New Developments in the Longhaul Air Travel Market - A Discussion of the Market Potential of Secondary Airports

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Abstract

Although, in Europe, most longhaul air traffic is concentrated at a few hubs, some secondary airports such as Manchester or Dusseldorf have been successful in attracting a number of longhaul services. In this paper, we first give an overview on longhaul flight supply apart from the hubs and classify the observed flights into different groups. In a second step, factors that might influence airport choice by longhaul carriers – derived from the literature on airline network economies – are discussed and empirically tested using the multiple regression analysis for a sample of about 80 European airports. It is shown that the size and GDP of a secondary airport's catchment area have a significant influence on the supply of longhaul flights, i.e. on the number of seats offered on direct intercontinental flight services from secondary airports.

The results might be of relevance for airport planning and management and help to avoid useless investment in longhaul infrastructure at airports with low demand. This kind of mis-allocation is especially relevant for countries such as Germany, where infrastructure dedicated for longhaul flights is provided at airports like Leipzig, where only few longhaul services arrive every week, while runway extension at Dusseldorf is not undertaken, despite sufficient demand.

***Keywords*:** airports, airlines, networks, hubs, longhaul
JEL codes: L93, R41, R42

Contents

1 Introduction

Although, in Europe, most longhaul air traffic is concentrated at a few hubs, some secondary, i.e. non-hub airports such as Manchester or Dusseldorf have been successful in attracting a remarkable number of longhaul services. In contrast, others, such as Stuttgart or Leipzig/Halle, have not, despite the provision of an infrastructure that is suitable for widebody, longhaul aircraft.

In this paper, we discuss the supply of longhaul traffic at European non-hub airports and its drivers. After a short definition of the terms “secondary airport” and “longhaul flights”, a status quo analysis illustrates the current distribution of longhaul flights between European hub and non-hub airports. In addition, typical forms of longhaul flight services from secondary airports are identified and classified (chapter 2). All-cargo services are not considered in this paper. In chapter 3, we first discuss the general consistency of hub bypass longhaul flights with the business models of the main types of airlines (legacy, leisure and low-cost carriers) and then derive factors which might affect the observed, unequal distribution of longhaul flights between secondary airports. Preliminary results of multiple regression analysis which was conducted for a sample of more than 80 European airports indicate that only the size and economic power of a secondary airport’s catchment area have a significant influence on longhaul flights supply, i.e. on the number of work load units offered on direct intercontinental flight services from secondary airports. In chapter 4, finally, we briefly discuss the impact of next-generation longhaul aircraft (Boeing 747-800 and 787, Airbus 350 and Airbus 380) on the future structure of the longhaul market.

The results might be of relevance for airport planning and management and help to reduce ressource misallocation in avoiding investments in runway extension projects at those airports that cannot generate enough local demand. At the same time, our results indicate that airports with economically powerful catchment areas might gain additional longhaul traffic if runway and capacity extension was undertaken.

While there has been much research on airport choice by hub carriers in particular, as well as on general factors affecting air travel demand, long haul air traffic apart from the hubs has been widely neglected (an exception is Dennis, 2005). Thus, the results of this paper might be a first step into a discussion about a market segment which the

aircraft manufacturing industry and a growing number of airlines seem to target increasingly, as the launch of the Airbus 350 and the Boeing 787 demonstrate.

2 The niche role of European non-hub airports in the longhaul market: Characteristics of current longhaul flight supply

2.1 Definitions

2.1.1 Longhaul flights

Both in literature and practice, different definitions of longhaul or intercontinental flights are employed. While Porger refers to every flight of more than 2.000 km as a long distance trip (Porger, 1978, p. 107), in this work – following the distinction of Lufthansa (Maurer, 2001, p. 10) – all flights from Europe to other continents except for those located around the Mediterranean are classified into the group of intercontinental or longhaul flights. Consequently, table 1 shows all regions we refer to as longhaul / intercontinental destinations.

Table 1: Longhaul destinations from Europe

Region	Countries
Africa	all countries except Northern Africa (Algeria, Egypt, Libya, Marocco, Tunisia)
Asia / Australia / Pacific	all countries except those located around the Mediterranean (Asian part of Turkey, Israel, Lebanon, Syria) and Jordan, but incl. east Uralian Russia
Amerika	all countries

2.1.2 Secondary airports

As the literature contains many different classifications of airports[1], there is no coherent definition for secondary airports. In this study, we refer to all airports as secondary or non-hub airports that fulfil the following two conditions:

(1) Hub-Function: A secondary airport must not serve as a primary connecting point (hub) between longhaul and shorthaul flights.

(2) Longhaul flight capability: A secondary airport must be technically capable of handling longhaul flights – at least subject to restrictions. This is to exclude airfields and very small regional airports from our sample.

Condition 1: Hub-Function

In the absence of a general definition of hubs, we refer to all airports as hubs that fulfil at least 3 of the 4 hub criteria shown in table 2. These hub criteria have all been discussed and employed in the economic literature.[2] All other airports are assigned to the group of secondary airports and thus included in our study.

In addition – to exclude regional hubs from our list of hub airports – we only refer to those airports as hubs that handle a significant amount of longhaul flights. Subsequently, an airport like Palma de Mallorca – where budget carrier Air Berlin operates a dense intra-European H&S network – would join our sample of secondary airports even if it fulfilled our hub criteria.

Table 2: Hub criteria

Transfer rate > 20%
Passenger numbers > 20 Mio.
Wave structure
Main airport of the national carrier

As a consequence, the largest European airports can be classified as follows:

- Amsterdam, Paris CDG, Frankfurt, London LHR, Madrid, Munich, Vienna and Zurich fulfil at least three of the hub criteria and thus are referred to as hubs (table 3).

- Due to missing information on transfer rates, Copenhagen, Lissabon, London LGW, Rome and Milan can not be clearly added to either the group of hubs or the group of secondary airports. Thus, we call these airports “secondary hubs” (table 4).

- Airports such as Düsseldorf, Manchester or Brussels, shown in table 5, and all other smaller European airports are referred to as secondary airports. Longhaul flights from here are discussed in this paper.

Table 3: Hub airports

Criteria	AMS	CDG	FRA	LHR	MAD	MUC	VIE	ZRH
Transfer rate > 20 %	yes	yes	yes	yes	?	yes	yes	yes
Passenger numbers > 20 Mio.	yes	yes	yes	yes	yes	yes	no	no
Waves	yes	yes	yes	yes*	yes	yes	yes	yes
Main airport of the national carrier	yes	yes	yes	yes	yes	yes	yes	yes
-> Hub?	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
No focus on continental traffic only	yes	yes	yes	yes	yes	yes	yes	no

*) Unlike other hubs, there are no real waves at Heathrow.

