of market-based allocation mechanisms in an ideal world (defined, among other things, by perfect information, rational and profit-maximising behaviour by airlines, no transactions costs and no feasibility problems). This process is described in Section E.2 below. Appendix F contains a detailed example of this calculation, for one particular hour at MAD airport;

- second, to take account of particular reasons why individual market mechanisms may fail to deliver the full impact of the ideal mechanism. These reasons, which are discussed in Sections 7, 8 and 9 of the main report, form the basis of the specific assumptions described in Sections E.3 to E.6 below. For each mechanism, we have generated "low case", "central case" and "high case" estimates, reflecting the potential degree of uncertainty associated with the impact of each mechanism.[255]

Our quantitative analysis is based on a mixture of hard data and specific numerical estimates or assumptions, and the results implied by each stage of our modelling work have been subject to extensive "sense checking". This was carried out to ensure that these estimates are consistent with the extensive qualitative analysis of the impact of either market mechanisms in general, or individual market mechanisms, as set out in Sections 6 to 11 of the main report.

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[255] The ranges for each mechanism are largely independent of each other. It would not be inconsistent, for example, for a reader to conclude that the low case is the most plausible estimate of the impact of one specific mechanism, but for another mechanism the high case estimate is the most appropriate.

E.2. Ideal Market Mechanism

E.2.1. Overview

Our analysis of the potential impact of an ideal market mechanism is based on three main stages, as summarised in Figure E.1 below:

- **Stage 1: Estimating the Extent of Excess Demand in 2007**. We have taken 2007 as a representative future year, so that our analysis can take account of expected demand growth and anticipated capacity additions, and also so that any short-term or transitional impacts may have ceased.[256] This analysis is based on data provided by slot co-ordinators and airports about both the current level and structure of demand, and also their forecasts of future demand growth and airport capacity changes;

- **Stage 2: Estimating the Impact of Using Market Mechanisms to Remove this Excess Demand**. There are two separate components to this part of the analysis

  - first, calculating the price increases required, at different times and at different airports, to remove the excess demand which was estimated in Stage 1. This is only an intermediate calculation (rather than an important result in its own right), since our analysis is driven by assumptions about the <u>relative</u> price sensitivity of different types of service, and

  - second, calculating the likely impact of such a price increase on different types of airline or service (given their differing degrees of price sensitivity), and therefore establishing the likely impact of market mechanisms on the pattern of usage at each airport. As well as changes in the mix of services (for example, a switch to more long haul services), we estimate the likely scale of traffic switching to off peak times, and the better utilisation of peak slots.

- **Stage 3: Calculating the Impact on Passenger Numbers, Air Transport Movements etc**. The final stage of the analysis, using industry data on plane sizes and load factors, is to translate the changes predicted during Stage 2 into specific overall impacts.

After outlining our theoretical framework in Section E.2.2, each of these three main stages is described in Sections E.2.3 to E.2.5. We also estimated environmental impacts, which are described in Section E.2.6. Finally, though not reported in this Appendix, at this stage we also generated estimates of hub concentration, as reported in Section 6 of the main report.

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[256] This does not necessarily mean, however, that we believe that each of the mechanisms could be introduced, and any transitional impacts would have definitely ceased, by 2007. Instead, it is adopted simply as a common future reference point for our comparative analysis. Moreover, we have not attempted to forecast any changes in service patterns at congested airports that might occur in the period to 2007 under the current slot allocation system – instead we have assumed that the distribution of traffic between different types of service remains unchanged.

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**Figure E.1
Overview of Modelling Stages**

Stage 1	Stage 2a	Stage 2b	Stage 3
How much excess demand?	What slot price increases required to remove excess demand?	How do these slot price increases affect slot allocations?	What impact on passenger numbers, movements, etc?
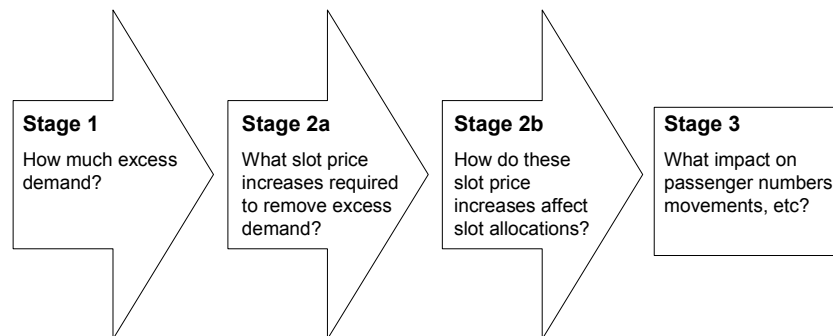
Figure E.2 summarises the way that we have used schedules data, forecasts of traffic growth and capacity changes, and estimates of relative price elasticities, to generate quantitative estimates of the impact of market mechanisms. We carried out separate calculations for a sample of five congested airports with varying degrees of excess demand (LHR, LGW, CDG, MAD and VIE), and then extrapolated the results to generate an estimate of the overall impact across all EU Category 1 airports. This provides the basis for the estimated impact of the ideal market mechanism, described in Section 6 of the main report.

**Figure E.2
Overview of Modelling Approach**
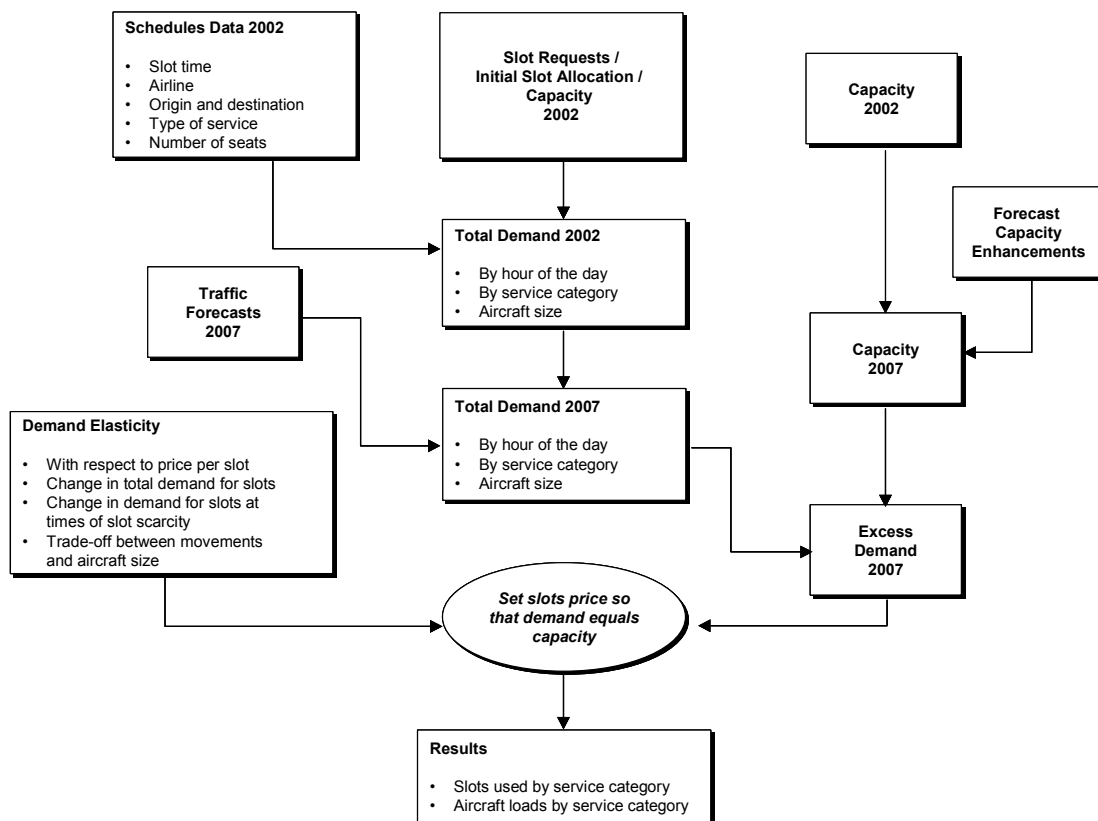
E.2.2. Theoretical framework

The current allocation of slots at congested airports may well reflect the historical development of services, especially the presence over a long period of certain airlines that obtained slots when the airport was uncongested and now continue to enjoy grandfather rights, rather than the relative values now associated with different types of service. If slots were allocated, instead, through an ideal market mechanism, then the price (or opportunity cost) per slot in each time period would be set so as to bring the demand for slots into line with the number of slots available. Where there is currently excess demand for slots, the price would need to rise until airlines had reduced their demand sufficiently (either by withdrawing existing services or by switching services to uncongested periods) to eliminate the excess demand.

The resulting impact on the mix of services is illustrated in Figure E.3 for an airport with two types of services, *1* and *2*.[257] The demand for airport slots at a particular time of day from each of the services is shown by the demand curves D_1 and D_2, with total demand shown by the line D_{1+2}. The maximum capacity of the airport at this time is $\overline{Q}$, but the cost-based airport charge is P and at this price total demand is considerably higher than the available capacity (indeed, at price P, the demand for slots from service *1* alone is greater than $\overline{Q}$).

In practice, we cannot observe the underlying demands from each type of service (ie Q_1 and Q_2) directly. While co-ordinators will know the number of slots that individual airlines apply for, this may differ from their true underlying demand. Instead, we observe the number of slots actually allocated to each type of service. These are not shown in Figure E.3, in part because this depends on how the co-ordinator resolves the situation of excess demand. If we assume that each type of service is allocated the same proportion (ie $\overline{Q}$ / Q_{1+2}) of its underlying demand for slots at price P, then service *1* will receive more slots than service *2*.

In this example, the demand for service *1* is more price sensitive (or "elastic") than the demand for service *2*. The application of a market mechanism to allocate capacity $\overline{Q}$ would require an increase in the price per slot from P to $\overline{P}$. This would reduce the total demand for slots to the level where it matches the available capacity (ie $\overline{Q}$). But the higher price per slot would have a relatively greater impact on the demand for service *1*, so that the airline(s) concerned would purchase fewer slots for service *1* than for service *2* under a market-based allocation mechanism.

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[257] This is a simplifying assumption so that the methodology can be represented diagrammatically. Our analysis considers eight categories of service, as already described.

Figure E.3
The Effects of Applying Market Mechanisms
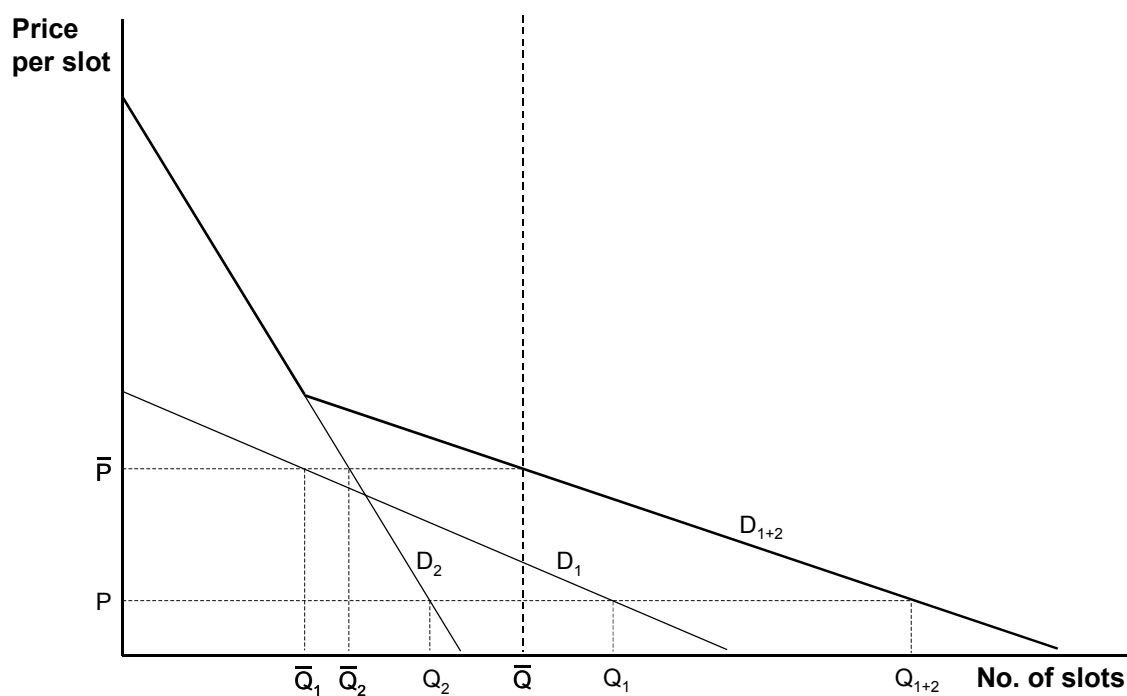
In order to apply this approach to estimate the impact of market mechanisms, we therefore need to employ data and assumptions on:

- the extent of excess demand for slots at each airport, and how this is distributed between different types of service; and

- the relative sensitivity of the demand from different types of service to changes in airport charges.

