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Market power and the need for regulation in the German airport market

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Abstract

With the increasing profit orientation of German airport operators the question as to whether they possess market power is gaining more importance. Whereas there have been some studies about the degree of market power of individual airports in countries such as Australia and Great Britain, the German airport market has not yet been studied in detail. This paper is part of a research project that tries to assess market power in this market. It indicates which of the 35 examined German airports possess market power and therefore need special regulatory attendance. We calculate a substitution coefficient for inter-airport competition that quantifies the quality of the best substitute for a certain airport. It is defined as the proportion of inhabitants within the relevant regional market of an airport that consider another airport, which has been identified as meeting the demands of the airlines, to be a good substitute from their perspective as well. The analysis is complemented by an assessment of intermodal substitution and countervailing power of airlines. The study gives strong indication that 23 out of the 35 German airports do not possess relevant market power. In contrast to this, four airports (HAM, FRA, MUC, STR) and Berlin Airport System (THF, TXL, SXF) have strong, five (BRE, DRS, LEJ, NUE, HAJ) have modest market power. These results provide a basis for the construction of an efficient regulatory framework for the German airport market.

Keywords: airport competition, countervailing power, market power, substitution
JEL codes:
L 93,R 48,D 42

I. Introduction

German airports were long regarded as passive providers of infrastructure without any interest in generating profits, whose sole purpose should be the provision of capacity for the functioning of the air transport market. During the last decade, however, airports have started perceiving themselves as enterprises competing with other sites for passengers and airlines. This increasing profit orientation can be attributed to three major developments: First, and most important, there has been a change of governance structure at many German airports: Although being organized as private companies for decades (contrary to other German transport infrastructure providers that were structured as public agencies), its shareholders were all public entities such as the federal or state government, public companies or municipalities. This has changed significantly: Of the 35 airports in Germany offering scheduled or holiday charter flights in 2004, now already ten are at least partially owned by private investors (Table 1 on the next page) and there are plans to open three more airports (Lübeck, Munich and Cologne) to private capital.[1] In 2005, more than 50 % of all passengers in Germany started or ended their journey at an airport with private capital involvement. This figure will rise to about 75 % if the federal government sells their stakes in Munich and Cologne.

Second, severe public budget problems lead to more cost and profit awareness of public shareholders, who strive for some return on their investment in the airport or at least expect the airport operator to minimize financial losses.

Third, the liberalization of the downstream airline market has led to a change of the business environment of the airport from ‘mutual existence’ with airlines to confrontation on service quality and prices. Airport managers suddenly have to deal with airlines pressing for lower charges and better quality and threatening to switch to another airport, thus ‘forcing’ airports into competition.

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[1] See Siegmund (2004), p. 72, Moring/Zamponi (2005), p. 22 and Handelsblatt (2004), p. 4.

Table 1: Ownership structure of privatised German airports

Airport	Airport operating company	Shareholders	Share
Altenburg-Nobitz (AOC)	Flugplatz Altenburg-Nobitz GmbH	County Altenburger Land Stadtwerke Altenburg GmbH Municipality of Nobitz Altenburger Destillerie und Liqueurfabrik GmbH Altenburger Brauerei GmbH Wellpappenwerk Luck GmbH County Chemnitzer Land	60.00 % 19.00 % 10.00 % 3.00 % 3.00 % 3.00 % 2.00 %
Dusseldorf-International (DUS)	Flughafen Düsseldorf GmbH	City of Dusseldorf Airport Partners GmbH[a)]	50.00 % 50.00 %
Dusseldorf-Mönchengladbach (MGL)	Flughafen Gesellschaft Mönchengladbach GmbH	Flughafen Dusseldorf GmbH Stadtwerke Mönchengladbach GmbH City of Willich	70.03 % 29.964 % 0.006 %
Frankfurt-Hahn (HHN)	Flughafen Frankfurt-Hahn GmbH	Fraport AG Federal state of Rhineland-Palatinate Federal state of Hesse	65.00 % 17.50 % 17.50 %
Frankfurt/Main (FRA)	Flughafen Frankfurt/Main AG (Fraport AG)	Federal Republic of Germany Federal state of Hesse Stadtwerke Frankfurt Holding Portfolio investments	18.38 % 32.13 % 20.52 % 28.97 %
Friedrichshafen (FDH)	Flughafen Friedrichshafen GmbH	County Bodenseekreis City of Friedrichshafen Luftschiffbau-Zeppelin GmbH ZF Friedrichshafen AG Federal state of Baden-Württemberg Others	24.75 % 24.75 % 13.23 % 16.13 % 1.18 % 19.95 %
Hamburg (HAM)	Flughafen Hamburg GmbH	City of Hamburg Hamburg Airport Partners GmbH & Co KG [b)]	51.00 % 49.00 %
Hanover (HAJ)	Flughafen Hannover Langenhagen GmbH	Hannoversche Beteiligung GmbH[c)] City of Hanover Fraport AG and Nord LB	35.00 % 35.00 % 30.00 %
Niederrhein (NRN)	Flughafen Niederrhein GmbH	Airport Niederrhein Holding GmbH [d)] County Kleve Municipality of Weeze	99.93 % 0.04 % 0.03 %
Saarbrücken (SCN)	Flughafen Saarbrücken Betriebsgesellschaft mbH	Fraport AG Flughafen Saarbrücken Besitz-gesellschaft [e)] City of Saarbrücken	51.00 % 48.00 % 1.00 %

Notes: Private companies are underlined; [a)] Airport Partners GmbH: Hochtief AirPort GmbH 60 %, Aer Rianta PLC (Dublin Airport Authority PLC) 40 %, [b)] Hamburg Airport Partners GmbH & Co KG: Hochtief AirPort GmbH 53 %, Hochtief Airport Capital 27 % Aer Rianta PLC (Dublin Airport Authority PLC) 20 %[c)] Sole shareholder: Federal state of Lower Saxony, [d)] Sole shareholder: Airport Network BV, [e)] Sole shareholder: Federal state of Saarland.

Source: Own compilation based on airport operators' reports and publications by shareholders.

With increasing profit orientation of German airports the question as to whether airports in Germany possess market power and therefore need to be regulated is gaining more importance. In essence an airport with market power is able to restrict the amount supplied and to raise the price in order to increase its profits at the expense of consumers; with the result that social surplus is reduced. Even if the airport can discriminate in pricing and thus

charges the marginal consumer prices equal to marginal costs – so that there is no shortage of supply compared to the competitive level – overall social surplus might be lower because of inefficient operations and higher marginal costs than in a competitive environment. The airport could also seek to reduce quality below consumers' preferences in order to increase its profits.

Whereas there have been some studies about the degree of market power of individual airports in countries such as Australia and Great Britain, the German airport market has not yet been studied in detail.[2] Most German research has focused on optimizing the regulatory framework, taking more or less as given the existence of market power. This paper is part of a research project that makes a contribution to filling this gap. It indicates which of the examined German airports possess market power and therefore need special regulatory attendance. The results can be used as a basis for designing an efficient regulatory framework for the German airport market.

The paper is structured as follows: Section II provides a closer look at the research question and the research subject. This is followed by a detailed assessment of the market power of German airports (section III), in which we take into account not only intramodal and intermodal competitive constraints on the market conduct of airports but also countervailing power of airlines. Section IV contains onclusions.