Table 4: Secondary hubs

Criteria	CPH	FCO	LIS	LGW*	MXP
Transfer rate > 20 %	yes	?	?	?	?
Passenger numbers > 20 Mio.	no	yes	No	yes	no
Waves	?	?	?	no	?
Main airport of the national carrier	yes	yes	Yes	no*	yes
-> Hub?	**?**	**?**	**?**	**?**	**?**
No focus on continental traffic only	yes	yes	Yes	yes	yes

*) On longhaul services from LGW, BA focuses on flights to the Caribbean and on some additional US services

Table 5: Large secondary airports

Criteria	ARN	BCN	BRU	BUD	DUB	DUS	HEL
Transfer rate > 20 %	?	?	no	no	no	no	?
Passenger numbers > 20 Mio.	no	yes	no	no	no	no	no
Waves	?	no	?	no	no	no	no*
Main airport of the national carrier	no	no	yes	yes	yes	no	yes
-> Hub?	**no**	**no**	**no**	**no**	**no**	**no**	**no**
No focus on continental traffic only	yes	yes	yes	yes	yes	yes	yes
Criteria	**LUX**	**MAN**	**ORY***	**PMI**	**PRG**	**WAW**	**OSL**
Transfer rate > 20 %	no	no	?	?	no	no	no
Passenger numbers > 20 Mio.	no	yes	yes	yes	no	no	no
Waves	no	no	?	yes	no	no	?
Main airport of the national carrier	yes	no	?	no	yes	yes	no
-> Hub?	**no**	**no**	**no**	**no**	**no**	**no**	**no**
No focus on continental traffic only	no	yes	no*	no	yes	yes	yes

*) In recent years, Air France has withdrawn virtually all longhaul services from ORY.

Condition 2: Technical capability of handling longhaul flights

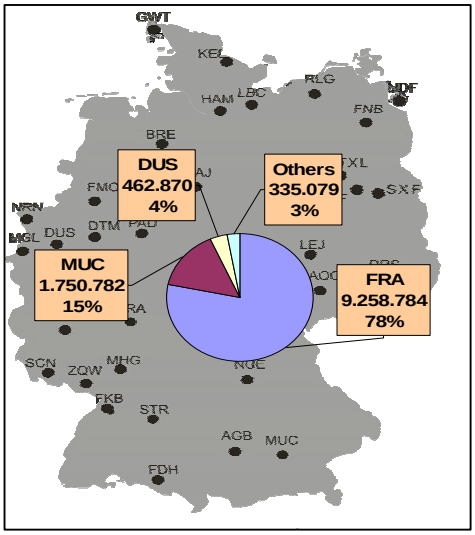
Secondary airports which are part of this study must have an infrastructure that allows them to handle longhaul aircraft without any or subject to only few restrictions. The objective of this exclusion is to avoid that hundreds of smaller airfields will join our group of secondary airports. Thus, we only include airports with a runway length of at least 2.000 m and a PCN (Pavement Classification Number) of 60[3] or higher. These values can be regarded as rough minima allowing for at least restricted longhaul operations. So far, we have included about 80 European secondary airports in

our sample. These are shown in appendix 1. Airports in Greece and in non-EU-countries other than Switzerland and Norway are presently not considered.

2.2 Status quo: Hub concentration of longhaul flights out of Europe

The times of line networks in the aviation industry have long passed away.[4] Today, most longhaul traffic from and to Europe is concentrated at a few hubs. As figure 1 shows, more than 90% of all passengers leaving Germany on a direct longhaul flight depart from Lufthansa's hubs in Frankfurt and Munich, and in the rest of Europe the situation is similar: Major carriers concentrate their longhaul flights on their respective main hubs and operate next to zero longhaul services from secondary airports in their home countries.[5]

Figure 1: Distribution of longhaul passengers between German airports in 2005

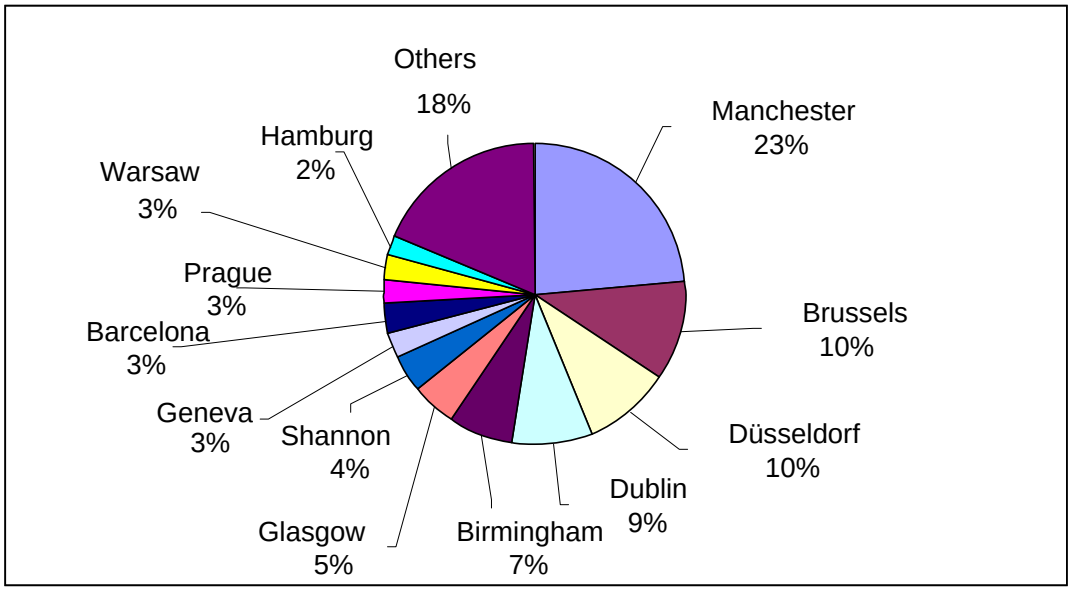


Source: Own figure and calculations based on data provided by the Federal Statistical Office in Germany.

2.3 Remaining longhaul services at non-hub airports in Europe

Figure 2 illustrates the distribution of those longhaul services which do take off from secondary airports and thus bypass the European hubs. It is evident that there is no equal distribution between airports but a concentration on a few, leading non-hub airports.