These issues are discussed in the next two subsections, which describe the first two stages of the overall methodology set out in Section E.2.1 above.

E.2.3. Stage 1: Estimating the extent of excess demand in 2007

The first stage of our quantitative analysis of the impact of an "ideal" market mechanism is to establish the likely degree of excess demand in 2007 (our reference year). In broad terms, our forecasts of excess demand in 2007 are based on an hour-by-hour comparison, for each of the five congested airports in our sample, of projections of:

- the <u>demand for slots</u> in 2007, which we calculate using a combination of current schedules data, information about current slot requests provided by co-ordinators, and airport operators' forecasts of demand growth; and

- the <u>available capacity</u> at each airport in 2007. This is based on information provided by airport operators and co-ordinators about existing capacity levels, and also their forecasts of any additions to capacity that will be provided by 2007.

At uncongested times of the day, the level of demand in 2002 could be taken directly from the schedules data provided by each co-ordinator (see Box E.1).

At congested times of the day, however, the actual number of movements is not necessarily a good indicator of the level of underlying demand for slots, as it does not take account of slot requests that have been turned down. We obtained detailed data on the number of slot requests from each co-ordinator, but even these data may not provide an accurate indication of the true level of underlying demand, as:

- at modest levels of congestion, airlines may submit "too many" slot requests, as they know that some of these requests are likely to be unsuccessful;

- in contrast, where excess demand is very high the number of slot requests is more likely to understate the true level of underlying demand, as in many cases airlines will recognise that they stand virtually no chance of obtaining a slot that they would like.

We have taken account of the first of these effects by reducing the extent of excess demand implied by slot request data (for each hour) by five percentage points. In cases of high excess demand, our approach was inevitably more subjective, based mainly on information collected at interviews with airport operators, co-ordinators and airlines.

Table E.1 summarises the current situation at each of the five airports. Although we obtained data from co-ordinators on the actual number of movements at each airport for each five-minute slot, Table E.1 only shows the averages across the day (04:00 to 22:00 hours GMT). The difference between the second and third columns (average ATMs per hour and

estimated demand) indicates our broad assessment of the level of excess demand at present at each of these airports.[258]

Box E.1
Schedules Data

Schedules, provided by each co-ordinator, were a key source of data in this analysis. Each row, or record, in the data provides information on a particular flight, and every flight allocated a slot during the course of a season is recorded. We used the main fields of the data as follows:

Slot time, frequency, start date, end date These fields together specify the dates and times at which each flight operates, and so can be aggregated to identify the number of flights scheduled for any hour on any particular day.

A/D We aggregated flights scheduled according to whether they were arrivals (A) or departures (D) to examine the implications for runway directional capacity constraints.

Airline code The airline code allows us to distinguish between hub carriers, other alliance carriers, low cost carriers and other carriers.

Seats The number of seats available for each flight was used, together with assumptions on load factors, to estimate the number of passengers using each flight. (We did not make use of the adjacent field stating the type of aircraft used.)

Service type The IATA type codes distinguish charter flights and schedule flights with passengers from other services (including all cargo services, military and general aviation) which we did not consider in our analysis.

O/D (airport code) This shows the origin or destination (for arrivals and departures respectively) of each flight. By analysing the airport codes, we were able to classify each flight as either short haul (which we defined as being within Europe) or long haul (beyond Europe).

We used three kinds of schedules data. The **end of season** data closely reflected the slots actually used during the season, because it incorporated late changes to the schedules. We were also provided with data **on slot requests**, and slots allocated in response to the requests (the **initial allocation**). We had requested the latter data in more aggregate form, distinguishing between arrivals and departures and by hour of the day – which allowed us to see if runway capacity constraints were binding - but not between short haul and long haul or other service characteristics. The data on slot requests were useful for understanding the extent of excess demand, whilst the initial allocation allowed us to check and improve our understanding of capacity constraints at the airport.

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[258] Table E.1 shows the average estimated demand across the day as a whole, whereas our detailed calculations are based on separate estimates of the extent of underlying demand for each hour of the day.

Table E.1
Extent of Excess Demand in 2002

	Average actual movements (ATMs per hour)	Estimated average demand (ATMs per hour)	Capacity (ATMs per hour)	Hours per day with excess demand
LHR	74	126	86.25	14
LGW	40	56	45.5	13
CDG	81	90	97	14
MAD	56	60	78	7
VIE	33	34	66	2
Source	*Co-ordinators' schedules data*	*NERA estimates, based on data on slot requests, slots used and information from interviews*	*Airport capacity declarations*	*Derived from data on slots used*

Note: Excess demand can occur even if the number of movements in a particular hour is less than the theoretical capacity. This reflects the impact of additional restrictions, such as directional constraints, which also affect an airport's capacity.

In order to carry this analysis forward to 2007, we have:

- increased estimated demand (for each hour of the day) in line with airport operators' forecasts of demand growth between 2002 and 2007; and

- increased airport capacity in line with any specific additions to capacity expected by airport operators by 2007.

The resulting estimates of excess demand in 2007 are shown in Table E.2. The second and third columns show our estimates of the average level of underlying demand at each airport, and also the capacity available, in 2007. The fourth column shows the number of hours per day that underlying demand is predicted to be above the available capacity, and the final column then shows the extent of excess demand, calculated as an average across all of the hours with excess demand.[259]

There are some significant variations within the average figures shown in Table E.2. At MAD and particularly VIE the periods of excess demand are quite isolated and we expect there to be significant spare capacity at other times of the day. At CDG there is some excess demand for both take-offs and landings during peak periods. However, at other times, excess demand for take-offs may coincide with unallocated landing slots (and vice-versa). When this occurs, the total demand (for take offs and landings) may be less than the

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[259] These data are shown in summary form, as averages across the entire day (or, in the case of the final column, across all periods where there is excess demand). Our detailed quantitative analysis is based on the projected extent of excess demand for each hour (and each airport), rather than the average data shown in Table E.2.

theoretical capacity of the airport if the volume of take-offs and landings was equal. But at LHR and LGW, we expect there to be severe excess demand more or less throughout the day. Because of this, and the fact that these airports are already very heavily congested, our estimates of the underlying demand for slots (and therefore the scale of excess demand) at these airports are inevitably quite subjective.

Table E.2
Projected Extent of Excess Demand in 2007

	Estimated average demand (ATMs 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
Source	*NERA estimates for 2002 (see Table E.1), & operators' demand forecasts to 2007*	*From airport operator information*	*Calculated from demand and capacity forecasts*	*Calculated from demand and capacity forecasts*

Note: Excess demand can occur even if the number of movements in a particular hour is less than the theoretical capacity. This reflects the impact of additional restrictions, such as directional constraints, which also affect an airport's capacity.

Figure E.4 illustrates the projected pattern of excess demand throughout the day at each of the five airports in 2007. Since excess demand can arise for a number of reasons (such as air traffic control restrictions or directional constraints) in addition to simply runway capacity constraints, we have had to make a number of simplifying assumptions in order to show excess demand in a diagram such as Figure E.4. The pattern of excess demand (shown with the lighter bars in Figure E.4) is consistent with our view of the likely situation at each airport in 2007, and reflects the combined impact of all relevant constraints.[260]

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[260] In some cases, the total number of movements is below the theoretical runway capacity at an airport, under conditions where the volume of take-offs and landings is approximately equal. However, the effective capacity of the airport may be less than the theoretical capacity, because of directional constraints. Under these conditions, there may be excess demand for arrival slots, but some departure slots are unallocated (and vice versa). Figure E.4, shows the extent of excess demand relative to the *effective* airport capacity. For CDG, the likelihood of there being unallocated slots even when there is excess demand for either take-offs or landings supports our prediction of additional off-peak movements for scheduled as well as charter carriers (see Section E.2.4.1).

Figure E.4: Estimated Patterns of Excess Demand in 2007
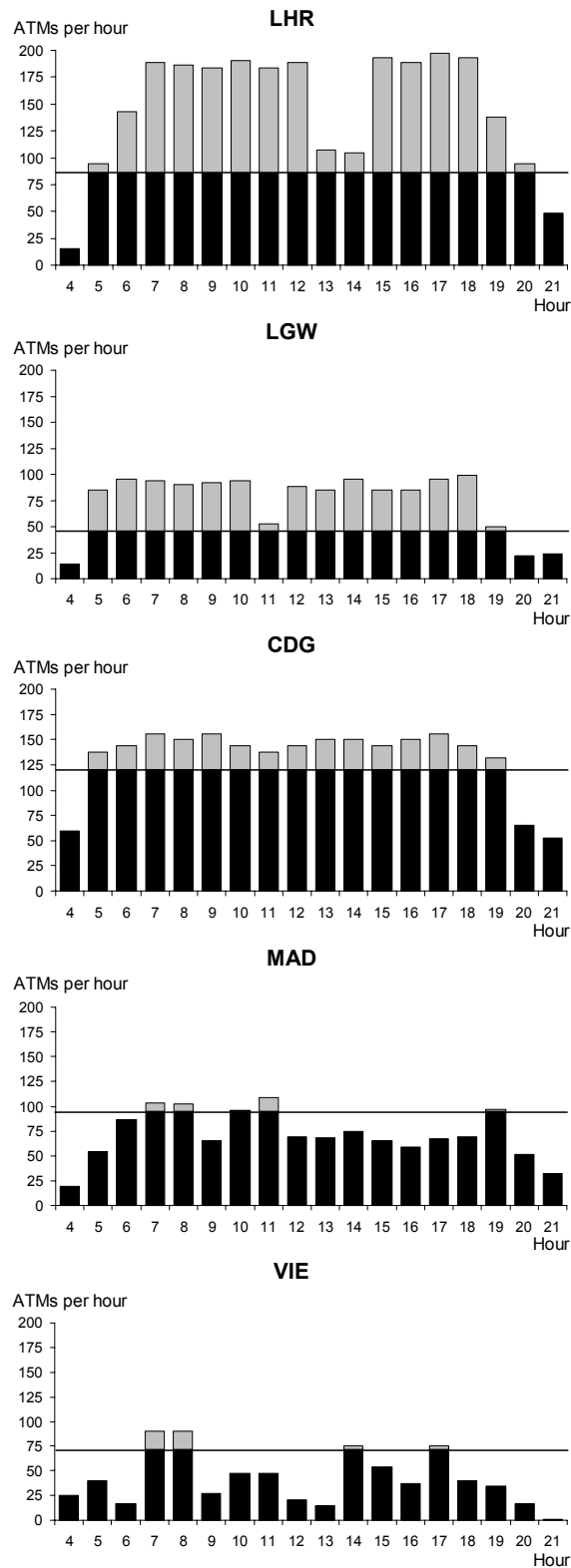
Note: These charts show our estimates of the extent of <u>excess demand</u>, rather than necessarily the total demand for slots. See the footnote above.

The estimates of excess demand in 2007 shown in Figure E.4, while disaggregated by airport and by hour, still refer to total demand from all airlines, rather than demand from each of the eight categories of service listed in Section E.1. In order to generate disaggregated demand projections for each individual service type, therefore we have broken down our projection of total demand as follows:

- in general, we have assumed that make-up of total demand (ie the percentage share of each service type) is the same as the current mix of actual services using the airport.[261] In effect, this assumes that the relative strength of underlying demand from different services is accurately reflected in the current pattern of airport usage, and also that future demand growth is spread evenly across different service types;

- in the case of low cost airlines, however, we have adjusted their shares to take account of the fact that they are likely to be underrepresented in existing slot allocations (except at LHR, as low cost airlines have no interest in operating from this airport). As most low cost airlines have entered the market quite recently, they will not have had many opportunities to acquire slots at currently congested airports. For most congested airports (and LGW and CDG in particular), therefore, we have assumed that low cost airlines' share of underlying demand is greater than their share of existing services.[262]

In addition, as demand for slots at LHR and LGW are interrelated, and airlines may chose to transfer between the two, we have reallocated demand by service type between the two airports on the basis of our understanding of airline strategy, informed by the interview programme (the principal implication of this is that most long haul airlines would prefer to operate from LHR).

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[261] The current mix of services using the airports that we have considered is shown in Table E.8 below for LHR and LGW, and in Table E.9 below for CDG, MAD and VIE.

[262] More specifically, we have assumed that low cost carriers account for respectively 38%, 5%, 4% and 4% of underlying demand <u>at current charges</u> during periods of excess demand at LGW, CDG, MAD and VIE. However, as these services are also assumed to be relatively price sensitive, they will account for lower proportions of demand at the levels of slot charges necessary to clear the market.