II. Definition of the research question and the research subject

Airports provide a series of services for their customers:

- Aeronautical services (e.g. infrastructure provision, rescue, security, fire-fighting, runway and taxiway maintenance)
- Aeronautical-related commercial services (e.g. baggage, passenger and cargo handling, catering, supply of fuel and lubricants, waste disposal)
- Non-aviation services (e.g. retailing, car rental, banks, hotels, restaurants)

Aeronautical and aeronautical-related commercial services are often called 'aviation services' to emphasize their core role for the functioning of the air transport market and differentiate them from additional services not needed for facilitating air traffic (non-aviation services).

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[2] See e.g. Australian Competition and Consumer Commission (2001) and Productivity Commission (2002) for Australian airports, Commerce Commission (2002) for New Zealand, Monopolies and Mergers Commission (1987) and Competition Commission (2002) for Great Britain.

The paper focuses on market power in aviation services as non-aviation services of an airport are generally regarded as being subject to competition from inner-city leasing or retailing.[3] Moreover, we concentrate on market power in enabling passenger transportation. This is mainly due to the reason that the market for providing aviation services for cargo-only flights and the cargo market itself are unanimously regarded by the relevant literature as being highly competitive, contrary to the passenger market.[4]

Because of prohibitively high entry barriers in the German airport market (mainly due to legal and administrative restrictions), competitive constraints can only derive from current substitutes.[5] Therefore we do not further analyse potential competition but only current.

Another restriction concerning the research subject deals with the character of passenger traffic at the airport: We exclusively look at market power of German airports with scheduled or holiday charter traffic. Market power of airports that are only used for general aviation is not analysed, because it is generally perceived as being non-existent due to the high number of airports (>100) that are able to provide the services needed for this segment of the aviation market.[6]

Figure 1 shows the spatial distribution, the size – measured in weekly departures – and the ownership structure of the 35 airports in Germany with scheduled and holiday charter traffic in summer 2004. Quite a lot of these airports do not operate independently but are part of airport groups with overlapping shareholder structures. As members of airport groups do not compete with each other, they do not mitigate potential market power of their partners. We will include this aspect in our analysis of market power later on.

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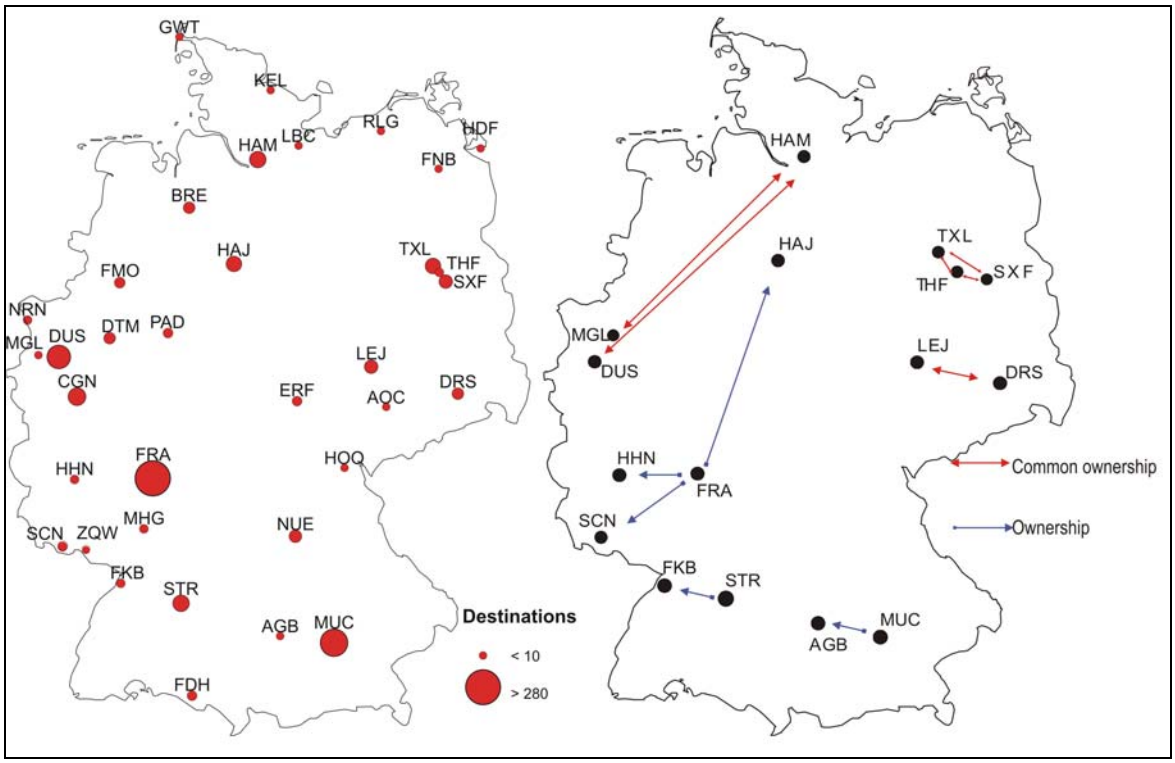
3 See Productivity Commission (2002), p. 177 and Brunekreeft/Neuscheler (2003), p. 270.

4 See e.g. Gillen/Henriksson/Morrison (2001), p. 47; Tretheway (2001), p. 39.

5 See Malina (2005), p. 132 ff. for a detailed discussion of entry barriers.

6 See Reuss (2003), p. 545 ff.

Figure 1: Spatial distribution, size and ownership structure of the German airport market



III. Assessment of the market power of German airports

1. Introduction to the approach

The standard approach for assessing market power is a two-stage procedure, consisting of the definition of the relevant market followed by an analysis of market power within the relevant market.

There are various competing methods for defining the relevant market. Probably most common is the concept of close substitutability, in which the relevant market can be described as "a group of sellers of close-substitute outputs who supply a common group of buyers" [7]. Close substitutability of the output of different suppliers is a result of the fact, „that they are all varieties of the same sort of good or service … with similarity in form or function and fulfilling the same sort of specific want or need of buyers"[8].

When we transfer this definition to the airport market, a close substitute of an airport can be every supplier that is able to satisfy the needs of the customers of aviation-services

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7 Bain (1959), p. 6.

8 Bain (1959), p. 211 f.

(passengers and airlines) as well as the currently used airport. Such suppliers can of course be other airports (intramodal substitutability), but also other means of transportation such as road and rail (intermodal substitutability) or even firms from other economic sectors (intersectoral substitutability) such as IT-companies that offer video-conferencing. However, as studies show that intersectoral substitution of air transportation is very low, we refrain from analyzing this point any further.[9]

Once the relevant market has been defined, different approaches exist for identifying market power. [10]

We develop a concentration ratio that accounts for different buyer preferences in the intramodal analysis. We call this ratio 'substitution coefficient'. It quantifies the quality of the best substitute for a certain airport. The substitution coefficient is defined as the share of inhabitants within the relevant regional market of an airport that consider another airport, which has been identified as meeting the demands of the airlines, to be a good substitute from their perspective as well.

A low substitution coefficient, however, is not sufficient for identifying market power, because it disregards potential countervailing power of airlines and intermodal constraints on the conduct of the airport. Therefore, we also take a closer look at the degree of intermodal competition from surface transport modes and the degree of countervailing power at the airports.