Figure 2: Distribution of longhaul services between secondary airports in Europe



Source: Own calculation based on flight data provided in the current winter season 2006/2007 timetables published by the respective airport operators. Charter flights at some airports have not been included because of poor data availability. All airports considered are listed in appendix 1. Major airports excluded are the hubs and secondary hubs listed above and airports in Greece and some other EU countries. Appendix 2 shows the number of seats offered at these airports, based on a typical week in January 2007.

Two of them are Brussels and Dublin where longhaul carriers SN Brussels and Aer Lingus offer flight connections. Thus, these airports could also be regarded as secondary or niche hubs, similar to Lisbon or Milan. The remaining secondary airports that handle a significant number of longhaul passengers without any hub function seem to be airports located in major conurbations that have traditionally been among the largest non-hub airports in the respective countries. Manchester, Düsseldorf, Geneva and Barcelona are examples for this group of airports.

Other airports, which handle less, but still a few regular longhaul services per day are either “third-league” airports in large European countries – such as Cologne, Berlin and Hamburg in Germany, Nice or Marseille in France or Edinburgh and London Stansted in the UK – or primary airports in smaller, usually Eastern European countries such as Prague, Budapest or Warsaw.

The current supply of longhaul flights from secondary airports can be divided into the following groups: scheduled flights by flag carriers, longhaul feeder flights, leisure flights, ethnic flights and all-business flights.

- ***Scheduled flights by national flag carriers:*** Some "flag" carriers of smaller EU countries operate from their home airports to major, globally important destinations, such as New York or Chicago: LOT from Warsaw, Malev from Budapest, CSA from Prague, Aer Lingus from Dublin.

- ***Longhaul feeder flights:*** A couple of foreign longhaul carriers connect their respective overseas hubs with second-and third-tier cities in Europe: The main carriers to be mentioned in this context are Continental Airlines, Delta Airlines and Emirates which fly from their hubs in the US (Newark and Atlanta mainly) and Dubai respectively to non-hub airports like Manchester, Barcelona or Düsseldorf and – increasingly – also to even smaller airports like Hamburg or Glasgow (table 6). As these flights feed the respective hub in oversea, they will be named "longhaul feeder flights".

Table 6: Western European hub and non-hub destinations served by Continental Airlines and Emirates

Continental Airlines		Emirates	
Amsterdam	**Geneva**	**Birmingham**	**Nice**
Athens	**Glasgow**	**Düsseldorf**	Paris CDG
Barcelona	**Hamburg**	Frankfurt	Rome
Belfast	Lisbon	**Glasgow**	**Venice**
Berlin	London LGW	**Hamburg**	Vienna
Birmingham	Madrid	**Larnaca**	Zurich
Bristol	**Manchester**	London LGW	
Brussels	Milan	London LHR	
Cologne	Paris CDG	**Malta**	
Copenhagen	Rome	**Manchester**	
Dublin	**Shannon**	Milan	
Edinburgh	**Stockholm**	Munich	
Frankfurt	Zurich	**Newcastle**	

Non-hub destinations are in bold type.

Source: Websites of Continental Airlines and Emirates.

- ***Leisure flights to holiday destinations*:** While in Germany, longhaul leisure/IT flights concentrate on the largest secondary airports like Düsseldorf,

virtually every UK airport handles at least a few flights per week to Florida, provided that a sufficient runway length is given. Typical carriers are (former) charter carriers such as Condor or LTU (Germany), Corsair (France) or Excel Airways, Monarch and Thomsonfly (UK). From abroad, Canadian carriers Air Transat and Zoom serve various destinations mainly in France, Germany and the UK.

- ***Ethnic traffic*:** Airports in major conurbations with high numbers of immigrants usually handle some "ethnic flights". Examples are PIA's flights from Manchester or Birmingham to various cities in Pakistan, Mahan Air's and Iran Air's services from Western Europe to Tehran and SN Brussels' daily flights from Brussels to destinations all over Africa.

- **All-Business-Class services:** Lufthansa (from DUS), Silverjet (from London-Luton), EOS and Maxjet (both from London-Stansted) offer non-stop, all-business-class services from secondary airports to destinations in the USA.

Based on these patterns, longhaul flight supply at European non-hubs can be summed up as follows: Most longhaul flights bypassing Europe's hubs include the leading secondary airports – such as Düsseldorf or Manchester – that benefit from large catchment areas. Most of these longhaul flights are operated by foreign, non-EU carriers, because European Hub-and-Spoke-Carriers widely neglect secondary airports of their home countries. In the remaining part of this paper, we discuss possible factors on this distribution of longhaul flights services.

3 Determinants of longhaul flight supply at secondary airports

3.1 Consistency of hub bypass longhaul flights with airline business models

Before we derive and discuss potential factors on longhaul flight supply at secondary airports, we briefly present the main different groups of airline types and discuss if longhaul operations to secondary airports are consistent with their business models. As most airlines operating into the EU are now privatised, profit-maximising firms, we assume profit-maximising route networks to be chosen.

The main types of passenger airlines are “traditional scheduled, full-service or legacy carriers”, “regional or feeder carriers”, “low-cost or low-fare carriers” and “charter or leisure carriers”.

- **Regional carriers** per se would not offer any longhaul services but concentrate on regional point to point routes or on feeder flights. Thus, they are excluded from further analyses and discussion.

- **Traditional scheduled carriers** rely on the hub and spoke model because it offers advantages both on the cost side (economies of scale, scope and density, see Caves/Christensen/Tretheway 1984, Hansen/Kanafani 1989, Kanafani/Ghobrial 1982) and the demand side. From the consumer’s point of view, the latter aspect is especially important because in offering connections at the hub, the hub carrier supplies a large variety of O&D connections to chose from, including niche routes which would not be profitable when served directly.[6] As every additional flight out of a carrier’s hub represents a multiple of new products and generates additional economies of density, it usually makes no sense for a hub carrier to start flights from secondary, non hub airports located in the same country or region as the hub. Hub-carriers based in other continents, in contrast, are more likely to serve secondary airports in Europe as they operate their hub at the other end of the route. An example is Delta Airlines connecting Düsseldorf with its Atlanta hub, from where onward connections to all over North and South America are offered.[7]

- **Low cost carriers (LCC)** achieve very low costs per seat mile in simply concentrating on pure point to point flights and in eliminating frills. In offering ping pong, shorthaul flights between usually smaller and uncongested airports with fast turnaround times, LCC manage to extend fleet utilization, leading to lower capital costs per seat mile. Although some experts claim the business model of low cost carriers could be transferred to the longhaul market, we question this because some key elements of the strategy of LCC either cannot be implemented on longhauls (higher daily fleet utilisation, lower personnel costs in avoiding hotel accommodation) or are of relatively less importance because of a different in cost structure between short- and longhaul carriers (The impact of discounted airport fees and the abandonment of

amenities such as lounges is much smaller on longhaul flights as fuel, personnel and capital costs are responsible for a larger share of total cost) (Ionides, 2006). In addition, we cannot imagine that many longhaul route would generate enough demand for daily point to point services.