E.2.4. Stage 2: Estimating the impact of using market mechanisms to remove this excess demand

Having estimated the underlying demand for slots, disaggregated for each airport and for each hour between eight different service categories, the next stage of our analysis is to simulate the impact of using a market mechanism to allocate slots in cases where there is excess demand. This analysis, in turn, is carried out in two separate stages:

- in Stage 2a, we estimate the increase in slot charges, for airport and each congested hour, necessary to eliminate excess demand. This is based on an analysis of airline price elasticities, which then allows us to calculate the required increase in slot charges;

- in Stage 2b, we examine the impact of these increases in slot charges on slot usage. As well as a change in the mix of traffic using slots at peak times, we expect some services to switch to off-peak times, and some services to maintain capacity by operating larger planes at less frequent intervals. In addition, the ability of low cost carriers to obtain peak slots may, in some cases, encourage them to introduce new regular services and therefore increase their use of off-peak slots as well.

It is only the <u>relative</u> price sensitivity (or "elasticity") of different types of service that affects our results. The aim of our analysis is to estimate the change in the mix of traffic following the introduction of market mechanisms, and the implied price increase at any airport or for any particular hour is only an intermediate input into this calculation. Thus, for example, if we had correctly estimated the <u>relative</u> price elasticities of the different service types, but underestimated the <u>absolute</u> level of each price elasticity, then our analysis would overestimate the price increase necessary to clear the market. But the final output of this analysis, namely the change in the mix of traffic caused by the introduction of market mechanisms, would still be correct.

E.2.4.1.   Stage 2a: Calculating the price increases required to remove excess demand

Our simulation of the likely impact of increased slot charges on different types of airline and service is based on a set of assumptions about the relative price sensitivity – or the "price elasticity" – of different types of service. In broad terms, we consider three main reasons why airlines might change their use of peak time slots in response to higher slot charges:

- airlines might simply withdraw services that become unprofitable (or insufficiently profitable) because of the increase in slot charges. We refer to this as the "<u>demand suppression</u>" effect, and show separate demand suppression elasticities below;

- some airlines might decide to <u>switch services to off-peak slots</u> or even to uncongested airports. Clearly, the ability to do this depends on there being suitable off-peak capacity available, and also on passengers' likely reactions to such switches. Leisure travellers, for example, or long haul passengers (except where they are

connecting with another flight), may be more willing to switch times than business travellers;

- some airlines, particularly on short haul routes with frequent services, might decide to maintain the same level of capacity by using <u>larger planes</u> and moving to less frequent services.

E.2.4.1.1.   Demand suppression elasticities

While an increase in airport (or slot) charges will affect all services using congested airports, they are likely to have the most serious impact on either services for which airport charges already represent a high proportion of total costs, or else services that operate on low margins at present. Both of these factors increase the risk that a certain (proportionate) increase in airport charges will render a service unprofitable.[263]

The proportion of total costs formed by airport charges for various types of service is shown in Table E.3. The figures in the table have mainly been supplied to us by airlines during our interview programme. But they are also consistent with evidence from other studies.[264]

Table E.3
Importance of Airport Charges in Total Airline Costs

Category	Airport charges as % of total costs
Long-haul	2 to 5
Short-haul	5 to 10
Regional/low-cost/charter	10 to 15

Source: Interview programme; NERA estimates

The next table, Table E.4, shows the assumptions that we have used for the relative size of this demand suppression effect for different types of service. These assumptions are based on:

- the relative importance of airport charges as a proportion of total service costs, as shown in Table E.3; and

- an analysis of the likely price sensitivity of different airlines within each group. In particular

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[263]   While airlines could try to pass these additional costs on to their passengers, for the reasons set out in Section 6.8 of the main report we do not believe this to be a realistic strategy (unless fares were previously set below the profit-maximising level).

[264]   For example, similar figures are cited, for specific airlines, in Doganis R, *Consultancy Advice on Aviation Issues for the Department of the Taoiseach*, January 2002.

- services operated by the hub carrier (or its alliance partners) at major hub airports will be least price sensitive, reflecting both the network externalities at hub airports and also the fact that airlines with large slot holdings at particular airports will have more chance to optimise their use of slots than will airlines with only a few slots or that only operate a small number of routes to that airport,

- low cost carriers and non-alliance scheduled operators are likely to be the most price sensitive, reflecting the different business model of low cost airlines and the fact that some services operated by non-alliance scheduled carriers are likely to operated at low margins (such as regional short-haul services, and some low value long haul-services).

Sections 6.2 and 6.3 of the main report contain a detailed discussion of the reasons we believe that particular types of service will be more price sensitive than others.

In addition, for LHR and LGW we have adjusted our assumptions to take account of the fact that some trading has already taken place within the existing grey market, and also that BA and its alliance partners are likely to take advantage of opportunities to transfer some services from LGW to LHR.

Table E.4
Relative Size of "Demand Suppression" Elasticities

	LHR	LGW	CDG, MAD & VIE
Hub alliance short-haul	-0.45	-0.6	-0.5
Hub alliance long-haul	-0.25	-0.4	-0.25
Other alliances short-haul	-0.6	-0.6	-0.7
Other alliances long-haul	-0.3	-0.3	-0.3
Low cost	-1.0	-1.0	-1.0
Charter	-0.5	-0.5	-0.5
Other short-haul	-0.7	-0.85	-1.0
Other long-haul	-0.4	-0.4	-0.4

Note: This table shows <u>relative</u> elasticities only, with the elasticity for low cost services "normalised" as –1.

E.2.4.1.2.   Elasticities for switching to off-peak slots and use of larger planes

Table E.5 summarises our assumptions in relation to these additional demand impacts, and then Table E.6 shows the total demand elasticities assumed for each type of service and for each airport.

The elasticity with respect to switching to off peak slots varies by airport according to the number of hours for which there is spare capacity. The fact that there is virtually no off-peak capacity at LHR, and very little at LGW, is reflected in assumptions (which are almost

all zero) for these airports. In contrast, as shown in Figure E.4 above, we believe there will be some off-peak capacity available at CDG, and quite a lot at MAD and VIE. For the reasons set out in Section 6.3 of the main report, we believe that charter services will be most likely to switch to off-peak slots, though there may be a smaller amount of switching by full service airlines other than the hub carrier. In setting these assumptions, we also drew on research carried out by BAA in the 1980s when it set higher peak time tariffs and recorded which flights rescheduled to off-peak times.[265]

We believe that short-haul services provide the greatest scope for switching to larger planes and lower frequencies (in response to higher charges for each slot), though much less so at LHR and LGW where the current structure of airport charges already discourages the use of small aircraft. For the other airports, the elasticities were derived by examining the impacts on aircraft size at different times of day, and checking that these sizes were comparable with those at other airports.

Table E.5
Other Demand Elasticity Assumptions

	LHR	LGW	CDG	MAD	VIE
Switching to off-peak slots					
Hub alliance short-haul	0	0	0	0	-0.1
Hub alliance long-haul	0	0	0	0	-0.1
Other alliances short-haul	0	0	-0.1	-0.2	-0.2
Other alliances long-haul	0	0	-0.1	-0.2	-0.2
Low cost	0	0	0	0	0
Charter	0	-0.1	-0.5	-1.0	-1.0
Other short-haul	0	0	-0.1	-0.2	-0.2
Other long-haul	0	0	-0.1	-0.2	-0.2
Use of larger aircraft					
Hub alliance short-haul	0	0	-0.05	-0.05	-0.05
Hub alliance long-haul	0	0	-0.01	-0.01	-0.01
Other alliances short-haul	-0.03	-0.03	-0.07	-0.07	-0.07
Other alliances long-haul	0	0	-0.02	-0.02	-0.02
Low cost	0	0	0	0	0
Charter	0	0	0	0	0
Other short-haul	-0.04	-0.04	-0.10	-0.10	-0.10
Other long-haul	0	0	-0.02	-0.02	-0.02

Note: This table shows <u>relative</u> elasticities only, with the "demand suppression" elasticity for low cost services "normalised" as –1.

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[265] Reported in M R Toms (1994), "Charging for Airports: The New BAA Approach", Journal of Air Transport Management.

Table E.6
Total Demand Elasticities

	LHR	LGW	CDG	MAD	VIE
Hub alliance short-haul	-0.45	-0.60	-0.55	-0.55	-0.65
Hub alliance long-haul	-0.25	-0.40	-0.26	-0.26	-0.36
Other alliances short-haul	-0.63	-0.63	-0.82	-0.97	-0.97
Other alliances long-haul	-0.30	-0.30	-0.37	-0.52	-0.52
Low cost	-1.00	-1.00	-1.00	-1.00	-1.00
Charter	-0.50	-0.60	-1.00	-1.50	-1.50
Other short-haul	-0.74	-0.89	-1.15	-1.30	-1.30
Other long-haul	-0.40	-0.40	-0.47	-0.62	-0.62

Note: This table shows <u>relative</u> elasticities only, with the "demand suppression" elasticity for low cost services "normalised" as –1.

From these elasticities, and our projections of excess demand in 2007 (see Section E.2.3), we can then calculate the increase in slot charges necessary to eliminate excess demand. We carried out iterative calculations (for each airport and for each hour where there is excess demand) in order to calculate the price change that would reduce excess demand to zero. As shown in Table E.7, for example, we found that a slot price increase of 29 per cent would be just sufficient to reduce demand at CDG between 14.00 and 15.00 from our projection of 150 slots to the available capacity of 120 slots.

Table E.7
Eliminating Excess Demand, 14:00 to 15:00 hours, weekday at CDG

	Underlying Demand for Slots	Total Elasticity	Predicted Demand for Slots[266]
Price per slot	As currently		+29%
Hub alliance short-haul	56.7	-0.55	47.8
Hub alliance long-haul	17.9	-0.26	16.6
Other alliances short-haul	18.5	-0.82	14.1
Other alliances long-haul	4.4	-0.37	3.9
Low cost	7.8	-1.00	5.6
Charter	7.4	-1.00	5.3
Other short-haul	28.6	-1.15	19.2
Other long-haul	8.7	-0.47	7.6
Total Slots	150.0		120.0

Note: The total number of available slots is 120

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[266] This is calculated by applying the relevant elasticity to the change in price. Thus demand for hub alliance short-haul slots is reduced by nearly 16% (from 56.7 to 47.8 slots) because +29% × -0.55 = -16%.

While we have calculated market-clearing price increases in a similar way for each airport and each congested hour, we would point out that these results are only intermediate calculations that feed into our analysis of the <u>relative</u> impact of market mechanisms on different types of service.

E.2.4.2. Stage 2b: Calculating the likely impact of these price increases

E.2.4.2.1. Change in mix of services

Using the slot price increase estimates described above (and illustrated in Table E.7), and the demand elasticity assumptions set out in Table E.4 and Table E.5, the next stage is then an entirely mechanical calculation to establish the mix of services that would be allocated slots, for each airport and each congested hour, under an ideal market mechanism.

Table E.8 and Table E.9 summarise the results of these calculations, by showing the change in the mix of traffic, on average (rather than by hour), at each airport. These results are discussed in more detail in Section 6.4 of the main report, and Appendix F includes an example of this calculation for one particular hour at MAD.

Table E.8
Modelled Shift in Services: LHR and LGW

	LHR		LGW	
	Current Movements (%)	Predicted Movements (%)	Current Movements (%)	Predicted Movements (%)
Hub alliance short-haul	34.3%	37.7%	32.6%	26.1%
Hub alliance long-haul	12.9%	15.8%	4.4%	2.1%
Other alliances short-haul	12.3%	10.2%	1.6%	2.3%
Other alliances long-haul	5.5%	7.4%	1.6%	0.0%
Low cost	0.0%	0.0%	7.9%	26.8%
Charter	0.2%	0.2%	27.3%	24.7%
Other short-haul	24.4%	15.9%	18.6%	11.3%
Other long-haul	10.4%	12.9%	5.9%	6.6%
All services	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Schedules data, NERA estimates

Table E.9
Modelled Shift in Services: CDG, MAD and VIE

	CDG		MAD		VIE	
	Current Movements (%)	**Predicted Movements (%)**	**Current Movements (%)**	**Predicted Movements (%)**	**Current Movements (%)**	**Predicted Movements (%)**
Hub alliance short-haul	39.0%	38.8%	40.7%	39.4%	61.7%	59.1%
Hub alliance long-haul	12.3%	13.2%	4.1%	4.0%	6.3%	6.2%
Other alliances short-hl	12.7%	11.9%	7.8%	7.5%	5.4%	5.1%
Other alliances long-hl	3.0%	3.2%	1.1%	1.1%	0.0%	0.0%
Low cost	2.1%	4.9%	1.1%	4.9%	0.0%	4.7%
Charter	5.1%	5.2%	1.1%	1.1%	8.2%	7.9%
Other short-haul	19.7%	16.7%	41.2%	39.3%	17.0%	15.7%
Other long-haul	6.0%	6.2%	2.8%	2.7%	1.4%	1.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Schedules data, NERA estimates

E.2.4.2.2.   Further impacts on demand at off-peak times

In addition to possible switching from peak to off-peak slots (which is captured by the elasticities shown in Table E.5), there may be some complementarities between peak and off-peak demand. In particular, if an airline wishes to introduce a regular service (either to ensure efficient utilisation of planes, or because a regular service is more likely to attract passengers), but cannot do so because it cannot obtain slots at certain times of the day, then this could depress the demand for slots at off-peak periods. If, because of the introduction of market mechanisms, the airline can now obtain the required pattern of slots, then this may lead to an increase in off-peak slot usage (as well as a change in the pattern of services provided at peak times).