2. Intramodal Analysis

We look at airport substitutability from the position of an airline as the direct customer of aeronautical services. The question we try to answer is: What requirements does an airport have to meet in order to be considered by the airline as a good substitute for a currently used airport?

One can differentiate between three types of demands: *Customer oriented demands* are requisitions derived from the determinants of airport choice of passengers. An air carrier is only able to profitably switch flights to another airport if this airport is accepted by passengers. A potential substitute has to meet *infrastructural demands* as well: In order to be

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[9] See Hughes (1995); Stephenson/Bender (1996); Elsasser/ Rangosch- du Moulin (1997); Mason (2002), Denstadli (2004).

[10] See e.g. Lerner (1934), Bain (1941), p. 272 ff.; Herfindahl (1950).

regarded as a good alternative the airport must be capable of providing the necessary services for the type of air traffic the airline operates at the currently used airport. Third, an alternative airport has to meet the necessary legal requirements for enabling the kind of air traffic that the airline operates at the current airport. We look at these demands in detail below.[11]

2.1. Customer oriented demands of an airline

Much econometrical work has been done on the determinants of passengers' airport choice. Starting with Kanafani et al. in 1975 numerous studies from various countries have been able to show that airport choice is influenced by mainly four factors:[12]

- Flight availability: Is there a flight from airport A to destination B?
- Flight frequency: How often can destination B be reached by flights departing from A?
- Ticket price: How much does it cost to fly from A to B?
- Access Time: How long does it take to get to airport A?

Obviously, the first factor is a precondition for an airport to be shortlisted and thus is equally important for all customer segments. Kanafani et al. (1975), Ashford/Benchemann (1987), Harvey (1987), Windle/Dresner (1975), Pels et al. (2000) and recently Hess/Polak (2003) could show, however, that the importance of the other three determinants differs significantly between business and leisure travellers (tourists and 'visiting friends and relatives'). Whereas frequency of flights and access time are the most important factors in the utility function of a business traveller (the more flights and the shorter the access time the higher the utility of airport usage), leisure travellers' utility is influenced most strongly by ticket prices (the cheaper the ticket the higher the utility of airport usage). These findings are consistent with estimations of own price elasticity of business and leisure travel demand, which show that the own price elasticity of business travellers is much higher than of leisure travellers.[13] The results are also supported by passenger surveys on various German airports, that show that

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[11] We do not look at prices as a factor of airport choice mainly due to two reasons: First we assume that airports are able to successfully discriminate in prices between new and old customers. This means that airlines which are willing to shift to another airport can be offered competitive prices. Second, as economies of scale of airport operations are generally perceived to flatten out around 5 million Work Load Units a year, airports can reach a competitive overall cost structure by making airline switch operations to them.

[12] See e.g. Kanafani et al. (1975); Harvey (1987); Ashford/Bencheman (1987); Windle/Dresner (1995); Cohas et al. (1995); Mandel (1999a) and (1999b), Pels et al. (2000) and (2003), Moreno/Mueller (2003); Hess/Polak (2003).

airports with a high percentage of leisure travellers have a larger catchment area c.p. than airports where business travel is more important.[14] These surveys also indicate that customers of low-cost-carriers are even more price and less time sensitive than the average leisure traveller.

Ticket prices, flight availability and flight frequency, however, are endogenous for an airline because it is the airline that sets prices, defines its network and the flight frequency. Only access time is an exogenous factor that cannot be influenced by an air carrier. Thus, an airline, looking for an alternative to the currently used airport has to check very carefully if access time to the new airport is adequate for its customers.

2.2. Infrastructural demands

The airport infrastructure mainly consists of a runway system and facilities for processing passengers or freight. The dominant factor that decides if a carrier is able to shift flights to a new airport is the runway system. Depending on the type of aircraft and the intensity of usage, the requirements of an airline regarding the configuration of the runway differ significantly both qualitatively and quantitatively: If an aircraft is heavier, the runway has to be longer and must be able to stand more load (qualitative dimension). If an airline wants to shift a flight to a new airport, this airport must have the capacity to process this flight (quantitative dimension).

The 'ACN/PCN system' (short for aircraft classification number / pavement classification number) indicates if an aircraft is suitable for regular takeoffs or landings on a specific runway without damaging the runway more than what has been defined as being normal. Basically, an ACN value is assigned to every type of aircraft depending on the load it exerts on the runway. This value is compared with the PCN of the runway, which shows its strength. If the ACN is lower than the PCN, the aircraft is suitable for regular usage of the runway.[15] In general the ACN of an aircraft rises with its weight.[16] The same is true for the required take-off (TODR) and landing distance (LDR). TODR and LDR, however, are also influenced by

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13 See Gillen/Morrisson/Stewart (2003) for a comprehensive survey.

14 See Klophaus (2004); Valentinelli et al. (2004).

15 See The Boeing Company (1998) for a more accurate and detailed description of ACN and PCN.

16 See annex 1 for ACN values of selected aircrafts.

external factors such as runway elevation and weather conditions.[17] As LDR is always shorter than TODR, the required take-off length is the limiting factor of runway usage.

The following table shows the TODR of six different aircraft types from wide-body aircraft to a 50-seater regional aircraft.[18] As starting aircraft often do not reach their maximum take-weight (due to, e.g., shorter flight length than possible and thus less fuel) we also display TODR with ¾ load capacity. The table indicates that even for regional aircraft 1,000 metre is the minimum required runway length.

Table 2: Take-off distance required for various aircraft with MTOW and 3/4 load capacity

Aircraft	TODR in metr	
	MTOW	¾ load capacity
B 747-400	3,488	2,616
B 767-300 ER	3,188	2,000
B 757-300	2,780	1,962
B 737-800	2,523	1,853
B 737-500	1,655	1,363
ATR 42-500	1,165	990

Notes: TODR is calculated in the following conditions: dry and even runway at sea level, 24° C., no wind.

Source: Own calculations based on information from aircraft manufacturers.

As required runway strength and length are quite similar for some aircraft types we can categorize aircraft regarding the necessary configuration of the runway starting with category 6 for regional aircraft such as ATR 42/72, Bae 146 and going up to category 1 for wide-body aircraft such as B 747 or A 340.[19]

Apart from runway strength and length, the quality of landing aids at the airport is also important for airport choice: In order to operate reliable regular air transport an airport has to be equipped with an instrument landing system (ILS) that enables precision approaches under bad visibility. Depending on the quality of the system, ILS can be divided into three main categories starting with Cat. I. (allowing landings for suitably equipped aircraft in weather as low as 550 metres visibility and a decision height of not less than 60 metres.) and going up to

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17 See Fraport AG (2003c) and ICAO (1993) for details.

18 See annex 3 for data of more aircraft.

19 See annex 2 for details.

Cat IIIc that enables zero/zero operations. If an airport does not possess an ILS, the airline has to redirect the flight to another airport, causing additional costs for staff and passenger surface transportation to the scheduled point of arrival. Not surprisingly there are no airports in Germany used for regular scheduled traffic or even holiday charter traffic that are not equipped at least with an ILS of Cat. I.