- **Charter or leisure carriers** have traditionally been operating longhaul flights, usually selling (parts of) their capacity to tour operators. They achieve low costs per seat mile in focusing on direct point to point flights using aircraft with high-density seating. As holidaymakers usually stay one week or longer at their destination, a temporal concentration of passenger demand to one destination on few flights per week is usually accepted. Furthermore, most leisure travellers are prepared to cover longer distances to their departure airport, which allows the airlines to spatially concentrate passenger flows on flights from few departure airports. The same applies to carriers focusing on ethnic flights (Brons/Pels/Nijkamp/Rietveld, 2002; Graham, 1995; Windle/Dresner, 1995). However, the range of longhaul destinations suitable for charter and ethnic carriers is rather limited.

3.2 Derivation and discussion of possible factors on longhaul flight supply at non-hub airports

3.2.1 Classification of determinants of longhaul flight supply – the airport perspective

Airport choice by airlines has been widely discussed in the literature (for a recent article and further references see Blackstone, Buck, Hakim, 2006), but there has hardly ever been any particular focus on intercontinental hub bypass flights. In this paper, potential factors on the above described supply of longhaul flights at secondary airports are discussed.

In times of increasing deregulation and competition in the aviation market, most airports had to intensify their marketing activities in recent years to secure sustainable growth. In this context, the acquisition of longhaul services plays an important role as additional longhaul services ceteris paribus increase an airport's slot productivity in bringing more passengers and thus generating more airport revenue per flight.[8]

This is especially important for heavily congested (secondary) airports like Düsseldorf, Berlin-Tegel or London-Gatwick.

When deriving and discussing potential determinants of longhaul flight supply at secondary airports, we therefore adopt the marketing-mix perspective of airport managements to find out what airport managers can do to improve their competitive position in the longhaul sector.

However, as table 7 shows, airport operators – unlike most other firms – cannot independently control all 4 P's (product, price, promotion, place) of the marketing-mix. Instead, crucial decisions on product characteristics such as runway length, terminal size or curfew are usually subject to approval by regional governmental institutions and courts. The size and wide of the catchment area - dimension "place" in the marketing mix – mainly depend on rail and road access and on the proximity of competing airports and thus are also exogenous. Thus, the degree of external influence is considered when classifying and discussing potential factors on longhaul flight supply.

Table 7:

Classification of potential factors on longhaul flights (the airport's perspective)

Airport-related factors (Marketing-Mix)				Non airport-related factors	Degree of external influence
Price	**Promotion**	**Product**	**Place**		
Airport usage charges (landing fees etc.) Incentives (discounts, rebates)	**Public relations Market research Airline-marketing**				**Low**
		Infrastructure Operational restrictions	**Accessibility**		**Medium**
				Catchment area Competition by hubs Bilaterals	**high**

3.2.2 Internal factors: Price and Promotion

As shown, promotion and price are the only two dimensions of the airport marketing mix that could possibly determine longhaul flight supply and that can be (highly) independently designed by airport management.[9] If the success of smaller airports in attracting low cost carriers by offering reduced airport could be transferred to the longhaul market, airport fees and thus pricing would possibly have a major impact on route acquisition.[10] However, compared to shorthaul carriers, airport charges are a relatively small part of total operating costs of longhaul carriers.[11] Thus, it is unlikely that low airport fees, volume based discounts and marketing support alone would help attracting new longhaul services. [12]

The same goes for the impact of promotional activities by airport operators on the aquisition on longhaul flights. Airports are free to support their customers in the fields of public relations or promotional activities. Examples are the sending out of press releases or the placement of ads in newspapers and magazines to promote new services. On top of that, some airports maintain market research departments that – often in cooperation with current or potential airline partners – compile feasibility studies on possible new services. However, such promotional activites ultimately correspond to indirect reductions on airport service fees, because airlines can save own financial ressources. Thus, and considering the fact that virtually all airports now offer promotional support, these activities alone are supposed to have as little impact on the attraction of new longhaul services as price reductions.

3.2.3 Semi-external factors (medium degree of external influence)

3.2.3.1 Airport infrastructure

As already mentioned, longhaul aircraft require a superior airport infrastructure than short- and medium-haul aircraft. Of highest importance are a sufficient runway length and strength. The minimum runway length a longhaul aircraft requires depends on various factors such as take off weight, humidity, altitude above sea level, weather and pavement surface. A runway length of at least 3.400 m is generally sufficient for all aircraft and take-off weights. From shorter runways, pilots might be forced to operate under payload restrictions that reduce flight profitability. A sufficient runway strength is important because widebody aircraft generally require a more stable runway than smaller aircraft. A runway's stability is usually expressed

by its so called “pavement classification number“ (PCN). A PCN of 60 can be regarded as an absolute minimum for longhaul aircraft (Malina 2005).

Since extensions of airport capacities usually depend on positive decisions of the local politicians and courts, airport infrastructure can be regarded as a semi-external factor.[13]

3.2.3.2 Operational restrictions

Besides the provision of a high-quality „hard“ infrastructure, the „soft“ infrastructure has strong effect on the attractiveness of an airports for longhaul carriers. The soft infrastructure of an airport describes parameters of its operational approval, such as:

- operating hours and curfews
- MTOW and / or size restrictions for aircraft on commercial flights exceeding technical restrictions imposed by the infrastructure
- aircraft noise restrictions
- limits on aircraft movements

Bans of night flights, for instance, negatively affect the attractiveness of an airport especially for cargo airlines und thus also for longhaul flights.[14] Limit on movements, such as in Düsseldorf, can cause slot shortage and hence reduce an airport’s attractiveness if slots for longhaul flights and feeder services are no longer available at attractive times.[15] Aircraft size restrictions, as practiced in Düsseldorf-Weeze, can effectively inhibit any longhaul services.[16]

Since these kinds of operating restrictions are usually imposed by governmental institutions or court decisions, airport managements cannot or can only indirectly influence them through lobbying efforts.