Given the changes in the allocation of peak slots shown in Table E.8 and Table E.9 above, such complementarities are most likely to affect low cost carriers. The business model of low cost airlines relies on high aircraft utilisation rates and fast turnaround times. While high utilisation rates might still be achieved, even in the absence of peak slots, by diagramming planes onto other routes at certain times of the day, we note that:

- congested airports tend to be attractive destinations in their own right, and therefore low cost airlines may well want to run services throughout the day to and from these airports; and

- the low cost carriers that acquire peak slots are most likely to be yield-oriented (rather than cost minimising) carriers.[267]   These airlines seek to attract business passengers (who generally prefer to fly with airlines that offer regular services) as well as leisure travellers.

We therefore conclude that the increased share of peak slots allocated to low cost carriers is likely to generate an additional demand for slots at off-peak periods as well. Our estimate of this impact is based on the ratio of peak to off-peak slots at each airport. At MAD and VIE, for example, the number of additional off peak-movements is estimated to be 2.5 times the number of additional peak movements.[268] For CDG, where there are fewer off-peak hours, the ratio is 0.2. And for LGW and LHR, the ratios are 0.05 and zero respectively.

E.2.4.2.3.   Better slot utilisation

In Section 4.3 we presented some evidence on the extent to which slots are returned to the slot pool after the deadline specified by Regulation 95/93, and so remain unused. On the basis of co-ordinators' statistics, we estimate that between 6 and 9 per cent of slots allocated at the time of the deadline are not used.

Currently, there is little incentive to return slots by the deadline. However if airlines were to incur a cost for late returns we would expect their incidence to decrease. This was demonstrated when the recent Royal Decree in Spain specified fines that would be levied on airlines who did not return unwanted slots by the deadline. The incidence of late returns fell to 2 per cent of all slots allocated in the season after this Decree was implemented, compared to more than 6 per cent in earlier seasons.

We infer from this that, with such a sanction, utilisation of scarce slots would increase. This is supported by analysis undertaken by AdP, which found that around 60 per cent of all unsatisfied slot requests at CDG could have been satisfied to within an hour of the requested time if there had been no late return of slots.

Market mechanisms impose a price on slots, irrespective of whether they are used, so that airlines would be less inclined to retain slots that they do not ultimately use. Hence, on the

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[267]   See Section 6.2 of the main report for an explanation and discussion of this distinction.

[268]   For many short haul routes, there are typically three or four rotations in a single day.

basis of the evidence we have reviewed, we have assumed that under an ideal market mechanism the incidence of slot utilisation increases by 3 per cent at CDG, MAD and VIE.[269]

At LHR and LGW very few slots are returned late, and so we have not assumed any equivalent increase in slot utilisation.

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[269] This is equivalent to assuming that around 30 to 50 per cent of all slots that are currently returned late would be used if slots were allocated by an ideal market mechanism.

E.2.5. Stage 3: Estimating the impact on passenger numbers, movements, etc

The final stage of our quantitative analysis is to translate the various separate impacts identified in Section E.2.4.2 into an overall impact on passenger numbers and the number of air traffic movements. This is based on the demand projections and results set out in the previous sections, together with:

- data on plane sizes (ie number of seats), derived from the schedules data supplied by co-ordinators; and

- assumptions about average load factors for different types of service, based on information provided during our interview programme.

E.2.5.1. *Projected changes in total movements*

Our results point to three separate reasons why there will be an increase in the total number of air traffic movements at congested airports. These are that:

- higher prices for peak slots will encourage some airlines to reschedule their services to off-peak times. The peak slots released by such switching will then be taken up by other airlines;

- we expect market mechanisms to result in fewer slots being returned to the pool late, and hence a better utilisation of slots; and

- on average, low cost airlines will tend to gain more slots at peak times. In some cases, they will also take extra slots at off-peak times, in order to be able to provide a regular service.

The methods used to estimate the size of each of these impacts are described in Section E.2.4 above. Applying these to the level of demand that we expect in 2007 (in the absence of market mechanisms), we obtain the percentage increase in total movements shown in Table E.10.

Table E.10
Project Increase in Total Movements

Reason for Increase	LHR	LGW	CDG	MAD	VIE
Extra low cost off-peak services	0.0%	0.9%	0.5%	2.9%	3.5%
Switching to off peak slots	0.0%	2.0%	1.3%	0.3%	1.2%
Better slot utilisation	0.0%	0.0%	3.0%	3.1%	3.1%
Total	**0.0%**	**2.9%**	**4.8%**	**6.3%**	**7.8%**

E.2.5.2.   Projected changes in passenger volumes

Project change in passengers per movement

Table E.11 and Table E.12 show our estimates of the <u>current</u> numbers of passengers per service, for each of the eight service categories used in our analysis. These data have been derived as follows:

- the number of seats for each flight is recorded in the schedules data. The schedules data also record the airline, flight origin or destination, and service type, which allow us to allocate each flight to one of the eight service categories. Hence, we can calculate the average number of seats per aircraft for each service category;

- we have then converted this into the average number of passengers per aircraft for each service category by using passenger load factors (the ratio of passengers to seats). We have used the following load factors, which are based on information provided during our interview programme: charter 90 per cent; low cost 80 per cent; long-haul 70 per cent; short-haul 65 per cent.

Table E.11
Current Usage Statistics: LHR and LGW

	LHR		LGW	
	Pax per movement	*Movements (%)*	**Pax per movement**	*Movements (%)*
Hub alliance short-haul	104	*34.3%*	69	*32.6%*
Hub alliance long-haul	188	*12.9%*	184	*4.4%*
Other alliances short-haul	102	*12.3%*	68	*1.6%*
Other alliances long-haul	194	*5.5%*	171	*1.6%*
Low cost		*0.0%*	118	*7.9%*
Charter	152	*0.2%*	208	*27.3%*
Other short-haul	95	*24.4%*	73	*18.6%*
Other long-haul	187	*10.4%*	195	*5.9%*
All services	**126**	*100.0%*	**126**	*100.0%*

Source: Derived from schedules data and passenger load factor assumptions.

Table E.12
Current Usage Statistics: CDG, MAD and VIE

	CDG		MAD		VIE	
	Pax per movement	*Movements (%)*	**Pax per movement**	*Movements (%)*	**Pax per movement**	*Movements (%)*
Hub alliance short-haul	85	*39.0%*	101	*40.7%*	58	*61.7%*
Hub alliance long-haul	166	*12.3%*	193	*4.1%*	121	*6.3%*
Other alliances short-haul	74	*12.7%*	78	*7.8%*	84	*5.4%*
Other alliances long-haul	171	*3.0%*	159	*1.1%*		*0.0%*
Low cost	112	*2.1%*	117	*1.1%*	115	*0.0%*
Charter	163	*5.1%*	155	*1.1%*	149	*8.2%*
Other short-haul	46	*19.7%*	71	*41.2%*	49	*17.0%*
Other long-haul	147	*6.0%*	142	*2.8%*	114	*1.4%*
All services	**97**	*100.0%*	**93**	*100.0%*	**70**	*100.0%*

Source: Derived from schedules data and passenger load factor assumptions.

There are two separate reasons why we expect the average number of passengers per air traffic movement to change as a result of the introduction of market mechanisms:

- a change in the mix of services using the airport will almost certainly lead to a change in the average number of passengers per movement. At most congested airports, for example, we predict an increase in the proportion of long haul flights (and a corresponding reduction in the proportion of short haul flights). This alone would be expected to increase the average number of passengers per flight;

- in addition, we expect that some airlines will choose to maintain existing capacity on certain routes, despite the introduction of slot charges, by switching to larger planes and lower frequencies. We have estimated the extent of this increase using the elasticities specified in Table E.4.[270]

Table E.13 shows the combined impact of these two factors. The greatest increase occurs at Heathrow, where there is predicted to be a large shift towards long haul flights.

Table E.13
Estimated Impact of Market Mechanisms on Passengers per Movement
(% change)

	LHR	LGW	CDG	MAD	VIE
Passengers per movement, current	126	126	97	93	70
Passengers per movement, predicted	135	128	99	95	73
Predicted increase in passengers per movement	7.1%	1.8%	4.2%	1.3%	3.6%

Source: NERA estimates

Projected changes in passenger volumes

Table E.14 shows our overall predicted increase in passengers. This is determined by the predicted increase in movements (from Table E.10) and the predicted increase in passengers per movement (from Table E.13).

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[270] The elasticity works as follows: for any particular service group, if the total demand elasticity is –1, say, of which the elasticity with respect to use of larger aircraft is –0.1, then a 20 per cent increase of the price per slot will result in a 20 per cent reduction in demand for slots, but a 2 per cent increase in passengers carried per slot.

Table E.14
Estimated Impact of Market Mechanisms on Passenger Numbers
(% change)

	LHR	LGW	CDG	MAD	VIE
Predicted increase in movements	0.0%	2.9%	4.8%	6.3%	7.8%
Predicted increase in passengers per movement	7.1%	1.8%	4.2%	1.3%	3.6%
Predicted increase in passengers	**7.2%**	**4.8%**	**9.1%**	**7.6%**	**11.4%**

Source: NERA estimates

E.2.6. Impact on the environment

Our assessment of the impact of market mechanisms on the environment is based on the estimated changes in the numbers of short and long haul movements, and the changes in the average number of passengers per movement, as described above. Our estimates of these changes are summarised in Table E.15. The changes in passengers per movement shown in this table reflect the combined impact of both an increase in the average number of passengers for each long-haul or short-haul service and also the change in the proportions of long-haul and short-haul services operating at each airport. In most cases, and especially at LHR and CDG, we predict an increase in the proportion of long-haul services.

Table E.15
Estimated Impact on Movements and Passengers per Movement in 2007

	Current system	Ideal market mechanism
LHR		
Short-haul movements	337,488	303,092
Long-haul movements	136,512	170,908
Total movements	**474,000**	**474,000**
Change in passengers per movement		+ 7.1%
LGW		
Short-haul movements	237,816	253,656
Long-haul movements	32,184	24,293
Total movements	**270,000**	**277,949**
Change in passengers per movement		+ 1.8%
CDG		
Short-haul movements	468,933	483,461
Long-haul movements	127,067	141,209
Total movements	**596,000**	**624,671**
Change in passengers per movement		+ 4.2%
MAD		
Short-haul movements	231,859	246,974
Long-haul movements	20,189	20,880
Total movements	**252,048**	**267,854**
Change in passengers per movement		+ 1.3%
VIE		
Short-haul movements	192,425	207,859
Long-haul movements	16,075	16,944
Total movements	**208,500**	**224,803**
Change in passengers per movement		+ 3.6%

Source: NERA estimates – see Section E.2.5

As noted in Section 6.9 of the main report, our estimates of the environmental impacts of market mechanisms do not take account of factors, such as changes in the number of movements at other airports or delays to airport expansion plans, that might reduce the impact on total environmental costs.

To assess the environmental impact of these changes, we have used a study on the external costs of aviation commissioned by the UK Department for Transport.[271] The study drew on the results of an earlier paper by Pearce and Pearce (2000),[272] who calculated environmental taxes for the UK on the basis of both noise nuisance and air pollution.

Pearce and Pearce's calculation of noise taxes is based on the level of activity at LHR. The noise taxes were calculated on the basis of the marginal noise produced by aircraft.   To this end, first the current overall noise level at LHR was calculated and then the change to this caused by one additional movement by a particular aircraft type. The marginal quantity depends on the existing level of noise: it will be higher at quieter airports. Optimal taxes were calculated using an hedonic price methodology, placing a value on an environmental detriment by analysing differentials in house prices around airports.

As far as air pollution is concerned, the paper provided emission factors for various types of aircraft for landing/take off, a 500 mile cruise and a 3500 mile cruise. Shadow prices for each pollutant are then applied to arrive at an emissions tax for the various aircraft types.

The UK Department for Transport updated the analysis by Pearce and Pearce, using what were believed to be more up-to-date marginal damage costs of pollutants (excluding local air pollution). The taxes estimated by the Department are summarised, after converting them into euros, in Table E.16.

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[271]   UK Department for Transport (2001) *Valuing the external costs of aviation.* Although the study was commissioned by the Department, the results do not represent the Department's official views.

[272]   Pearce, B, Pearce, D (2000) "Setting environmental taxes for aircraft: a case study for the UK". CSERGE Working Paper GEC 2000-26.