Airport infrastructure has to meet the demands of an air carrier not only qualitatively but also quantitatively. All the different infrastructure components of an airport (runways, apron, terminals etc.) have individual capacities. In essence, the capacity of the runway system determines overall capacity of the airport in the long run. This is due to the fact that terminals and aprons can be enlarged more easily than runway capacity because of less restrict legal and administrative barriers and of the possibility to enlarge the capacity in smaller units.[20] If the runway is used to its capacity limit, an airline that would like to shift flights to this airport is not able to do so because it cannot supersede the incumbent airlines even if it is willing to pay higher airport fees. The incumbents can rely on so-called 'grandfather rights', which guarantee incumbents their take-off and landing rights on the airport.[21]

2.3. Legal demands

An airport has to fulfil numerous legal requirements in order to be able to cater for scheduled or leisure traffic: First of all it needs an approval as a public airport or public airfield. Some airports in Germany such as Hamburg-Finkenwerder, Lemwerder and Oberpfaffenhofen are so-called 'Werksflughäfen' (special airfields), not open for general public use and thus not suitable for shifting flights to them. In addition, the airport must have the right to enable take-offs and landings of the aircraft type the airline wants to use. Some smaller airports in Germany have legal restrictions concerning the maximum permissible weight (MPW) of aircrafts using the runway that are not due to runway length or strength but to environmental reasons, protection of nearby residents or 'reasons of public interest'.[22] Some airfields, for example, are restricted to a MPW of 14 t or 20 t although their runway is suitable for heavier aircraft as well. Such a restriction leads to a limitation of usable aircraft types to small

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[20] See Wendlik (1995), p. 5.; Hüschelrath (1998), p. 47; Wolf (2003), p. 65; Urbatzka/Wilken (2003), p. 7.

[21] See e.g. Ewers et al. (2001).

[22] In some federal states 'Public interest' is in first place a euphemism for protecting publicly owned incumbents from competition of other airports, see e.g. the airport policy in the federal states of Brandenburg and Berlin as analysed in Malina (2005), p. 150.

regional aircraft such as DO-328 (<14 t) or ATR 42, ATR 72, CRJ 200 (< 20 t). These airports thus cannot be used for holiday charter traffic, for most normal feeder-flights to hubs or for point-to-point traffic with dominant aircraft in these segments like Fokker 100, B 737 and A 320 family or heavier aircraft.

Apart from weight restrictions authorities sometimes impose limitations on the number of aircraft movements, preventing the airport from fully utilizing its technical runway capacity. This could lead to the result that flights have to be rejected by an airport although the runway still has ample technical capacity. There could also be long curfews, leading to the result that the airport is not suitable for intercontinental flights that often start or end early in the morning or very late in the evening: There is not a single European airport with a relevant number of intercontinental destinations that has a curfew of more than 6 hours. For holiday traffic the possibility of nighttime operations is essential because, in contrast to business passengers, leisure travellers are willing to accept flights at night. Thus, the airline is able to increase the number of aircraft utilisation, thereby raising profitability of operations. Some airports are restricted in operations not only at night but also during the day, as the legal approval to enable air traffic on its infrastructure might be limited to weekdays or some hours throughout the day. These restrictions, in effect, make the airport unsuitable for the type of traffic we analyse in this paper.

All the above mentioned restrictions are based on national law. For some airports, however, there are severe limitations of the kind of traffic that can be operated on their infrastructure that result from bilateral agreements: Whereas the air transport market within the European Union is fully liberalized (each air carrier from any member state is allowed to use every airport in the union),[23] traffic to countries outside the EU is subject to agreements of various regulatory intensity between the country of origin and the country of destination.[24] Irrespective of the regulatory intensity all bilaterals contain so-called ‘ownership clauses’, which specify that only carriers that are under substantial ownership and effective control of shareholders from one of the two contracting countries are allowed to fly routes from one country to another.[25] This clause prevents airlines from other EU member states from shifting non-EU flights to a German airport and vice versa. This is a problem particularly for

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[23] See e.g. Sinha (2001), p. 73.

[24] See Jung (1999), p. 33 ff.

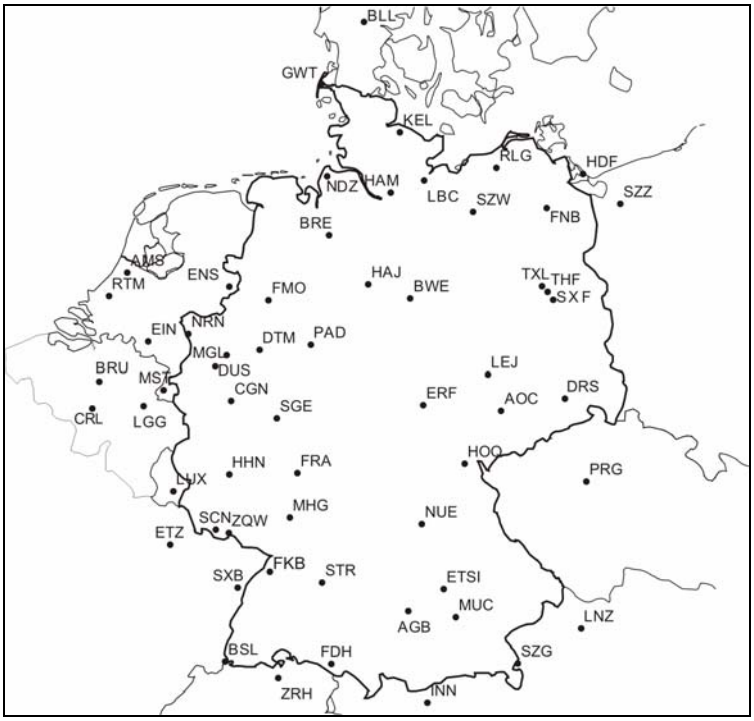
[25] See Lelieur (2003) for details.

European network carriers with a high percentage of flights to destinations outside the common market such as Lufthansa or Air France/KLM, which are restricted to use airports in their home country as hubs.

2.4. Application to the German airport market

After analysing the customer oriented, infrastructural and legal demands of an airline concerning the choice of an airport in general, we now apply the findings to the airport market in detail. Our point of view is that of an airline currently using one of the 35 German airports with scheduled and holiday charter traffic and looking for a good substitute. In principle, this substitute can be situated in Germany or another country. As the new airport has to be accepted by the passengers, we only include foreign airports with an access time of less than 2 hours from the nearest German district. There are over 100 airports within that area with a runway of more than 1,000 metres. Only 67 of them, however, are open to public use. 59 of these public airports are equipped with an instrument landing system of at least Cat. I. Figure 2 shows the spatial distribution of the airports. These are the airports for which we assess in the following whether they are good substitutes for one of our 35 German airports.