3.2.3.3 Intermodal connectivity

Since a good connectivity to other modes of transport, i.e. motorways and long distance trains, enlarges an airport’s catchment area in reducing the airport users’ access costs, it might enhance an airport’s attractiveness for longhaul carriers.[17]

3.2.4 External factors (high degree of external influence)

3.2.4.1 Catchment area and local demand

While in hub-and-spoke networks, the demand from various origins is canalized at the transfer hub, sufficient local demand is an indispensable condition for airlines to inaugurate direct longhaul passenger or freight services from secondary, non-hub airports.

As discussed in the literature, the following, exogenous factors describe the attractiveness of an airport's catchment area and could thus influence the viability of longhaul flights: number of inhabitants, economic power, industry structure, political importance and attractiveness as a destination for incoming passengers, cluster of immigrants from other continents (See for example Ash/Trent/Ewald 1990, Brons/Pels/Njikamp 2002, Doganis 2002, Bonné 2003, Derudder/Witlox 2005, Hanlon 1996, Janic 2006, Pagliari 2005).

Of special importance is the demand generated by business travellers as this group is by far less price elastic than leisure travellers and thus is willing to pay for unrestricted, full-fare economy, business and first class tickets (Oum/Gillen/Noble 1986, Dresner 2006).

3.2.4.2 Hub distance and capacity constraints

Nowadays, most longhaul air traffic is operated within hub-and-spoke networks. As explained before, the reasons for the dominance of this network model are its cost and strategy related advantages over other forms of networks. On the cost side, as mentioned above, airlines operating hub-and-spoke networks can achieve significant economies of scale, scope and density. On the marketing or strategy side, the two main advantages of hub-and-spoke-networks are as follows: First, passenger demand usually rises because of increased frequencies and a wider range of O&D combinations offered (network externalities). Second, hub carriers usually get a dominant position at their hub(s) which can result in charging higher fares and in the ability to deter entrance of other carriers (see for example Borenstein 1991 or Oum/Zhang/Zhang 1995).

Today, high infrastructure utilization during the waves of incoming and departing flights is the main problem of hubs and thus represents the main disadvantage of hub

and spoke networks. Movements at European hubs like Frankfurt or London have long surpassed the capacity supplied at these airports.[18] Some authors argue that these developments could boost longhaul flights from smaller airports which currently have idle capacities (see for example Seebohm, 1999, p. 10). Especially new and independent longhaul carriers could be forced to make use of secondary airports because they do not possess enough slots at the major hubs (Ewald, 1990, pp. 61-62).[19] For these reasons, the distance to the nearest hub and its capacity situation are supposed to influence the supply of longhaul flights from secondary airports.

3.2.4.3 Developments in the airline sector

Apart from this, it is likely that the number of longhaul flights at a secondary airport might also depend on the market structure in the (regional) airline market. According to Beyhoff/Ehmer/Wilken, the increasing formation of global airline alliances has led to additional feeder flights to the partner airlines' hubs and at the same time to a decrease of direct longhaul flights from secondary airports (Beyhoff/Ehmer/Wilken, 1995, p. 52). In establishing these multi-hub networks, the alliances' members try to benefit even more of the advantages of hubbing – not least to reduce competition.

Also, as discussed above, direct longhaul flights from non-hubs require sufficient demand and thus attractive catchment areas at both ends of a route. In addition to local passengers, transfer passengers can make these flights more viable as they might help the carrier to reach load factors critical to break even (Ash/Trent/Ewald, 1990, p. 3). To generate transfer passengers at non-hubs like Düsseldorf, a longhaul airline has to find independent short-haul carriers to co-operate with. This will be a difficult task if – like today – most airlines that offer possible connecting flights belong to other alliances or are low cost carriers that per se do not sign interline agreements. An example of an independent carrier which feeders longhaul services from a secondary airport is Air Berlin which offers connecting flights to LTU's longhaul operations from Düsseldorf and Munich.

3.2.4.4 Bilateral Air Service Agreements

In bilateral air service agreements (ASA's), governments rule which and how many airlines are allowed to offer how many weekly scheduled flights between how many airports in the respective countries. While restrictive ASA's usually only allow the (former) national carriers to operate scheduled services (from their respective hubs),

"Open Sky" agreements permit all airlines of the countries involved to fly as often as they want – and from whatever airport they like (Gillen et al., 2001, pp. 31-32). Today, though, only the aviation markets within Europe and between parts of Europe and the US are highly liberalised, while flights from Europe to most other longhaul destinations are still relatively restricted; direct flights in these regions from secondary airports are often prohibited. Thus, a further liberalization of ASA's is supposed to make it easier for secondary airports to attract new longhaul services (Haworth, 1996, p. 68; Seebohm, 1999, p. 13). A study conducted for the airport of Hamburg has shown this for flights to Asia (Gillen et al., 2001, pp. 185-187).

3.3 Empirical test of the discussed factors

3.3.1 Determination and quantification of input and output variables

The multiple regression analysis is used to test the dependence of one output variable from one or more independent variables (input variables). The analysis is conducted for flights in the winter season 2006/2007, but – subject to data availability – other years will also be taken into account in forthcoming, updated versions of our study.

Output variable

We want to test the dependence of the degree of longhaul flights at secondary airports from the input variables discussed above. Thus, our output variable must describe the degree of longhaul flights at non-hub airports.

Air transport delivers two seperate outputs, passengers and cargo[20]. Thus, our output variable should both consider all passengers on longhaul flights and all intercontinental cargo shipments. An indicator which was created to fulfil these requirements is the "Work Load Unit" (short WLU). One WLU is defined as either one passenger or 100 kg of cargo (Nydshadham/ Rao, 2000).

Since the statistical offices of many European countries do not provide any data on passengers numbers carried and cargo transported on route level, the output variable „Work load units handled on direct intercontinental flights" cannot be quantified for all airports in our sample. Thus, and as we focus on passenger traffic, our output variable is "Seats offered on direct longhaul flights".[21]

Input variables

Above, possible factors which might influence the number of longhaul flights from secondary airports have been derived from the literature and discussed. In the following analysis, we want to test if these factors really have an significant influence on longhaul flight supply at German non-hub airports. Table 8 displays a possible quantification of input variables.