Table E.16
Environmental Taxes for Various Types of Aircraft[273]

	Noise tax (€)	Climate change tax (central estimate, €)	Total (€)
Short haul operations			
B737-400	49	301	350
A320	44	363	407
MD82	70	429	499
B757	63	526	589
A310	91	473	564
Long-haul operations			
A340	110	5,051	5,161
B747-400	240	7,103	7,343
B767-300	77	3,493	3,570
B777	47	5,387	5,434

Source: UK Department for Transport (2001) Valuing the External Costs of Aviation.
Note: the figures do not represent the official views of the Department

To get a broad idea of the costs caused by the changes in short and long haul flights resulting from an ideal market mechanism, we have applied these costs to the numbers in Table E.15. The analysis is intended to illustrate orders of magnitude only because of the following factors:

- the noise cost estimates in Table E.16 are specific to London Heathrow. At quieter airports, they are likely to be higher. But the impact of this is probably small as noise costs account for a relatively small proportion of the total estimated environmental costs in the table;

- the climate cost changes are subject to very large uncertainties; and

- the estimates in Table E.16 do not cover all aircraft types. In addition, our empirical analysis only distinguishes between short and long haul flights, not between individual aircraft types. Because of this, we have not related the information in the table to the aircraft mix at particular airports, but instead we have used the unweighted average of the environmental costs for short and long haul aircraft as a proxy value.

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[273] The values have been converted from GBP in EUR using an exchange rate of EUR 1 = GBP 0.70.

The average costs that we have used are shown in Table E.17.

Table E.17
Environmental Costs for Short and Long Haul Movements (€)

	Noise costs	Climate change costs	Total costs
Short-haul movements	63	418	481
Long-haul movements	118	5,259	5,377

Source: Averages calculated from Table E.16

We then used the data set out above to calculate the change in environmental cost per passenger km. To do this, we first calculated the change in the total environmental cost arising from the changes in the number of long-haul and short-haul movements described in Table E.15 above. This is shown in Table E.18.

Table E.18
Environmental Cost Changes due to Ideal Market Mechanisms (€m)

	Due to change in short haul movements	Due to change in long haul movements	Total change
LHR	-16.6	185.0	168.4
LGW	7.6	-42.4	-34.8
CDG	7.0	76.0	83.0
MAD	7.3	3.7	11.0
VIE	7.4	4.7	12.1
Total (all Category 1 airports)	**78.0**	**546.9**	**624.9**

Source: NERA estimates - calculated by multiplying the costs per movement shown in Table E.17 by the changes in the number of movements shown in Table E.15.

We then took Pearce and Pearce's estimates of the current environmental cost per passenger km for long-haul and short-haul services, and used these (plus our estimates of the change in the number of passengers per movement) to calculate the change in the environmental cost per passenger km.

Table E.19 shows Pearce and Pearce's estimates of environmental costs expressed as both an amount per movement and also an amount per 1000 passenger kms. Comparing these two numbers generates a consistent assumption for the current average passenger kms per long-haul and short-haul movement.

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Table E.19
Environmental Costs for Short and Long Haul Movements

	Environmental costs per movement (€)	Environmental costs per 1000 passenger kilometres (€)	Passenger kilometres per movement[274]
Short-haul movements	481	4.57	104,974
Long-haul movements	5,377	4.20	1,285,830

Source: UK Department for Transport (2001) Valuing the External Costs of Aviation*; NERA calculations*

Although the environmental costs of a long-haul flight are much higher in absolute terms than those of a short haul flight, the higher number of passenger kms on long haul flights (reflecting both the longer distances flown and the larger planes used) means that the average environmental cost per passenger km of a long haul flight is actually below that of a short haul flight.

Using these figures, we have calculated the environmental costs per passenger km for both the current situation and the ideal market mechanism. The costs under the current mechanism were calculated simply by taking a weighted average of the costs per passenger km shown in Table E.19, where the weights reflect the current mix of traffic at each airport.

We then estimated the corresponding costs under the ideal market mechanism by adjusting these figures to take account of:

- the change in the proportion of long-haul and short-haul movements at each airport (see Table E.15); and

- the change in the number of passengers per movement (also shown in Table E.15).

The results of this calculation are shown in Table E.20 below.

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[274] Unweighted average of values for individual aircraft types.

Table E.20
Environmental Costs per 1000 Passenger Kms (€)

	Current system	Ideal market mechanism
LHR	4.25	3.95
LGW	4.33	4.29
CDG	4.28	4.10
MAD	4.38	4.33
VIE	4.38	4.24
Average (all Category 1 airports)	**4.30**	**4.13**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

E.3. Secondary Trading

Having established our quantitative estimates of the impact of an ideal market mechanism, we now consider, first for secondary trading and then for other mechanisms, how the impact of specific mechanisms may differ from the impact of the ideal mechanism. The focus of our analysis is the particular features of each mechanism that may prevent it from achieving the full impact described in SectionE.2.

In Section 7.4.1 of the main report, we highlight three main aspects of secondary trading that may cause its impact to fall short of that of the ideal mechanism:

- the fact that secondary trading only presents airlines with an opportunity cost, rather than a direct cash cost, of continuing to use valuable slots. Overall, for the reasons set out in Section 7.4.1.1, we do not think that airlines will ignore this opportunity cost in the medium to long term, and therefore secondary trading should be able to deliver much of the impact of the ideal mechanism. But secondary trading is less suitable for "fine tuning" slot allocations when there are only small differences between the values attached to slots by potential buyers and sellers, so it is unlikely that secondary trading alone would ever deliver the optimal allocation of slots. And there is some risk, reflected in our low case assumptions (see below), that airlines will be slower than we expect in responding to the opportunity costs created by secondary trading;

- imperfect information, and the risk that potential buyers and sellers may not be aware of each other. As with the opportunity cost, this means that secondary trading is not suitable for fine tuning (as buyers and sellers valuations of a slot may be only slightly different) and is therefore unlikely to deliver the entire impact of the ideal mechanism.   But we expect airlines' own knowledge of market conditions, potentially boosted through the activities of market facilitators, to ensure that many (and probably most) mutually beneficial trades take place. Nevertheless there is

some risk, reflected again in our low case assumptions, that these problems will be more widespread than we expect;

- airlines might be unwilling to trade with each other. For the reasons set out in Section 7.4.1.3 of the main report, for example that it is likely to be in airlines' own interests to sell any slots to the buyer willing to pay most for them, we do not expect this to be a major impediment in practice.

Secondary trading is the only one of our specific mechanisms for which there is some practical experience, albeit on a very limited scale. This experience is discussed in Sections 5.4.2 and 5.4.3 of the main report, and further details of slot trading in the US is provided in Appendix C. The questionable legal status and small volumes of the UK grey market, and the fact that US slot trading is confined to domestic services (so there is no scope, for example for substitution between domestic and transatlantic services), limits the lessons that we can draw from these examples. Nevertheless, there is some potentially useful qualitative evidence, in particular:

- first, we note that trading volumes in the US were substantial initially, but then tailed off. This is consistent with our belief that airlines (both buyers and sellers) will respond to the initial opportunities available for mutually advantageous trades, even though potential sellers face only an opportunity cost rather than a direct cash cost;

- second, trading within the UK grey market has typically involved airlines such as regional airlines or those operating low value short haul services selling slots to BA (the hub alliance carrier). This is in line with our general expectations about the impact of market mechanisms, and the most likely sellers in particular.[275]

This experience from the US and UK is useful in confirming our qualitative views about the likely impact of market mechanisms, but offers little or no quantitative information that could be used to help estimate these impacts.

Overall, therefore, our quantitative analysis of the impact of secondary trading is based on the proposition that such trading will deliver most, though not quite all, of the impact of the ideal mechanism described above. We have taken account of specific features of trading that may place particular airlines at a relative advantage or disadvantage, or that mean that trading is more effective at some airports than at others. And we have also adopted rather conservative low case assumptions, to reflect the risk that the existence of only an opportunity cost, or problems of imperfect information, will pose more difficulties than we expect.

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[275] We place less weight on the identify of BA as the main purchaser, as it might be difficult for other potential purchasers to make themselves known in such a market and, more generally, BA holds a lower proportion of slots at LHR and LGW than many other hub carriers at congested airports elsewhere in the EU.

Our specific assumptions, which are based on the issues set out above (which are discussed in more detail in Section 7.4 of the main report), are as follows:

- our central case assumptions for LHR and LGW are that only 80 per cent of the changes in slot allocations described in Section E.2.4.2 would occur with secondary trading (and only 70 per cent where the sellers are full service carriers that are not members of a major alliance, as some of these airlines might be more likely to be pursuing non-profit objectives). Our high case assumptions predict a somewhat higher impact, with 90 per cent (or 80 per cent for slots sold by non-alliance full service carriers) of changes occurring. But for the reasons discussed above, we have adopted a conservative low case, with only 30 per cent of changes occurring;

- for CDG and especially MAD and VIE, we have adjusted our assumptions further to reflect the fact that excess demand is more limited at these airports. This means that the potential gains from trading are likely to be smaller (as there will generally be less difference between buyers' and sellers' valuations of particular slots), and also that the markets at each of these airports may be less liquid. Compared with our assumptions about the impact of secondary trading on slot allocations at LHR and LGW, we have assumed that the impacts of secondary trading at CDG are 80 per cent of these, and only 50 per cent at MAD and VIE. These adjustments are applied in each of our central, high and low cases;

- furthermore, within the changes in slot allocations predicted at each of these airports, we have adjusted our assumptions about the likelihood of different types of airline purchasing any slots that become available. Hub operators (and their alliance partners) will be in the strongest position at each airport, reflecting both their superior knowledge of likely events affecting the demand and supply of slots at the airport, and also their greater flexibility to adjust their schedules and make the best use of any slots they purchase. Other operators will be in a weaker position. We have assumed that airlines in other alliances and charter airlines will only be able to take advantage of 80 per cent of the purchasing opportunities relative to the hub alliance. These proportions are reduced to 70 per cent for low cost carriers and 60 per cent for full service carriers that are not members of a major alliance (though in practice we do not expect these airlines to be net purchasers of slots). The net effect of these assumptions is that the hub alliance is able to purchase a greater number of the slots that become available than it would under the ideal market mechanism;

- finally, we have also adjusted our estimates of the potential impact of market mechanisms on the utilisation of slots. We still expect secondary trading to lead to a reduction in the number late slot returns, as airlines will have the option of selling a slot to another airline rather than simply returning it to the co-ordinator. But the discipline this imposes on airlines is unlikely to be as strong as under mechanisms where the airlines face a direct cash cost for each slot. In our central case, therefore, we assume that only two-thirds (ie 2 per cent rather than 3 per cent) of the estimated improvement in slot utilisation at CDG, MAD and VIE occurs under secondary

trading. And for our high and low cases, we assume respectively that the impact of secondary trading in terms of improving slot utilisation is 90 per cent or 50 cent of the impact of the ideal market mechanism.

The overall impact of these assumptions is described in Section 7.4.3 of the main report.

E.3.1. Impact on the environment

The impact of secondary trading on the environment is based on the changes in the numbers of short and long haul movements (central case) under secondary trading. These are shown, for each of our five airports, in Table E.21.

Table E.21
Estimated Change in Movements under Secondary Trading

	Change in short haul movements	Change in long haul movements
LHR	-23,080	23,080
LGW	14,187	-7,714
CDG	8,138	8,842
MAD	7,611	436
VIE	7,724	456

Source: NERA estimates

After applying the environmental costs of short and long haul flights shown in Table E.17 above, we have obtained the cost changes shown in Table E.22.

Table E.22
Environmental Cost Changes due to Secondary Trading
(€m)

	Due to change in short haul movements	Due to change in long haul movements	Total change
LHR	-11.1	124.1	113.0
LGW	6.8	-41.5	-34.7
CDG	3.9	47.5	51.5
MAD	3.7	2.3	6.0
VIE	3.5	2.5	5.9
Total (all Category 1 airports)	**40.7**	**333.9**	**374.7**

Source: NERA estimates

To calculate the change in environmental costs per passenger km, we applied the methodology described in Section E.2.6 above. Taking account of the shift in the

proportions of short-haul and long-haul movements, and the predicted increase in the number of passengers per movement under secondary trading, we derived the following estimates of environmental costs per passenger km.

Table E.23
Environmental Costs Per 1000 Passenger Kms Under Secondary Trading (€)

	Current system	Secondary trading (central case)
LHR	4.25	4.03
LGW	4.33	4.31
CDG	4.28	4.19
MAD	4.38	4.36
VIE	4.38	4.33
Average (all Category 1 airports)	**4.30**	**4.20**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

E.4. Higher Posted Prices

The main potential practical problem associated with higher posted prices is the difficulty of setting a price that will eliminate excess demand but not leave potentially valuable slots unused. As discussed in Section 8 of the main report, we believe that airport operators and co-ordinators would be likely to take a conservative approach, as the disadvantages of setting prices a little too low and therefore still having a small amount of excess demand will be relatively minor compared with the consequences of setting prices too high and therefore having peak slots unused.