Figure 2: Spatial distribution of German and neighbouring foreign airports open to public traffic with a runway of at least 1,000 metres length and ILS



First of all we categorize the 35 German airports based on their passenger structure: Depending on the importance of low-cost-traffic, traditional leisure traffic and classic feeder or point-to-point traffic by full-service-carrier, we divide them into three groups: Low-cost airports at which this segment has a market share of at least 40 % (measured in weekly departures), holiday airports with the same market share threshold in the holiday traffic segment, and standard airports that neither reach such a market share in leisure nor in low-cost travel.[26] Based on the analysis of airport choice of passengers we assume that passengers of a low-cost airport are willing to accept an access time of max 2 hours, passengers of a holiday airport 90 minutes and of a standard airport 60 minutes. Using route planning software we calculate access time from all German and neighbouring foreign districts to the 35 examined airports, getting core catchment areas. For each district within the catchment area of an airport (we call this airport 'basis airport' in the following) we then try to find another airport that can be reached within a certain threshold time (= acceptance by passengers) and that satisfies the legal, infrastructural and ownership demands of the airline as well. The threshold time we use depends on the type of airport we observe (60, 90 or 120 minutes). The data is again compiled by using a route planning software. The airport which fulfils these demands and is accepted by the highest number of inhabitants within the catchment area of our basis airport is the best substitute of the basis airport. We calculate for this airport/airport combination a substitution coefficient (s_A) by dividing the number of inhabitants within the catchment area of the basis airport that can reach the substitute within the threshold time by the population in this area. As a result we get the share of people in the catchment that regard another airport as a good substitute that is perceived as a good substitute from the airlines point of view as well. The substitution coefficient is a measure, indicating the ability of an airline to switch to another airport without losing its customers or having to change their flight operations. Obviously s_A-values are between 0 and 1, the higher the values, the better the quality of the alternative airport and therefore the higher the competitive constraints on the basis airport.

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[26] We use 40 % as the relevant threshold because both holiday and low-cost traffic is operated using on average bigger and heavier aircraft than other types of traffic (e.g. B 737/800 in comparison to Bae 146 or CRJ 200). As airports usually impose aircraft fees based on MTOW and, additionally, passenger fees, a market share of 40 % share based on the number of flights leads to a share of this segment of overall revenues of more than 50 %, which shows that the segment is pivotal for the airport operator. See annex 4 for details.

We have not yet discussed the process of deciding whether an alternative airport meets the infrastructural and legal demands of an airline. The ownership structure has not been accounted for so far either.

Infrastructural requirements are taken into consideration as follows:Infrastructural requirements are taken into account as follows: Analysing airport timetable data for all of our 35 basis airports in summer 2004 we identify the biggest/heaviest aircraft category regularly using the infrastructure of one airport. Based on runway strength and runway length we then analyse the biggest aircraft category the 59 airports can cater for.[27] We then compare the current aircraft usage at the basis airport with the potential aircraft usage at an alternative airport. If its airport infrastructure is capable of handling aircraft of at least the category that is currently used at the basis airport, this alternative is investigated in greater detail. In this case we analyse if this alternative has ample capacity to take up traffic from the basis airport: Most of the analysed airports indeed have excess capacity; only Frankfurt/Main, Dusseldorf and Berlin-Tegel operate more or less permanently at full capacity.[28] This means that FRA, DUS and TXL are only capable of providing services for just a few more flights. DUS for example is still able to additionally dispatch the 8 daily flights that used Mönchengladbach (MGL) in 2004 but not a relevant share of the average 300 daily flights in Cologne. We include the capacity situation of these three airports in the analysis by categorizing all airports regarding the number of weekly departures and by restricting substitutability of other airports by these three to small airports of category 5 and 6 (less than 100 flights per week).[29]

After that we look at the legal demands. Some of these have already been taken into account when choosing our 59 potential substitute airports, e.g. the necessity of being an approved public airport. What remains is the implementation of curfews and ownership clauses. We integrate curfews in the model by requesting that a potential substitute for a basis airport with regular flights at night must be open for traffic during the night as well. Ownership clauses

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[27] See annex 5 for details.

[28] See DFS (2004). FRA is confronted with a demand that exceeds technical capacity throughout the day. In DUS, the technical capacity cannot be fully used because of aircraft movement restrictions by local authorities. Estimations by DFS (2003), however, show that even if these administrative restrictions were lifted, demand would exceed technical capacity in DUS. TXL is different from the other two airports, because it is not the runway system that is operating at full capacity but the terminal and apron. As public shareholders of Tegel have officially pronounced to increase terminal capacity only marginally due to the planned upgrade of Berlin-Schönefeld and closure of TXL in 2010, we have to take terminal and apron capacity in TXL as given and not increasable.

[29] See annex 4 for details.

are integrated by eliminating foreign airports from the analysis if the basis airport has a significant share (> 20 %) of non EU-flights.

Finally, the ownership structure between the basis airport and an alternative is taken into account. As previously shown, airports with substantial overlap of ownership do not compete with each other and thus do not reduce each others market power. Thus we eliminate all airports from the analysis that have a similar shareholder structure as the basis airport.

The following scheme gives an overview about the calculation of the substitution coefficient.

Scheme 1: Formal presentation of calculating s_A

$$s_{A_i} = \frac{E_{KA_{F_i}}}{E_{GA_{F_i}}}$$

$$T = \left\{ z \mid d_{zF_i} \leq \begin{cases} 60, \text{for all } F_i \ \forall \ BU_{F_i} > 2 \wedge BLC_{F_i} > 2 \\ 90, \text{for all } F_i \ \forall BU_{F_i} \leq 2 \ \wedge \ BLC_{F_i} > 2 \\ 120, \text{for all } F_i \ \forall \ BLC_{F_i} \leq 2 \end{cases} \right\}$$

$$E_{GA_{F_i}} = \sum_{z=1}^{n} E_z, \forall \ z \in T$$

$$E_{Fj} = \sum_{z=1}^{n} E_z \ \forall \left\{ z \in T \mid d_{zF_k} \leq \begin{cases} 60 \text{ for all } F_i, F_j \ \forall FP_{Fj} \leq AF_{Fi} \wedge \ BU_{Fi} > 2 \wedge \ BLC_{Fi} > 2 \\ 90 \text{ for all } F_i, F_j \ \forall FP_{Fj} \leq AF_{Fi} \wedge \ BU_{Fi} \leq 2 \ \wedge \ BLC_{Fi} > 2 \\ 120 \text{ for all } F_i, F_j \ \forall FP_{Fj} \leq AF_{Fi} \wedge \ BLC_{Fi} \leq 2 \end{cases} \right\}$$

$$s.t. \ Kap_{F_j} = 0 \vee BG_{F_i} \geq 5 \wedge NF_{F_i F_j} = 0 \qquad \text{for all } j \in \{F^{-1} \cup L\}$$

$$E_{KA_{F_i}} = \max E_{F_j}$$

AF: Biggest / heaviest category of aircraft currently using the basis airport
BLC: Importance of the low-cost segment for an airport (≤ 2 means market share higher than 40 %)
BU: Importance of the holiday traffic segment for an airport (≤ 2 means market share higher than 40 %)
d: Access time (in min)
$d_{z_{Fi}}$: Access time (in min) from district z to the basis airport F_i
$d_{z_{Fj}}$: Access time (in min) from district z, from which the passengers can reach the basis airport F_i within the threshold time, to an alternative airport F_j.
E_{Fj}: Number of inhabitants that can reach alternative airport F_j and basis airport F_i within the threshold time.
$E_{GA_{Fi}}$: Number of inhabitants that can reach alternative airport F_i within the threshold time.
$E_{KA_{Fi}}$: Number of inhabitants that can reach a substitute of the basis airport F_i within the threshold time
E_z: Population of district z
F_i: Basis airport, $i \in F, F = \{1,2,...,35\}$
F_j: German oder foreign alternative airport, $j \in \{F^{-i} \cup L\}$
FP Biggest / heaviest aircraft category that can use an airport without relevant weight restrictions
Kap: Capacity utilisation of an airport. (takes the value 1 when operating at full capacity, 0 in case of no relevant excess demand)
L: Number of analysed foreign airports, $L = \{1,...,20\}$
n: Number of analysed districts z
$NF_{F_i F_j}$: Comparison of nighttime curfews of airports F_i and F_j. Takes the value 1, if the basis airport has no curfew and it is used at nighttime by airlines and the alternative airport F_i has a curfew. Takes the value 0 in all other cases
s_{Ai} Substitution coefficient of basis airport i.
T: Assistance set
z: German or foreign district

When calculating the substitution coefficient we can divide the airports into four groups. The first group shows high values of more than 0.70, which indicates very high competitive constraints from other airports and thus low market power. The second group is confronted with lower but still significant competition from another airport [0.5 to 0.69]. The third group has a substitution coefficient lower than 0.5 but higher than 0.2, the last shows very low values, with $s_A = 0$ for 12 airports.