Table 8: Determinants of the supply of longhaul flights

Variable		Quantification
Internal	**Promotion and Pricing**	
	Market research department and active airline marketing	Dummy-Variable (0=no active market research and airline marketing; 1= active market research and airline marketing)
	Pricing	landing fee in EUR / t for typical widebody aircraft Financial marketing support for new flights
Semi-External	**Airport Infrastructure**	
	Number of runways	Number of runways
	Length and strength of the longest runway [RWY]	Physical length (in metres), PCN value [22]
	Operational restrictions	
	Night ban	Dummy (0=no; 1=yes)
	Limit of movements	Dummy (0=no; 1=yes)
	Intermodal connectivity	
	Motorway / Long Distance Train Station	Dummy (0=no; 1=yes)
External	**Catchment area**	
	Economic power in the catchment area [GDP]	Total GDP in all NUTS 2 regions whose largest city is located less than 90 minutes from the airport
	Industry structure	Number of global players
	Main national airport	Dummy (0=no; 1=yes)
	Attractiveness of the catchment area for incoming passengers	Number of hotel beds in the catchment area
	Ethnic minorities	Number of foreigners with origin from non-European countries
	Distance to the nearest hub [Hub Distance]	Kilometers (on motorways)
	Degree of congestion at the nearest hub [Hub Capacity]	Dummy (0=idle capacity available; 1=congestion)
	Airline market	Availability of an independent carrier which can provide interline connections; Dummy (0=no; 1=yes)
	Bilaterals	Number of Open-Sky-Agreements with other countries

At the first, the analysis is conducted for the factors which we expect to have the highest influence on the supply of longhaul services and for which data availability is given. These factors are marked with a grey background colour. Input variables for which data is not (yet) available are not included at this time.

Due to limited data availability, GDP data are from 2003 while our output variable refers to flight data of the current winter season 2006/2007. While a certain time lag is justified as airline network decisions are based on past economic development, we will try to conduct further analyses with more up to date GDP data.

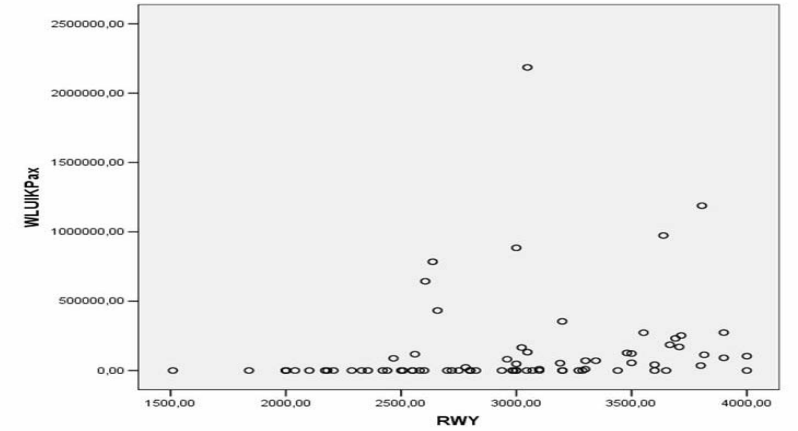
3.3.2 Discussion of the results

In our study, we want to test the significance of the identified variables, using the multiple regression analysis. Our sample contains the variables marked in table 8 and covers 80 out of more than 250 European secondary airports (see appendix 1).

A first analysis (Table 9) of the impact of all factors chosen above shows that not all variables are significant at the 10% level, and that the coefficient of the variable "runway length" (RWY) does not have the expected sign. Possible reasons for these results could be as follows:

- The insignificance of the variable runway length could underline that this variable only is a sine qua non for the operation of longhaul flights, but this does by far not mean that a sufficient runway infrastructure always yields in a good number of longhaul flights. Figure 3 underlines this conclusion.

Figure 3: The influence of runway length on longhaul flight passengers



- The possible insignificance of the variable "distance to the next hub" – indicated by its high p value – might result from the relative short distance of major secondary airports such as Düsseldorf, Manchester or Birmingham to the hubs Frankfurt and London, that means from the highly concentrated conurbations in major countries in Western Europe.

- The low p values of the variables "GDP in the catchment area" and "Main national airport" could be a sign of their significance: A secondary airport like Brussels, Dublin, Prague or Warsaw, which is a main base of the respective country's flag carrier, can easier attract longhauls services than a second-tier airport in the same country, and a high economic power in an airport's catchment area generally leads to more air traffic than elsewhere.

Table 9: Impact of the discussed variables on the supply of seats on direct long-haul services from our sample of European non-hubs

Regression Statistics

Multiple R	R Square	Adjusted R Square	Standard Error
,488(a)	,238	,167	335449,46704

ANOVA

	SS	df	MS	F	Significance F
Regression	1897734573409,602	5	379546914681,921	3,373	,010(a)
Residual	6076422626492,790	54	112526344935,052		
Total	7974157199902,400	59			

Coefficients

	Coefficients	Standard Error	T	P Value
(constant)	-104008,818	358351,922	-,290	,773
GDP	,822	,319	2,577	,013
Main national airport	416562,750	153371,903	2,716	,009
RWY	-15,266	112,609	-,136	,893
HUB Distance	213,496	230,124	,928	,358
Hub Capacity	169387,068	105688,021	1,603	,115

However, the coefficient of determination is quite low which indicates that the model does not explain much of the total variance. There could be other factors with a high influence on the output variable, or the model might be misspecificated. The adjusted

coefficient of determination (R^2adj) is smaller than the coefficient of determination which underlines the insignificance of some of the factors.

If the variable runway length is left out, the coefficient of determination remains stable at (R^2 = 0,238), and the variables "GDP" and "Main national airport" remain significant at the 5% level (table 10).

Table 10: Impact of the variables "GDP", "Main national airport", Hub Distance" and "Hub Capacity" on the supply of seats on direct longhaul services from our sample of European non-hubs

Regression Statistics

Multiple R	R Square	Adjusted R Square	Standard Error
,488(a)	,238	,182	332442,49115

ANOVA

	SS	df	MS	F	Significance F
Regression	1895666654105,237	4	473916663526,310	4,288	,004(a)
Residual	6078490545797,160	55	110518009923,585		
Total	7974157199902,400	59			

Coefficients

	Coefficients	Standard Errorr	T	P Value
(constant)	-149558,055	123458,515	-1,211	,231
GDP	,813	,310	2,626	,011
Main national airport	410569,752	145545,912	2,821	,007
Hub Distance	210,595	227,073	,927	,358
Hub Capacity	171457,236	103641,499	1,654	,104

Further tests with less variables and reduced sample sizes – that means with less airports included – always result in the variables "GDP" and "Main national airport" remaining stable and significant at the 5% level. This underlines the conclusions made above.

In the forthcoming steps of the study, the sample will be enlarged by adding additional airports and data for additional variables that might have an influence. In addition, a panel analysis might be conducted to further extend the data sample and to eliminate temporary changes caused by one-off events such as avian influenza or 9/11.