As our approach to modelling the impact of the ideal market mechanism is based on a process of establishing a notional market clearing price and then examining the impact of this price, it is relatively straightforward to use the same model to simulate the impact of a slightly more conservative approach to setting prices. To estimate the impact of higher posted prices, therefore, we have applied the modelling methodology described in Section E.2, but assumed instead that:

- in the central case, slot charges for any hour do not rise any further once excess demand is five per cent of capacity or less. Thus if excess demand is expected to be less than five per cent in any case, then we assume there is no increase at all in slot charges. But if excess demand is expected to be greater than five per cent, then we estimate the slot price increase required to reduce excess demand to five per cent and then examine the impact of this price increase on slot allocations;

- the same approach is used for both the high and low cases, except that the threshold levels of excess demand are set at 7.5 per cent and 2.5 per cent of capacity respectively.

As these prices will not clear the market, we assume that existing slots are allocated on the basis of historic rights, while pool slots are allocated to each category of service in proportion to its share of unsatisfied demand. Within alliances, some rebalancing between long and short haul services is permitted.

We also assume that most (in fact, 90 per cent) of the improvement in slot utilisation (reflecting fewer late returns of slots) that occurs under the ideal market mechanism will also occur under higher posted prices. This difference reflects the relatively low levels of excess demand in some hours at CDG, MAD and VIE, which means that because of the conservative approach to setting posted prices there will in fact be little or no change to the cost of using the airport in those hours.

As discussed in Section 8.4.1 of the main report, moreover, there is a risk that the introduction of higher posted prices will disrupt airlines' scheduling and planning

processes, and this may encourage airport operators and co-ordinators to adopt a conservative approach to capacity declarations.[276]

Table E.24 shows our assumptions, for each airport, about these two additional impacts.

Table E.24
Increase in movements

Reason for Increase	LHR	LGW	CDG	MAD	VIE
Better slot utilisation (fewer later returns)	0.0%	0.0%	2.7%	2.7%	2.7%
Impact of schedule disruption	-0.5%	-0.5%	-0.1%	-0.1%	-0.1%
Total	**-0.5%**	**-0.5%**	**2.2%**	**2.6%**	**2.6%**

Source: NERA estimates

We also estimate the impact of applying higher posted prices alongside secondary trading. As discussed in Section 8.4.1.2 of the main report, however, we do not expect that secondary trading will make a major contribution to resolving the small amount of residual excess demand that remains following the application of higher posted prices. Secondary trading is not well suited to such "fine tuning" as the potential gains from trade may be relatively small. Uncertainty about future levels of posted prices together with the increased likelihood that buyers and sellers will be direct competitors are also likely to constrain the potential impact of secondary trading, when applied alongside higher posted prices.

In order to estimate the impact of applying these two mechanisms together, we have considered how much of the difference between the impacts of higher posted prices and the ideal market mechanism (this is the residual inefficiency that remains after the application of higher posted prices) might be removed by secondary trading. Our estimates are therefore based on applying the methodology for higher posted prices described above, and then assuming that secondary trading removes a relatively small proportion of the remaining excess demand, specifically:

- 30 per cent of the residual inefficiency, in our central case; or

- 40 per cent or 10 per cent of the residual inefficiency, respectively in our high and low cases.

The overall impact of these assumptions is described in Section 8.4.3 of the main report.

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[276] If schedules are expected to change to a greater extent from one year to the next, the capacity declaration must necessarily be more conservative to allow for consecutive movements which all impact on a particular dimension of the capacity constraint (for example, they all require international terminal departure facilities).

E.4.1. Impact on the environment

E.4.1.1. Higher posted prices alone

To estimate the impact of higher posted prices alone on the environment, we have used the estimated changes in the numbers of short and long haul movements (central case) that would result from this mechanism. These are for each of the five airports shown in Table E.25.

Table E.25
Estimated Change in Movements under Higher Posted Prices Alone

	Change in short haul movements	Change in long haul movements
LHR	-30,051	27,681
LGW	14,149	-8,158
CDG	6,926	10,868
MAD	7,307	638
VIE	7,014	715

Source: NERA estimates

After applying the environmental costs of short and long haul flights shown in Table E.17 above, we have obtained environmental cost changes that would result from higher posted prices. These are shown in Table E.26.

Table E.26
Environmental Cost Changes due to Higher Posted Prices Alone
(€m)

	Due to change in short haul movements	Due to change in long haul movements	Total change
LHR	-14.5	148.8	134.4
LGW	6.8	-43.9	-37.1
CDG	3.3	58.4	61.8
MAD	3.5	3.4	7.0
VIE	3.4	3.8	7.2
Total (all Category 1 airports)	**31.6**	**414.6**	**446.2**

Source: NERA estimates

To calculate the change in environmental costs per passenger km, we applied the methodology described in Section E.2.6 above. Taking account of the shift in the proportions of short-haul and long-haul movements, and the predicted increase in the number of passengers per movement under higher posted prices, we derived the following estimates of environmental costs per passenger km.

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Table E.27
Environmental Costs Per 1000 Passenger Kms Under Posted Prices Alone (€)

	Current system	Higher posted prices alone (central case)
LHR	4.25	3.98
LGW	4.33	4.29
CDG	4.28	4.15
MAD	4.38	4.36
VIE	4.38	4.33
Average (all Category 1 airports)	**4.30**	**4.17**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

E.4.1.2.   Higher posted prices with secondary trading

The impact of secondary trading and higher posted prices on the environment is based on the changes in the numbers of short and long haul movements (central case) under the combination of these two mechanisms. These are for each of the five airports that we have examined shown in Table E.28.

Table E.28
Estimated Change in Movements under Higher Posted Prices and Secondary Trading

	Change in short haul movements	Change in long haul movements
LHR	-31,809	29,439
LGW	14,276	-8,114
CDG	8,078	11,521
MAD	9,361	630
VIE	9,298	741

Source: NERA estimates

Applying the environmental costs of short and long haul flights shown in Table E.17 above results in the cost changes shown in Table E.29.

Table E.29
Environmental Cost Changes due to Higher Posted Prices and Secondary Trading
(€m)

	Due to change in short haul movements	Due to change in long haul movements	Total change
LHR	-15.3	158.3	143.0
LGW	6.9	-43.6	-36.8
CDG	3.9	61.9	65.9
MAD	4.5	3.4	7.9
VIE	4.5	4.0	8.5
Total (all Category 1 airports)	**41.8**	**444.5**	**486.3**

Source: NERA estimates

To calculate the change in environmental costs per passenger km, we applied the methodology described in Section E.2.6 above. Taking account of the shift in the proportions of short-haul and long-haul movements, and the predicted increase in the number of passengers per movement under higher posted prices (with secondary trading), we derived the following estimates of environmental costs per passenger km.

Table E.30
Environmental Costs Per 1000 Passenger Kms Under Posted Prices and Trading (€)

	Current system	Higher posted prices & trading (central case)
LHR	4.25	3.97
LGW	4.33	4.29
CDG	4.28	4.14
MAD	4.38	4.35
VIE	4.38	4.31
Average (all Category 1 airports)	**4.30**	**4.16**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

E.5.   Auctions of Pool Slots

As discussed in Section 5.5 of the main report, we have only examined auction mechanisms that are applied alongside secondary trading. This is because the ability to buy and sell slots after the end of an auction is likely to increase the effectiveness of the auction, as airlines will know that they will still be able to adjust their slot holdings (for example, by selling on any unwanted slots) even after the auction has finished.

In the case of auctions of pools slots and secondary trading, moreover, it is important to recognise that the auctions will be confined to a relatively small number of slots. For the majority of slots, therefore, the impact of this combined option will be identical to the impact of secondary trading applied alone. Indeed, as we are not expecting additional capacity to be provided at LHR and LGW before 2007, the impact at these two airports is identical to that described in Section E.3 above.

At the other three airports, we have calculated the number of slots (per congested hour) that we believe would be allocated from the slot pool by 2007. As secondary trading will provide airlines with an incentive to sell unwanted slots, rather than simply returning them to the pool, we believe that almost all of the pool slots that are auctioned will be the result of increases in capacity that are provided over the next few years. Based on our projections of future demand and capacity, as described in Section E.2.3 above, we estimate that by 2007:

- 20 per cent of slots in each (congested) hour would have been auctioned at CDG and MAD, as substantial capacity increases are planned at these airports; and

- 10 per cent of slots in each (congested) hour would have been auctioned at VIE.

These are cumulative figures. The number of slots that would be auctioned in any season would be smaller - less than five per cent of slots - and therefore many of the complexities and risks associated with larger auctions (see Section 11 of the main report) will not affect auctions of pool slots. In view of the relatively small number of slots involved in these auctions, our assumptions in relation to their impact have only a small effect on our overall estimate of the impact of auctions of pool slots and secondary trading combined. Therefore, we have adopted a relatively simple approach – we have assumed that, in relation to the small number of pool slots being auctioned each year:

- in our central and high cases, the auction of pool slots delivers an efficient outcome (ie it has the same impact as the ideal market mechanism as described in Section E.2, though this impact is confined to a small subset of slots); and

- in our low case, the auction of pool slots achieves only 50 per cent of the efficiency improvements predicted for the ideal market mechanism.

The overall impact of these assumptions is described in Section 10.4.3 of the main report. And the fact that the incremental effect of auctions of pool slot (in addition to secondary trading) has only a minor impact on our overall estimates can be seen by comparing these estimates with those of the impact of secondary trading alone, as described in Section 7.4.3 of the main report.

E.5.1. Impact on the environment

Our assessment of the environmental impact of auctions of pool slots with secondary trading starts from the estimated changes in the numbers of short and long haul movements (central case). These are for each of the five airports shown in Table E.31.

Table E.31
Estimated Change in Movements under Auctions of Pool Slots with Secondary Trading

	Change in short haul movements	Change in long haul movements
LHR	-23,080	23,080
LGW	14,187	-7,714
CDG	8,443	9,602
MAD	7,881	441
VIE	7,387	474

Source: NERA estimates

Using environmental costs of short and long haul flights (shown in Table E.17 above), we have obtained estimates of the changes in environmental cost changes that would be the result of auctions for pool slots with secondary trading. Table E.32 contains our estimates.

Table E.32
Environmental Cost Changes due to Auctions of Pool Slots with Secondary Trading
(€m)

	Due to change in short haul movements	Due to change in long haul movements	Total change
LHR	-11.1	124.1	113.0
LGW	6.8	-41.5	-34.7
CDG	4.1	51.6	55.7
MAD	3.7	2.4	6.2
VIE	3.6	2.5	6.1
Total (all Category 1 airports)	**41.9**	**349.8**	**391.7**

Source: NERA estimates

To calculate the change in environmental costs per passenger km, we applied the methodology described in Section E.2.6 above. Taking account of the shift in the proportions of short-haul and long-haul movements, and the predicted increase in the number of passengers per movement under auctions of pool slots (with secondary trading), we derived the following estimates of environmental costs per passenger km.

Table E.33
Environmental Costs Per 1000 Passenger Kms Under Auctions of Pool Slots (€)

	Current system	Auctions of pool slots & trading (central case)
LHR	4.25	4.03
LGW	4.33	4.31
CDG	4.28	4.17
MAD	4.38	4.35
VIE	4.38	4.32
Average (all Category 1 airports)	**4.30**	**4.19**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

E.6. Auctions of Ten Per Cent of Slots

The impact of auctioning ten per cent of slots each year is the most difficult to predict. These auctions would be likely to be significantly more complex than any that have been applied before in any sector, let alone in civil aviation markets. As discussed in Section 11 of the main report, this complexity (plus the fact that only some slots are auctioned each year) is likely to prevent these auctions from delivering all of the efficiency improvements that might result from introducing an ideal market mechanism. And we also argue that hub carriers are likely to enjoy significant benefits compared with other airlines (and particularly airlines that are not part of a major alliance) when participating in large and complex auctions.

In order to estimate the impact of such auctions, we have adopted the following approach:[277]

- we assume that, in our central case, the auctions deliver 70 per cent of the potential improvements in slot allocations that would result from applying an ideal market mechanism. We believe that there is only a limited potential for such large and complex auctions to achieve a better outcome than this, therefore our high case assumption is that they deliver 75 per cent of the potential improvements. In contrast, there is some risk that auctions would have a disruptive impact on schedules and errors in bidding would lead to inefficient outcomes. Our low case assumption, therefore, is that auctions would deliver only 40 per cent of the improvements in slot allocations that would result under an ideal market mechanism. And we believe there is a non-negligible risk that the outcome could be even worse than this;

- in order to simulate the advantage to hub carriers over other airlines (and especially those that are not part of a major alliance), we have adjusted our demand elasticity assumptions. Our assumptions for the hub carrier (and its alliance partners) are unchanged, but we have increased our elasticity assumptions by 10 per cent for members of other alliances, and by 50 per cent for other airlines (including charter and low cost airlines, as well as full service carriers that do not belong to a major alliance). This approach, of adjusting demand elasticities, means that the hub carrier's advantage is relatively minor when excess demand is low, and greater where there is substantial excess demand (and therefore the auctions would be much more complex);

- finally, as with posted prices, we have assumed that auctions of ten per cent of slots would deliver 90 per cent of the improvement in slot utilisation (reflecting fewer late returns of slots) that occurs under the ideal market mechanism. However, we also assume that the much greater disruption to scheduling caused by large and complex

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[277] With the exception of LGW – where we assume that the hub operator sells all slots that it wishes to sell – we have not made a separate explicit adjustment for the impact of secondary trading.

auctions means that declared capacity is reduced by 1 per cent as a result of this effect in the central case, 2.5 per cent in the low case and 0.5 per cent in the high case.