Table 3: Best substitutes and substitution coefficients for 35 German airports

Basis airport	Best / second best substitute	s_A
Altenburg-Nobitz	Leipzig	0.94
Lübeck-Blankensee	Hamburg	0.93
Niederrhein	Eindhoven / Dusseldorf	0.96 / 0.93
Kiel	Hamburg	0.79
Paderborn/Lippstadt	Münster/Osnabrück	0.77
Mönchengladbach	Cologne/Bonn	0.76
Münster/Osnabrück	Paderborn	0.76
Dusseldorf	Cologne/Bonn	0.75
Friedrichshafen	Zurich	0.68
Karlsruhe	Frankfurt/Main	0.61
Frankfurt-Hahn	Zweibrücken / Cologne/Bonn	0.61 / 0.61
Cologne/Bonn	Liege	0.56
Saarbrücken	Zweibrücken / Luxembourg	0.56 / 0.52
Augsburg	Manching	0.53
Dortmund	Cologne/Bonn	0.52
Mannheim	Frankfurt Main	0.43
Zweibrücken	Frankfurt Main	0.39
Rostock-Laage	Neubrandenburg	0.11
Leipzig	Berlin-Schönefeld	0.08
Bremen	Münster Osnabrück	0.07
Dresden	Altenburg Nobitz	0.03
Berlin Airport System (TXL, THF; SXF)	-	0.00
Erfurt	-	0.00
Frankfurt	-	0.00
Hamburg	-	0.00
Hanover	-	0.00
Heringsdorf	-	0.00
Hof-Plauen	-	0.00
Munich	-	0.00
Neubrandenburg	-	0.00
Nuremberg	-	0.00
Stuttgart	-	0.00
Westerland/Sylt	-	0.00

3. Intermodal Analysis

We now take a closer look at the impact of intermodal substitution of airports' services. Competitive constraints could result from passengers switching to other transport modes if an airport abuses its market position by increasing prices (leading to higher ticket prices as airlines will pass the increase on to its customers) or decreasing quality. The standard economic approach for determining the effects of such a conduct is the concept of cross-price elasticity. However, there are no studies estimating the cross-price elasticity of demand for intermodal substitutes such as road and rail transportation when airport fees change.

Even the more general question of cross-price elasticity of different transport modes has found only scant attention compared to the analysis of own price-elasticities. Most existing studies are rather old and analyse much bigger countries than Germany (Canada, USA) in which air transportation is much more important due to travel distances, and countries with a much weaker road and rail infrastructure (Norway) and thus should not be used for the German transport market.[30]

There are, however, some studies for the German transport market based not on price elasticities but on a comparison of transport quality (measured in travel time) and transport costs.[31] They come to the conclusion that air transport in general underlies strong surface competition only in the segment of ultra short haul flights of under 500 km bee-line. Malina (2005) sees indications for a smaller competitive segment for business travellers due to their high time sensitivity (<300 km) and of a slightly wider one for leisure travellers (< 600 km, approx. 60 minutes scheduled flight time).[32]

Table 4 shows the importance of this segment for all 35 German airports analysed. For most airports we find a low share of ultra short haul flights. Only Westerland, Augsburg, Mannheim, Heringsdorf, Kiel and Hof are dominated by this segment. As we present weekly departures with a scheduled flight time of less than 60 minutes, a high share in this segment does not necessarily express high intermodal substitution as we have to look at the passenger structure as well: If there are mainly business travellers on the airport flying to destinations

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[30] See Taplin (1980); Oum/Gillen (1982); Andrikopoulos/Terovitis (1983); Fridström/Thune-Larsen (1988) and Battersby/Oczkowski (2001).

[31] See Vgl. Haupt/Wilken (1985); Piper (1986); Röpnack (1991); Baum/Weingarten (1992); Giese (1993); Weingarten (1995a) and (1995b), Malina (2005), p. 73 ff.

[32] See Malina (2005), p. 75 ff.

less than 600 km but more than 300 km away, intermodal competition is small; if there are mainly leisure travellers, competition is high.

Table 4: Importance of ultra short haul flights on German airports

Airport	Weekly departures with scheduled flight time ≤ 60 min.		Airport	Weekly departures with scheduled flight time ≤ 60 min.	
	absolute	in % of overall flights		absolute	in % of overall flights
Hof-Plauen	15	100.00	Frankfurt	989	22.41
Kiel	27	100.00	Berlin-Tempelhof	45	21.74
Heringsdorf	8	100.00	Dusseldorf	454	21.15
Mannheim	49	90.74	Hamburg	275	19.80
Augsburg	28	87.50	Dortmund	45	15.79
Westerland/Sylt	36	83.72	Niederrhein	19	15.08
Erfurt	44	43.56	Hanover	91	14.33
Dresden	126	38.18	Berlin-Schönefeld	57	13.80
Berlin-Tegel	546	38.10	Stuttgart	147	11.33
Saarbrücken	38	34.86	Karlsruhe	8	10.13
Paderborn/Lipp-stadt	59	29.65	Neubrandenburg	0	0.00
Bremen	91	28.26	Lübeck-Blankensee	0	0.00
Cologne/Bonn	321	28.13	Mönchengladbach	0	0.00
Nuremberg	123	27.33	Rostock-Laage	0	0.00
Munich	988	25.95	Frankfurt-Hahn	0	0.00
Münster/Osna-brück	59	24.58	Altenburg-Nobitz	0	0.00
Leipzig	76	23.31	Zweibrücken	0	0.00
Friedrichshafen	14	22.22			

Source: Own calculations based on airport timetables of summer 2004.

Westerland and Heringsdorf are airports in holiday destinations that are used mainly by leisure travellers. Although both are islands, they have direct road and rail connections through a dam. The combination of very short routes and a high share of leisure travellers make these airports highly vulnerable to surface competition.

Hof-Plauen offers just one route to Frankfurt, operated by a Lufthansa partner and aiming at business travellers. Flight distance from Hof to Frankfurt (220 km) is well below the threshold of 300 km for business travellers so that Hof-Plauen is also subject to intermodal competition.

Augsburg, Kiel and Mannheim, however, are not constrained by significant intermodal competition because they are all mainly used by business travellers flying to Lufthansa's hubs

or Berlin. All routes on the airports have a length of at least 430 km, what is higher than the defined threshold for business travellers.