4 The impact of next-generation aircraft

Both Airbus and Boeing are currently working on next-generation longhaul aircraft. While first deliveries of the 550-seater Airbus 380 are expected for autumn 2007, new medium-sized longhaul aircraft Boeing 787 and Airbus 350 might start flying in 2009 and 2014, respectively. Since the launch of Boeing's 787 in April 2004 more than 450 orders have been placed, making it the most successful aircraft launch in the manufacturer's history (Boeing, 2006a; Boeing, 2006b). In addition, Boeing is working on a larger, updated version of its Boeing 747 "Jumbo Jet".

Both manufacturers lay emphasis on drastically reduced operating costs and fuel consumption of these new aircraft types (Sobie 2007, www.airbus.com, www.boeing.com). These operating cost reductions will – ceteris paribus – reduce total costs both for hub-and-spoke and point-to-point carrier. As hub-and-spoke carriers will still rely on feeder flights with smaller aircraft and connecting processes, it is likely that total costs for point-to-point airlines will decrease relatively more. This, along with enduring hub congestion, could further increase hub bypass and longhaul feeder flights in high-demand markets.

5 Conclusions

This paper shows interim results of an ongoing study on the determinants of longhaul flights from secondary airports. We have illustrated the current distribution of longhaul flights between secondary airports in Europe and derived and discussed possible factors that might influence this distribution. Using a data sample of more than 80 European airports, a multiple regression analysis was conducted to find out if these factors really have an impact on the output variable "Supply of seats on direct longhaul services".

Several variations of the analysis all resulted in a low coefficient of determination, but the variables "GDP in the catchment area" and "Main national airport" seem to be significant at the 5% level and remain stable. Thus, it can be assumed that the economic power of the catchment area has a positive influence on the supply of longhaul flights which seems realistic.

The insignificance of the variable runway length underlines that this variable is only a sine qua non for the operation of longhaul flights, but a long runway alone does not automatically yield in a good supply of longhaul flights, as airports like Leipzig/Halle, Berlin, Hannover or Basle demonstrate.

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Appendix 1: Sample of secondary airports

Austria	Graz	Germany	Düsseldorf-Weeze
Austria	Innsbruck	Hungary	Budapest
Austria	Klagenfurt	Irland	Dublin
Austria	Linz	Irland	Shannon
Austria	Salzburg	Italy	Bergamo
Belgium	Brussels	Italy	Rom - Ciampino
Belgium	Charleroi	Italy	Treviso
Belgium	Liege	Italy	Venice Marco Polo
Belgium	Ostend	Luxemburg	Luxemburg
Czech Republic	Prague	Poland	Gdansk
Denmark	Billund	Poland	Katowice
Estonia	Tallinn	Poland	Krakow
France	Bordeaux	Poland	Warsaw
France	Lille	Poland	Wroclaw
France	Lyon	Portugal	Lisbon
France	Marseille	Portugal	Porto
France	Nizza	Slowakia	Bratislava
France	Paris ORY	Spain	Barcelona
France	Toulouse	Spain	Gran Canaria
Germany	Berlin-Schönefeld	Spain	Malaga
Germany	Berlin-Tegel	Spain	Palma
Germany	Bremen	Spain	Teneriffa Norte
Germany	Dortmund	Spain	Teneriffa Sur
Germany	Dresden	Sweden	Goteborg-Landvetter
Germany	Düsseldorf	Sweden	Malmö-Sturup
Germany	Erfurt	Sweden	Stockholm
Germany	Frankurt-Hahn	Switzerland	Basle-Mulhouse
Germany	Friedrichshafen	Switzerland	Geneva
Germany	Hamburg	UK	Belfast Int'l
Germany	Hanover	UK	Birmingham
Germany	Karlsruhe/Baden-Baden	UK	Bristol
Germany	Cologne/Bonn	UK	Edinburgh
Germany	Leipzig-Halle	UK	Glasgow
Germany	Lübeck	UK	Liverpool
Germany	Münster/Osnabrück	UK	London-Luton
Germany	Nürnberg	UK	London-Stansted
Germany	Paderborn/Lippstadt	UK	Manchester
Germany	Saarbrücken	UK	Newcastle
Germany	Stuttgart	UK	Prestwick

Appendix 2: Longhaul flight supply at our sample airports

Airport	Longhaul flights per week	Seats / week	Interest	Cumulated interest
Manchester	149	42.039	19,2%	19,2%
Lisbon	105	22.856	10,4%	29,6%
Copenhagen	73	19.249	8,8%	38,4%
Brussels	81	18.725	8,5%	46,9%
Düsseldorf	69	17.012	7,8%	54,7%
Dublin	62	15.082	6,9%	61,6%
Birmingham	25	12.378	5,6%	67,2%
Glasgow	32	8.324	3,8%	71,0%
Shannon	32	6.817	3,1%	74,1%
Geneva	22	5.264	2,4%	76,5%
Barcelona	22	5.249	2,4%	78,9%
Prague	24	4.854	2,2%	81,1%
Warsaw-Okecie	20	4.460	2,0%	83,2%
Hamburg	16	3.574	1,6%	84,8%
Budapest	17	3.271	1,5%	86,3%
Berlin-Tegel	16	3.189	1,5%	87,8%
London-Stansted	29	2.544	1,2%	88,9%
Porto	4	2.444	1,1%	90,0%
Marseille	8	2.359	1,1%	91,1%
Edinburgh	12	2.266	1,0%	92,1%
Cologne/Bonn	11	2.182	1,0%	93,1%
Lyon	7	1.996	0,9%	94,0%
Basle-Mulhouse	7	1.760	0,8%	94,8%
Bristol	9	1.690	0,8%	95,6%
Nizza	5	1.569	0,7%	96,3%
Stuttgart	7	1.365	0,6%	97,0%
Venice Marco Polo	7	1.365	0,6%	97,6%
Toulouse	3	1.064	0,5%	98,1%
Bratislava	5	1.020	0,5%	98,5%
Berlin-Schönefeld	3	924	0,4%	99,0%
Leipzig-Halle	3	808	0,4%	99,3%
Hanover	4	682	0,3%	99,6%
Belfast Int'l	2	440	0,2%	99,8%
Bordeaux	1	187	0,1%	99,9%
Goteborg	1	184	0,1%	100,0%
Others	0	0	0,0%	100,0%

The figures are based on the airport's timetables and refer to a typical week in mid-January 2007. Charter services of some airports have not been included due to poor data provison by the airport operators. Lisbon and Copenhagen have later been excluded from the sample and been added to the group of "secondary hubs".