The overall impact of these assumptions is described in Section 11.4.3 of the main report. These results suggest a much wider range of potential outcomes than for the other specific market mechanisms, reflecting the very significant uncertainty about the impact of applying auctions to existing slots as well as pool slots.

E.6.1. Impact on the environment

Table E.34 contains the estimated changes in short and long haul movements (central case) at each of our airports that would be the result of auctions of 10 per cent of all slots.

Table E.34
Estimated Change in Movements under Auctions of Ten Per Cent of All Slots

	Change in short haul movements	Change in long haul movements
LHR	-28,514	23,774
LGW	9,943	-6,621
CDG	8,463	10,388
MAD	7,231	647
VIE	8,964	740

Source: NERA estimates

After applying the environmental costs of short and long haul flights shown in Table E.17 to the changes in the number of movements shown above, we have obtained estimates of the environmental cost changes due to auctions of 10 per cent of all slots. These are shown in Table E.35.

Table E.35
Environmental Cost Changes due to Auctions of Ten Per Cent of All Slots
(€m)

	Due to change in short haul movements	Due to change in long haul movements	Total change
LHR	-13.7	127.8	114.1
LGW	4.8	-35.6	-30.8
CDG	4.1	55.9	59.9
MAD	3.5	3.5	7.0
VIE	4.3	4.0	8.3
Total (all Category 1 airports)	**36.7**	**387.5**	**424.2**

Source: NERA estimates

To calculate the change in environmental costs per passenger km, we applied the methodology described in Section E.2.6 above. Taking account of the shift in the proportions of short-haul and long-haul movements, and the predicted increase in the number of passengers per movement under auctions of ten per cent of slots (with secondary trading), we derived the following estimates of environmental costs per passenger km.

Table E.36
Environmental Costs Per 1000 Passenger Kms Under Auctions of Ten Per Cent of Slots (€)

	Current system	Auctions of ten per cent of slots (central case)
LHR	4.25	4.04
LGW	4.33	4.26
CDG	4.28	4.16
MAD	4.38	4.36
VIE	4.38	4.34
Average (all Category 1 airports)	**4.30**	**4.19**

Source: Derived from applying environmental parameters (DfT 2001) to NERA model of slot allocation

APPENDIX F.   EXAMPLE CALCULATION

F.1.   Introduction

In this Appendix we present the calculations we have undertaken to estimate the impact of using market mechanisms in the allocation of airport slots at EU category 1 airports. We have presented the workings using data for Madrid airport (MAD), concentrating on a particular hour, 11:00 to 12:00 GMT.

As we explained in Appendix E, we have undertaken equivalent calculations, by hour, at five major EU airports; in each case we have estimated impacts with respect to a typical day in 2007. We extrapolated the results of this analysis to estimate the impacts of market mechanisms for all EU category 1 airports in 2007.

F.2.   Forecasting Excess Demand

F.2.1.   Excess demand in 2002

Table F.1 shows the number of slots requested, allocated and used at MAD for a typical day in the summer season.[278] We have used these data to estimate the extent of excess demand.

In summer 2002 the most relevant runway constraint for MAD was:

> *a maximum of 39 arrival movements, 39 departure movements and*
> *78 total movements per hour between 05:00 and 20:59 GMT.*

Outside these hours, requests did not exceed demand for the day in question. Capacity constraints were also declared with respect to the terminals and parking, but these were less binding constraints.

As Table F.1 shows, the number of *requests* exceeded the capacity available in 14 hours. In contrast, the number of slots *used* exceeded 90 per cent of the directional runway capacity for only five hours. In many airports requests tend to overstate demand, because some requests are highly speculative and are unlikely to result in services being operated; but actual use may be less than demand, because some slots would have been returned to the coordinator late and so were not able to be reallocated even though other demand originally existed.

The final line in Table F.1 shows our estimate of the hours for which there is excess demand for slots, calculated according to a single criterion for all airports: *that if the number of slots used exceeds 80 per cent of the hourly runway capacity, then demand is equal to or exceeds capacity.*

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[278]   The day we have used is Monday 17 June 2002, which represents a typical day in the summer season.

We estimated excess demand at MAD in 2002 using the data on slot requests. Because of the tendency for airlines to overstate demand, we have assumed that slot requests exceed demand by 5 percentage points.[279] Hence, the proportion of excess demand is

{(number of slots requested − 78)/78 − 5%},

where 78 is the hourly slot capacity.

For example, for 11:00 to 12:00 hours there were 101 slot requests, so excess demand is calculated to be 24 per cent of capacity.

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[279]   Although more than 5 per cent of slots that are allocated in MAD are returned, the proportion is smaller for peak hours.

Table F.1
Slot Data for MAD, A Typical Day in Summer 2002

Hour commencing (GMT)	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
Number of requests for slots																		
Arrivals	8	17	47	49	51	38	40	51	36	40	34	36	36	40	40	45	44	22
Departures	13	43	39	49	46	37	50	50	44	41	47	39	35	41	37	46	17	13
Total	21	60	86	98	97	75	90	101	80	81	81	75	71	81	77	91	61	35
Requests exceed runway capacity constraints?		Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
Initial allocation of slots	24	64	74	76	77	73	75	74	72	72	74	74	73	73	72	75	60	35
Actual slot use																		
Arrivals	8	17	37	35	34	29	28	28	31	28	30	25	31	26	31	36	35	15
Departures	9	31	32	39	31	28	38	38	30	32	35	32	21	33	30	29	10	13
Total	17	48	69	74	65	57	66	66	61	60	65	57	52	59	61	65	45	28
More than 90% of directional capacity used?			Yes	Yes			Yes	Yes								Yes		
Proportion of capacity used	22%	62%	88%	95%	83%	73%	85%	85%	78%	77%	83%	73%	67%	76%	78%	83%	58%	36%
Potential excess demand? (= more than 80% of capacity is used)			Yes	Yes	Yes		Yes	Yes			Yes					Yes		

Source: data provided by AENA

F.2.2. Excess demand in 2007

We used AENA's forecasts of the increase in traffic and growth in runway capacity from 2002 to 2007 to model excess demand in 2007. The calculation of excess demand for 11:00 to 12:00 hours for MAD is set out in Table F.2.

Table F.2
Calculation of Excess Demand in 2007
(MAD, Typical Day, 11:00 to 12:00 hours)

			Source
	Excess demand in 2002	24%	See section F.2.1
+	Forecast traffic growth	+ 12%	AENA (growth in passengers)
-	Forecast growth in runway capacity	- 22%	AENA
=	Percentage excess demand in 2007	= 14%	Sum of the above
	Runway capacity	94	AENA[280]
	Total number of slots demanded	107.2	= 114% x 94

We then disaggregated this demand according to different types of service.

Our estimates of demand for each type of services are shown in the last column of Table F.3. With the exception of low cost airlines, we have assumed that the proportion of *demand* for each flight category is the same as for the slots *used* during a typical week in the summer 2002 season, which we calculate from schedules data.

The one exception is that low cost airlines are underrepresented in existing slot allocations. As most low cost airlines have entered the market quite recently, they will not have had many opportunities to acquire slots at congested airports. On the basis of our interview programme, we have assumed that low cost airlines would have around four times the demand per slot allocated to them compared to all other types of airline; this is equivalent to demand for 4.6 slots between 11:00 and 12:00 hours.

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[280] From AENA's projections for capital expenditure, we estimate total runway capacity in 2007 to be 95 movements. This assumes that the two new runways are both in service, but airport operations are being adjusted in phases and therefore the full long-term capacity (120 movements per hour) is not yet available. Moreover, as we know from the 2002 schedules, the practical capacity is likely to be less than this because a directional capacity constraint will be binding before the total capacity is reached. We have used a slightly lower capacity constraint to reflect these additional complexities, though in practice the results are not sensitive to this assumption.

Table F.3
Calculation of Demand for Slots in 2007
(MAD, Typical Day, 11:00 to 12:00 hours)

	Slots used, 2002		Demand for slots, 2007	
	(slots / week)	(%)	(%)	(slots / hour)
Hub alliance short-haul	2,548	40.7%	39.4%	42.3
Hub alliance long-haul	259	4.1%	4.0%	4.3
Other alliances short-haul	490	7.8%	7.6%	8.1
Other alliances long-haul	69	1.1%	1.1%	1.1
Low cost	70	1.1%	4.3%	4.6
Charter	66	1.1%	1.1%	1.1
Other short-haul	2,581	41.2%	39.9%	42.8
Other long-haul	178	2.8%	2.7%	2.9
All	6,261	100%	100%	107.2

Note: 2002 figures calculated using AENA schedules data

F.3. Application of Elasticities

For hours in which demand does not exceed capacity, we have simply assumed that all demand for slots is satisfied. For those hours in which excess demand is expected, we simulate the process by which slots would be allocated under an ideal market mechanism by increasing slot charges and modelling the effect this has on demand for slots using elasticities.[281] We followed an iterative process to establish the slot charge that would just eliminate excess demand for this particular hour.

As explained in Appendix E, it is the relative elasticity assumptions for different types of service that determine our results. Neither the absolute level of price elasticities nor the size of the price increase required to remove excess demand should affect the final outcome.

The elasticities for MAD are shown in Table F.4. We have undertaken three calculations using the elasticities:

- we used the total demand elasticity (column D) to determine the increase in slot charges at peak times required to eliminate excess demand, and therefore the change in the mix of traffic at these times;

- we used the elasticity of switching to off-peak slots (column B) to estimate the net number of additional movements undertaken at off-peak times as a result of an increase in slot charges at peak times; and

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[281] In general, an elasticity of demand is defined as being: {% change in demand} / {% change in price}.

- we used the demand suppression elasticity (column A) to estimate the change in the number of passengers using the airport.

We present each of these calculations in turn.

Table F.4
Elasticities used for MAD

	Demand suppression	Switching to off-peak slots	Use of larger aircraft	Total Demand
	A	B	C	D = -(A + B + C)
Hub alliance short-haul	0.50	0.00	0.05	-0.55
Hub alliance long-haul	0.25	0.00	0.01	-0.26
Other alliances short-haul	0.70	0.20	0.07	-0.97
Other alliances long-haul	0.30	0.20	0.02	-0.52
Low cost	1.00	0.00	0.00	-1.00
Charter	0.50	1.00	0.00	-1.50
Other short-haul	1.00	0.20	0.10	-1.30
Other long-haul	0.40	0.20	0.02	-0.62

Note: see Appendix E for discussion concerning the derivation of these elasticities.

F.3.1. Estimating allocation of slots at peak times

We first determine the allocation of slots during peak hours, by which we mean hours for which there is excess demand.

The estimation process is set out in Table F.5. We have used the example of MAD on a typical day between 11:00 and 12:00 hours, where we forecast a total demand of 107.2 slots, but a capacity of 94 slots. Column A shows demand for slots in 2007, and column B shows the total demand elasticity, repeating information presented in earlier tables.

Under the ideal market mechanism, the slot charges are set so that the demand for slots is equal to the number of slots that are declared to be available. We have computed the charge for each hour, determining it by iteration according to this criterion. The same proportionate increase in charges is applied to all airlines, and for this hour the slot charge would need to increase by 14.1 per cent in order to eliminate excess demand (ie to reduce the underlying demand for slots during this particular hour from 107 to 94).[282]

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[282] As noted above, this estimate of the price increase required is only an intermediate calculation. It should not be seen as a valid estimate of the actual price increase that would occur in practice.

In column C the charge increase and elasticity are multiplied together to estimate how demand changes for each category of airline in response to a 14.1 per cent increase in charges. For example, demand for slots from charter airlines is expected to decrease by 21.1 per cent as a result of this price increase. This is then multiplied by column A to determine total demand with the new price. This demand represents the actual allocation of slots under the ideal market mechanism for the particular hour. As can be seen, total demand is now equal to the capacity available.

Table F.5
Calculation of the Allocation of Slots for a Peak Hour in 2007
(MAD, Typical Day, 11:00 to 12:00 hours)

	Demand before price increase	Total demand elasticity	Reduction in demand	Revised demand = slots allocated
	A	B	C = B x 14.1%	D = A x (100% + C)
Hub alliance short-haul	42.3	-0.55	-7.7%	39.0
Hub alliance long-haul	4.3	-0.26	-3.7%	4.1
Other alliances short-haul	8.1	-0.97	-13.6%	7.0
Other alliances long-haul	1.1	-0.05	-0.7%	1.1
Low cost	4.6	-1.00	-14.1%	4.0
Charter	1.1	-1.50	-21.1%	0.9
Other short-haul	42.8	-1.30	-18.3%	35.0
Other long-haul	2.9	-0.62	-8.7%	2.7
All slots	107.2			94
Source	*Table F.3*	*Table F.4*	*Computation*	*Computation*

Note: the price per slot is increased by 14.1% in this example, so that demand is equal to capacity (94 slots per hour).