4. Countervailing power

So far we have not considered the possibility of countervailing power of airlines that could substantially mitigate airport's market power: An airline could abandon serving the catchment area of an airport and could switch to another regional market. Such a threat could impose restrictions on pricing even of airports that have been identified as not underlying competitive constraints from intramodal or intermodal substitutes.

The aspect of countervailing power of airlines has so far attracted scant attention. The only substantial survey was conducted by the Australian Productivity Commission as part of a comprehensive analysis as to whether price regulation of Australian airports should be abolished.[33] The commission basically argues that, if an airline is able to threaten convincingly with a withdrawal from the airport because this withdrawal has more negative effects on financial results for the airport than for the airline, it has countervailing power and can force the airport to set more competitive prices. As we cannot directly measure the financial impact of a withdrawal directly either due to lack of data or to accountability problems, we derive it from the following indicators:

- Importance of the catchment area for the airlines measured in:
    - Population: The bigger the population, the higher the importance of the catchment area
    - Gross value added: The higher the gross value added, the higher the importance of the catchment area
    - Number of weekly flights: The higher the number of weekly flights, the higher the importance of the catchment area
    - Airline alliance connection:
        1. The higher the number of alliances using the airport, the higher the importance of the catchment area
        2. The more alliances using the airport, the higher the revenue impact when withdrawing from the airport due to passengers switching to the

[33] See Productivity Commission (2002), p. 190 ff.

network of a competing alliance, thus the higher the importance of the catchment area

- Switching Costs due to specific investments: The higher the switching costs, the higher the financial impact of switching
- Market share of the airline at the airport: The higher the market share of an airline, the higher the financial impact for the airport if the airline leaves
- Likelihood of other airlines filling in for switching airlines, measured in:
  - Population: The bigger the population, the higher the likelihood of other airlines filling the gap
  - Gross value added: The higher the gross value added, the higher the likelihood of other airlines filling the gap

We now take a closer look at all the airports which have been identified as not being subject to strong competition from intermodal or intramodal substitutes. All flight data is from summer 2004, all other data from 2003 or 2002.

4.1. Airports confronted with strong countervailing power

We are able to find evidence for high countervailing power at the airports *Rostock-Laage, Neubrandenburg, Erfurt*, *Zweibrücken* and *Mannheim*. All five airports are rather small and with the exception of Mannheim remote airports with a weakly populated catchment area and just a few destinations offered.[34]

Rostock-Laage is mainly used for holiday (charter) traffic by airlines such as Air Berlin, Span Air or Air *Europa* on behalf of just a few tour operators TUI, Thomas Cook etc, for which the catchment served by the airport is of minor importance. There is no relevant specific investment of the airlines on the airport. The airport operator, on the other hand, strongly relies on the flights as most of its revenues (revenues from 15 flights per week with B 737 or similar versus 11 remaining flights with Dash 8-100) are produced by them.

Neubrandenburg is an even smaller airport than Rostock-Laage and served only by two airlines, one operating to Varna in Bulgaria on behalf of TUI, alltours and other tour operators

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[34] Neubrandenburg: Cat. WG 6 with a population within 60 minutes access time of 0.24 M., within 90 minutes of 0.75 million.; Rostock-Laage: Cat. WG 5 with a population within 60 minutes access time of 0.53 M., within 90 minutes of 1.12 M.; Erfurt: Cat. WG 4 with a population of 1.0 million within 60 minutes, within 90 minutes of 2.3 million, Zweibrücken, Cat. WG 6 with a population of less than 1.4 million inhabitants within 90 minutes. All four catchment areas show a number of inhabitants by far under average.

to Varna in Bulgaria. The other airline is Regio Air / Mecklenburger Flugdienst. Thus, only two airlines generate all revenues for the airport. There is no relevant specific investment of the two airlines at Neubrandenburg. The catchment area of Neubrandenburg airport is one of the least densely populated and underdeveloped areas in Germany with a gross value added per capita of just 15,000 EUR a year compared to 22,000 EUR per capita on average in the whole of Germany.

The same holds true for *Zweibrücken*, which is only used for one holiday charter traffic flight per week and is the least frequently used airport surveyed in this study. GVA within 60 minutes is slightly below average (21,000 EUR), the airport has no connection to one of the global airline networks. Moreover and contrary to Neubrandenburg and Rostock-Laage it does not show a substitution coefficient near 0 but of a moderate 0.39, further increasing the impact of a withdrawal threat of the airline.

19 airlines operate at *Erfurt* airport. 30 % of its traffic derives from flights to holiday destinations for tour operators, for which the catchment area of Erfurt airport is of minor importance due to a very small population. Most flights (approx. 70 %) are to other German airports, there is just one daily flight to London. These flights are operated by just three airlines: OLT Ostfriesische Lufttransporte, LGW Luftfahrtgesellschaft Walter and Ryanair. Ryanair is one of the biggest European airlines serving 87 destinations, using 61 aircraft and is known for very price-elastic reactions to change of airport fees and has a proven track record of exercising pressure on smaller airports.[35] OLT and LGW are smaller regional airlines, specialising in flights between minor airports and connecting them to some major German airports as well. However, Erfurt is just a negligible outpost of their network. On the other hand the airport operator relies heavily on these three airlines as most revenues are generated by their activities on the airport.

Mannheim is a small airport mainly used for business travel with small aircraft (54 weekly departures). Due to its short runway it is not suitable for aircraft bigger than category six.[36] Although a Lufthansa partner operates on the airport, there are no flights to Lufthansa's hubs. All flights are operated by Cirrus Airlines, thus all flight-related revenue on the airport relies

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[35] See e.g. negotiations between Ryanair and airports Strasburg, Charleroi, Hahn or Lübeck as shown in Gröteke/Kerber (2004) and the following statement by Ryanair CEO, Michael O'Leary, who stated during a hearing in the Irish parliament: "We are able to dictate terms to airports ... We move around based on whoever comes up with the lowest cost." as cited by Parliament of Ireland (2003).

[36] See annex 2.

on just one customer. Cirrus Airlines specialises in short haul point-to-point and feeder traffic mainly between German cities. Its main bases are Berlin-Tempelhof, Hamburg and Munich, its overhaul station is based in Hamburg. There is no relevant specific investment of Cirrus in Mannheim. GVA per capita and the number of inhabitants within 60 minutes access time are very high (GVA: 33900 EUR, 6.9 million inhabitants). Like Zweibrücken, Mannheim, however, was ranked as one of the airports with a moderate substitution coefficient. Around 40 % of its regional market can also be served by Frankfurt/Main, 23 % from Karlsruhe and 20 % from Stuttgart airport which all show similar GVA and population in the catchment area.

4.2. Airports not confronted with countervailing power

A completely different balance of power can be found at the airports *Hamburg, Stuttgart, Berlin Airport System*, *Munich* and *Frankfurt*/Main, where airlines do not possess countervailing power:

Hamburg and *Stuttgart* serve a catchment area that is very important for many airlines operating at the airport because of a very high economic potency.[37] Both airports, the fifth (HAM) and seventh (STR) biggest airport in Germany, are mainly used for traditional scheduled traffic and show only a small share of holiday flights (18 % in HAM and 32 % in STR). They are used by 60 (HAM), resp. 67 (STR) airlines; Lufthansa Group as the most important customer of the airports accounts for 50 % (HAM) resp. 40 % (STR) of all weekly departures. With several hundred weekly departures they are one of the most important spokes of the Lufthansa Network. Both airports are used by competing alliances such as Star Alliance (Lufthansa), Oneworld (British Airways) and SkyTeam (Air France / KLM). This first of all underlies the quality of the catchment area and, second, prevents Lufthansa from convincingly threatening to cancel feeder flights to Munich or Frankfurt, as it would lose customers to rivalling alliances which would swiftly fill the gap.