Appendix 3: Airport IATA-Codes

AMS	Amsterdam	LIS	Lisbon
ARN	Stockholm	LUX	Luxemburg
BCN	Barcelona	MAD	Madrid
BRU	Brussels	MAN	Manchester
BUD	Budapest	MUC	Munich
CDG	Paris Charles de Gaulle	MXP	Milan Malpensa
CPH	Copenhagen	ORY	Paris Orly
DUB	Dublin	OSL	Oslo
DUS	Dusseldorf	PMI	Palma
FCO	Rome Fiumcino	PRG	Prague
FRA	Frankfurt	VIE	Vienna
HEL	Helsinki	WAW	Warsaw
LGW	London Gatwick	ZRH	Zurich
LHR	London Heathrow		

Endnotes

[1] There are many different approaches for the classification of airports: The International Civil Aviation Organization (ICAO), among others, employs a technical classification which refers to the infrastructural capability to handle certain aircraft types (Airports Authority of India, 2005). Other institutions such as Airports Council International (ACI), the European Union or – for North America – Transport Canada and the FAA classify airports according to their output, that means passenger and cargo figures, irrespectively of the character of the flight mix (ACI, 2005; EU Commission, 2005; FAA, 2006; Transport Canada, 2006). Consultant groups like Boston Consulting Group, Mercer Management Consulting, DB Research or Booz/Allen/Hamilton usually classify airports accordingly to their function in the global aviation market (BCG, 2004; Heymann, 2006; Ringbeck/Hauser/Franke/Clayton, 2005; Mercer Management Consulting 2005).

[2] For Burghouwt/de Wit, a hub must be characterized by a high number of flight connections and by wave-structured flight operations (Burghouwt/ de Wit, 2005). According to Roth, hubs must be dominated by one single carrier (Roth, 2002).

[3] The PCN value indicates the strength of a runway. Widebody aircraft used on longhaul flights require a PCN of at least 60 (Malina, 2005).

[4] For example, in the 60ies and 70ies of the 20th century, SAS had four en route stops on its flight from Copenhagen to Buenos Aires – via Lisbon, Rio de Janeiro and Sa Paulo. Today, only a few, slightly "exotic" and state-owned carriers such as Royal Brunei Airlines (Frankfurt-Sharjah-Bangkok - Bandar Seri Begawan) still operate kinds of line networks (Source: current schedule data provided by OAG).

[5] Besides Lufthansa (Frankfurt and Munich) and Air France-KLM (Paris and Amsterdam), Alitalia – albeit on a much smaller scale – is the only other European hub carrier to operate two parallel longhaul hubs today, since British Airways has increasingly been neglecting its former secondary hub in Gatwick. Today, the Britons only operate a handful of longhaul services – mainly into the Carribean – out of Gatwick every day and – in con-

trast to Heathrow – hardly offer any onward connections at London's second largest airport (BAA, 2006).

[6] For a detailed analysis of the function of hub-and-spoke-networks, see Bailey/Graham/Kaplan, 1986, Hansen/Kanafani, 1989, or Hanlon,1996

[7] Other carriers serving European spokes from there overseas hubs include Continental Airlines (Newark) and Emirates (Dubai).

[8] It is likely that an increase in longhaul passengers even leads to a disproportional rise in airport revenues as longhaul passengers usually check-in earlier than shorthaul passengers and thus have more time to spend money on the airport premises.

[9] In the EU, airport charges are indeed regulated by governmental and European regulations. Nevertheless, in practice, airport managers usually are given a certain carte blanche to individually negotiate with airlines on landing fees.

[10] Knibb (1993) reports on marketing support for international services. Barrett (2004), S. 36, BCG (2004), S. 22, Gillen/Morrison (2005), S. 164-165, Morrison/Mason (2006), S. 6-10 and Gillen/Lall (2004), S. 47-48 – just to refer to a few works – show the importance of low airport-related costs for low-cost-carriers. Graham (2003) provides a good overview of the structure of aeronautical charges and explains how discounts are used to attract new services.

[11] According to Dennis (1995), landing fees sum up to only 10-15% of total costs of a typical shorthaul airline. Thus, their ratio on a longhaul flight is expected to be even smaller.

[12] Nevertheless, there are some examples for rebates being critical for the inauguration of new longhaul flights. Lufthansa, for instance, was paid 2 Mio. USD by Denver International Airport, the state of Colorado and Metro Denver Economic Development Corp. to begin daily flights to Frankfurt (Griffin, 2006).

[13] In Germany, it can take more than 20 years to plan and construct a new runway (Bickenbach/Kumkar/Sichelschmidt et al., 2005).

[14] Facing a night flight ban at Frankfurt Airport following the construction of a fourth runway, Lufthansa Cargo (2006) stresses the importance of night flights for the cargo industry.

[15] At Düsseldorf, a maximum number of aircraft movements allowed between May and October each year and a maximum hourly runway usage prevent the airport from growing sustainably (Düsseldorf Airport, 2007).

[16] See http://www.airports-worldwide.com/germany/niederrhein_germany.htm [22 May 2007].

[17] There are many articles focusing on the importance of airport accessability. In an early paper focusing on the New York – New Jersey area, Augustinus (1974) showed that airport choice depends on ground access time. Later studies conducted by Weisbrod/Reed/Neuwirth (1993) or Windle/Dresner (1995) confirm the importance of access time.

[18] In the end of the 1990s already, on working days, demand for slots at Frankfurt airport had already reached a level of more than 110 movements per hour. Between 7:30 and 21:30, it was constantly higher than the airport's capacity of 80 movements per hour (Bundesregierung, 2000). Up to now, slot supply has slightly increased to 82 movements per hour, but the demand is supposed to have risen even faster causing severe peak load problems.

[19] Slots are allocated in a system based on grandfather rights, that means an airline can use a slot as long as it uses it regularly which makes it nearly impossible for "new" airlines to access a congested hub (Graham, 2003).

[20] Mail services are not considered because we do not know of any longhaul mail-only services from Europe.

[21] The supply of longhaul seats has been calculated based on current schedule data and airline-specific aircraft configuration information.

[22] The physical length (in metres) of airport runways is one of our input variables. This implicates that each marginal enlargement of the runway would lead to a marginal increase

in the supply of longhaul flights which is not practicable. Thus, in the forthcoming work, we might instead employ a dummy variable describing different categories of runway qualities which consider both runway length and strength. The exact boundaries between these classes will be discussed at a later stage, considering the operating manuals of the most common longhaul aircraft.