F.3.2. Estimating the net shift in demand from peak to off-peak times[283]

The increase in slot charges will result in a decrease in underlying demand at peak times, but some of the decrease will consist of flights which have been rescheduled to off-peak times, when slot prices are lower. Hence, there will be more movements at off-peak times. We expect the extent of this effect to be proportionate to the size of the price increase, and so we have modelled it using elasticities which reflect propensity to reschedule.

We present these calculations, for the same peak hour at MAD, in Table F.6. The calculations are similar to those in Table F.5, but the price increase is already specified to be 14.1 per cent.

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[283] Note that we estimate two separate impacts on the demand for off-peak slots. First, we expect some existing users of peak slots to switch instead to off-peak slots – this is the impact discussed in this section. Second, we also expect some low cost carriers that gain access to peak slots to operate regular services and therefore to increase their demand for off-peak slots as well – this impact is discussed in Section F.4.1 below.

If the price of slots between 11:00 and 12:00 hours were increased by 14.1 per cent, then we calculate that on average 1.7 flights each day would be rescheduled from this peak hour to off-peak times.

Table F.6
Calculation of the Number of Movements Shifting from Peak to Off-Peak Times
(MAD, Typical Day, traffic shifting *from* 11:00-12:00 to off-peak hours)

	Demand before price increase	Off peak elasticity	Reduction in demand	Additional slots used in off-peak
	A	B	C = B x 14.1%	D = A x C
Hub alliance short-haul	42.3	0.00	0.0%	0.0
Hub alliance long-haul	4.3	0.00	0.0%	0.0
Other alliances short-haul	8.1	0.20	2.8%	0.2
Other alliances long-haul	1.1	0.20	2.8%	0.0
Low cost	4.6	0.00	0.0%	0.0
Charter	1.1	1.00	14.1%	0.2
Other short-haul	42.8	0.20	2.8%	1.2
Other long-haul	2.9	0.20	2.8%	0.1
All slots	107.2			1.7
Source	*Table F.3*	*Table F.4*	*Computation*	*Computation*

F.3.3. Estimating number of passengers

In addition to the impact of changes in the mix of services and switching to off-peak slots, passenger numbers may be affected by a possible increase in aircraft size. If the slot charge increases, all other things being equal, larger aircraft (possibly accompanied by lower frequencies) would become more cost effective for some routes, and so the average number of passengers carried by each aircraft would increase within each service category. We would expect this effect to be proportionate to the size of the increase in charges, and so have modelled it using elasticities.[284]

In order to calculate the total number of passengers carried, we first estimated the average number of passengers being carried per movement for each type of service, and this is shown in Table F.7. We used 2002 summer season schedules data to compute the average number of seats per movement, averaged over a typical week.[285] We then applied load

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[284] We have not shown the calculation of this impact separately. The impact of this effect, the switching to off-peak slots and the traffic mix is capture in Table F.8 because passenger numbers are calculated by applying the demand suppression elasticity (column A in Table F.4) to underlying demand, whereas the impact on peak demand (and hence the price increase required) is calculated using the total elasticity (column D in Table F.4).

[285] 17 to 23 June 2002. The types of data contained within this dataset, and the ways in which we used it are discussed in Appendix E.

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factors to convert these data into the number of passengers per movement. We specified the load factors on the basis of information given to us during our interview programme.

Table F.7
Calculation of Passengers Per Movement at MAD

	Number of seats per movement, 2002	Load Factor	Passengers per movement, 2002
	A	B	C = A x B
Hub alliance short-haul	155.9	65%	101.3
Hub alliance long-haul	275.1	70%	192.5
Other alliances short-haul	120.2	65%	78.1
Other alliances long-haul	226.6	70%	158.6
Low cost	146.2	80%	117.0
Charter	171.9	90%	154.7
Other short-haul	109.7	65%	71.3
Other long-haul	202.2	70%	141.6
Source	*Schedules data*	*Interview programme*	*Computation*

These values are then used to calculate the number of passengers carried if the ideal market mechanism was used for slot allocation. The calculation is intended to reflect the change in the mix of traffic resulting from the market mechanism, the rescheduling of some flights to off-peak times, and the general shift to larger aircraft. The results are shown in Table F.8.

Table F.8
Calculation of the Number of Passengers Carried
(MAD, Typical Day, 11:00 to 12:00 hours)

	Passengers per movement	Demand before price increase	Passenger Demand	Demand suppression elasticity	Reduction in demand	Passenger carried under slot allocaton
	A	B	C = A x B	D	E = D x 14.1%	F = B x (100% + E)
Hub alliance short-haul	101.3	42.3	4,283	-0.50	-7.0%	3,982
Hub alliance long-haul	192.5	4.3	821	-0.25	-3.5%	792
Other alliances short-haul	78.1	8.1	633	-0.70	-9.8%	571
Other alliances long-haul	158.6	1.1	181	-0.30	-4.2%	173
Low cost	117.0	4.6	539	-1.00	-14.1%	464
Charter	154.7	1.1	177	-0.50	-7.0%	164
Other short-haul	71.3	42.8	3,051	-1.00	-14.1%	2,622
Other long-haul	141.6	2.9	411	-0.40	-5.6%	388
All slots		107.2	10,096			9,157
Source	*Table F.7*	*Table F.3*	*Computation*	*Table F.4*	*Computation*	*Computation*

F.3.4. Aggregation of hourly impacts

The calculations using elasticities were repeated for each hour from 04:00 to 21:00 GMT at the five airports we have considered. For those hours for which there is no excess demand in 2007, the slot charge does not change so it is not necessary to apply the elasticities to estimate demand - instead all airlines that demand slots are allocated them.

The main outputs of these calculations are:

- the number of movements for a typical day for each of the eight categories of air service; and

- the number of passengers for a typical day for each of the eight categories of air service.

These outputs are computed by summing the estimated number of movements and the number of passengers for each service category for each hour. The results for MAD are shown in Table F.9. [286]

Table F.9
Estimate of Movements and Passengers After Application of Elasticities
(MAD, 04:00 to 21:59 GMT, Typical Day 2007)

	Movements	Passengers
Hub alliance short-haul	477	48,387
Hub alliance long-haul	48	9,340
Other alliances short-haul	91	7,116
Other alliances long-haul	13	2,056
Low cost	26	3,077
Charter	13	1,995
Other short-haul	476	33,993
Other long-haul	33	4,659
Total	1,177	110,623

F.4. Other factors

Two further adjustments are made to the estimates of movements and passengers:

- an increase in demand for off-peak slots by low cost carriers;

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[286] The total number of movements shown in this table (1,177) is slightly higher than the number we would predict under the current slot allocation system (1,173). This reflects the impact of a small number of services switching from peak to off-peak times (the calculation of this impact is illustrated, for services that switch from 11.00-12.00 to less congested hours, in Table F.6).

- a decrease in the incidence of late return of slots.

Each is described in turn.

F.4.1. Demand at off-peak times

We expect there to be some demand complementarities between peak and off-peak periods, so that an increase in the number of slots allocated at peak periods will result in increased demand for slots in off-peak periods. This is in addition to traffic that is rescheduled to off-peak slots in response to price increases. As described in Section E.2.4.2.2 of Appendix E, we expect this to be a significant effect for low cost airlines, because their business model relies on high utilisation of aircraft.[287]

For many low cost short haul routes there are typically three or four rotations in a single day. Taking account of this, and also the ratio of peak to off-peak hours at MAD, we assume that low cost airlines schedule 2.5 additional off-peak movements for each additional peak movement.

For MAD in 2007, 26 slots in a typical day were allocated to low cost airlines under the ideal market mechanism, representing 2.2 per cent of all slots (see Table F.9). This compares to only 1.1 per cent of slots allocated to low cost airlines currently (shown in Table F.3). So the increased in movements of low cost airlines at peak times is 1.1 per cent, or 13.4 movements. By applying the factor of 2.5, we calculate that there are 33.5 additional off-peak movements operated by low cost airlines. To estimate the number of additional passengers travelling, we simply apply the average number of passengers per low cost airline movement by this adjustment. The revised estimates are shown in Table F.10.

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[287] As congested airports are usually attractive destinations, and also because the type of low cost airline that is likely to seek slots at congested airports (ie "yield oriented" rather than "cost minimising", adopting the distinction described in Section 6.2 of the main report) will be seeking to attract business as well as leisure passengers, we believe that low cost airlines will seek to establish regular services to and from these airports.

**Table F.10
Impact of Increased Off-Peak Demand
(MAD, Typical Day 2007)**

	Movements per day		Passengers per day	
	Before Increase	**After Increase**	**Before Increase**	**After Increase**
Hub alliance short-haul	477	477	48,387	48,387
Hub alliance long-haul	48	48	9,340	9,340
Other alliances short-haul	91	91	7,116	7,116
Other alliances long-haul	13	13	2,056	2,056
Low cost	26	60	3,077	6,995
Charter	13	13	1,995	1,995
Other short-haul	476	476	33,993	33,993
Other long-haul	33	33	4,659	4,659
Total	1,177	1,210	110,623	114,542

F.4.2. Slot utilisation

As we discussed in Appendix E, the ideal market mechanism imposes a price on slots, irrespective of whether they are used, so airlines will be less inclined to retain slots that they do not ultimately use. On the basis of evidence reviewed in Appendix E, we have assumed that the incidence of slot utilisation increases by 3 per cent at MAD as a result of this effect.

This is a factor that we have applied across all movements and passengers, irrespective of the type of air service. As a result of this increase, there are 37 additional movements and 3,436 additional passengers on the typical day in 2007 at MAD.

F.5.   Overall Impact

The final results of our analysis of the outcome of an ideal market mechanism are shown in Table F.11.

Table F.11
Outcome under an Ideal Market Mechanism for Slot Allocation
(MAD, Typical Day 2007)

	Total Movements	Total Passengers
Hub alliance short-haul	491	49,839
Hub alliance long-haul	50	9,620
Other alliances short-haul	94	7,329
Other alliances long-haul	13	2,118
Low cost	62	7,205
Charter	13	2,055
Other short-haul	490	35,013
Other long-haul	34	4,799
Total	1,247	117,978

Source: Table A.10 x 103%

In order to identify the impact of this mechanism, as compared with a continuation of the current system, we project the current system of allocation to take account of 2007 capacity constraints and traffic levels. To do this, we use the estimates of demand described in 0, together with the capacity constraints projected for 2007, which gives a daily total of 1,173 slots used. We then simply apply the traffic mix proportions and average passenger loads experienced in 2002 – which we have presented earlier in this Appendix – to determine the number of movements and number of passengers for each type of air service. This is shown in Table F.12.

Table F.12
Calculation of Passengers and Movements under the Current System of Allocation
(MAD, Typical Day 2007)

	Slots used, 2002	Passengers per movement, 2002	2007 Allocation - Current Mix	
			Movements	Passengers
	A	B	C = A x 1,173	D = B x C
Hub alliance short-haul	40.7%	101.3	477	48,370
Hub alliance long-haul	4.1%	192.5	48	9,283
Other alliances short-haul	7.8%	78.1	92	7,160
Other alliances long-haul	1.1%	158.6	13	2,047
Low cost	1.1%	117.0	13	1,509
Charter	1.1%	154.7	13	1,997
Other short-haul	41.2%	71.3	484	34,489
Other long-haul	2.8%	141.6	33	4,650
All	100%		1,173	109,505
Source	*Table F.3*	*Table F.7*	*Computation*	*Computation*

A comparison of movements under the two systems is shown in Table F.13. This table generates some of the key results for MAD that are presented in the main report. For example, the increase in movements resulting from a market mechanism at MAD is {(1,247 – 1,173) ∕ 1,173} = 6.3%; the increase in passengers per movement resulting from a market mechanism at MAD is {(117,978 – 109,505) ∕ 109,505} = 7.7%.

Table F.13
Comparison of Movements under Systems of Slot Allocation
(MAD, Typical Day 2007)

	Current System		Ideal Market Mechanism	
	(Total)	(%)	(Total)	(%)
	A	B	C	D
Hub alliance short-haul	477	40.7%	491	39.4%
Hub alliance long-haul	48	4.1%	50	4.0%
Other alliances short-haul	92	7.8%	94	7.5%
Other alliances long-haul	13	1.1%	13	1.1%
Low cost	13	1.1%	62	4.9%
Charter	13	1.1%	13	1.1%
Other short-haul	484	41.2%	490	39.3%
Other long-haul	33	2.8%	34	2.7%
All	1,173	100.0%	1,247	100.0%
Source	*Table F.12*	*From column A*	*Table F.11*	*From column C*