A similar situation is found at Berlin Airport System: The three airports are used by 85 different air carriers. Lufthansa Group again has the highest market share of 40 %, including alliance partners of 50 % at Tegel airport, which is by far the biggest of the three airports,

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[37] HAM: 3.6 million inhabitants within 60 minutes, GVA per capita: 23,000 EUR within 60 minutes, in the city of Hamburg alone 1.7 Mio. inhabitants with a GVA per capita approx. 37,000 EUR; STR: Population of 4.7 million with GVA per capita of 29,000 EUR within 60 minute catchment area, in the city of Stuttgart alone: 0.6 million inhabitants, GVA per capita of 48,000 EUR.

using the airport for point-to-point and feeder traffic to Munich and Frankfurt. Other network carriers such as British Airways, Iberia, Alitalia, Air France / KLM offer several daily flights to their hub airports. Berlin with its hinterland has approx. 4 million inhabitants with a substandard GVA per capita of ca. 20,000 EUR. However, its role as the German capital leads to strong air traffic demand by administrations, associations and media. Moreover, Berlin is one of the most important destinations for city-holidays in Europe, generating additional air traffic.

Munich and *Frankfurt* are by far the most important airports with more than 4400 weekly departures to 281 destinations (FRA) resp. 3800 departures to 207 destinations worldwide. Both catchment areas are economically very strong, with a large population and high GVA per capita.[38] They are used as Lufthansa Group's main hub, Star Alliance's market share at the two airports is thus very high (70 % in FRA and 60 % in MUC). Both airports are connected to competing hubs such as London-Heathrow, Paris Charles de Gaulle, Madrid and Rome on a high frequency. Due to the high market share of Star alliance, the revenues of the airport operators rely very strongly on the alliance remaining at the airports. If star alliance decided to shift its hub operations to another German airport, the airport would lose a high percentage of its revenues. Other foreign network airlines would not be able to completely fill the gap, as they cannot shift hub operations to FRA or MUC due to legal restrictions already discussed in detail above. However, a high dependency of the airport operators on an airline group is not sufficient for stating countervailing power. Dependency of the airport is not of importance for countervailing power if the airline cannot convincingly threaten to leave the airport. Exactly this is the case in Munich and Frankfurt, however: Not only is the catchment area very important, switching to another airport would also create high switching costs due to specific investments in the flight network and maintenance / overhaul (FRA/MUC) and terminal facilities (MUC).[39] Moreover only a few other airports in Germany are capable of providing capacity for hub operations, what further mitigates the likelihood of a change of hub operations. Lufthansa Group is thus bound to Munich and Frankfurt.

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[38] FRA: 5.2 million inhabitants within 60 minutes access time, GVA per capita: approx. 27,700 EUR, MUC: 3.1 million inhabitants within 60 minutes, GVA per capita: approx. 28,200 EUR

[39] See Malina (2005), p. 131 ff.

4.3. Airports confronted with modest countervailing power

We identify modest countervailing power for the remaining airports *Hanover, Nuremberg, Leipzig, Dresden* and *Bremen* in the sense that some airlines possess countervailing power on the airports but others do not.

The indication for countervailing power in this group is the strongest in Dresden and Leipzig: Dresden airport is the fifth smallest of the 18 international airports in Germany, used for flights to classical holiday destinations (18 % market share measured in weekly departures) and particularly for feeder traffic to Munich and Frankfurt (28 %) and traffic to other important German airports. Most scheduled flights are operated by Lufthansa Group or partners, Lufthansa's market share in Dresden is 80 % measured in weekly departures. No foreign network carriers use Dresden airport. It has a catchment area of 2 million inhabitants within 60 minutes access time, GVA per capita is slightly below average (20,000 EUR). All these aspects indicate countervailing power at the airport. However, Lufthansa has 100 weekly departures to its hubs from Dresden, offering 3,000 to 4,000 seats per week. This suggests that Lufthansa is generating substantial profit from these feeder-flights through increased load factor of its widebody aircraft on intercontinental routes.

Leipzig airport is a medium sized airport in eastern Germany (tenth biggest German airport). 43 % of all aircraft leaving the airport fly to holiday destinations, the rest is mainly feeder traffic to Munich and Frankfurt and point-to-point traffic to other main German airports. Lufthansa holds a market share of 55 % measured in weekly departures. No airline operating from Leipzig generates a significant share of its revenues by using Leipzig. The airport has a catchment area of 2 million inhabitants within 60 minutes access time, GVA per capita is substandard at 16,000 EUR. Leipzig airport, however, is the only airport for holiday travellers that is accessible within 90 minutes driving time, as neighbouring Dresden airport – which belongs to the same airport group – concentrates (e.g. due to shorter runway) on traditional scheduled traffic. Thus, a potential of 5.2 million people rely on Leipzig airport for their holiday flights, this is 8 % of the German population. Whether tour operators are willing to relinquish this market is questionable.

There are strong similarities between flight schedules of Dresden and *Bremen* airport, the sixth smallest international airport in Germany. However, the market share of Lufthansa Group, is smaller in Bremen (50 %). Air France / KLM connect Bremen with the SkyTeam network. Bremen is home basis of OLT, which operates 124 of its 148 weekly flights from

Bremen and has one of overall two maintenance stations at the airport. Bremen is thus of central importance for OLT. Whether the catchment area of the airport is also of significant importance for other carriers remains unclear: On the one hand GVA per capita and population are slightly below average (1.7 Mio. inhabitants within 60 minutes access time, GVA per capita 20,000 EUR), on the other hand 95 flights per week are operated by Lufthansa to Munich and Frankfurt; this shows the importance of the airport for network revenues.

Nuremberg is the ninth biggest airport in Germany, providing not only services for holiday flights but also feeder flights and point-to-point traffic to various German and some foreign airports. Nuremberg is relatively loosely connected to FRA and MUC (42 resp. 21 weekly flights); however, this is probably due to the proximity of Nuremberg to both hubs. The airport is only used by 11 airlines, the market share of Lufthansa and its partners is 45 %. The catchment area is small but shows a GVA per capita slightly above average (24,000 EUR). Air France / KLM connect the airport to Amsterdam and Paris. Moreover, the airport is of major importance for Air Berlin, which has built its second European hub in Nuremberg and has invested specifically in the network configuration.

Hanover airport is used for classical point-to-point and feeder traffic and particularly for holiday traffic. Market share of holiday traffic is 67 % measured in destinations and more than 40 % measured in weekly departures. Because of the high share of leisure travellers and their insensitivity to access time, the catchment area is bigger than that of other airports. Within 90 minutes it can be reached by 5.8 million inhabitants, the GVA per capita in this area is slightly below German average (21,000 EUR). Lufthansa Group connects Hanover 103 times a week to FRA and MUC. Its market share on the airport is approx. 45 %. Air France / KLM, Iberia and British Airways have integrated Hanover into their networks as well. The airport is home base to HLX and HLF, carriers dominating the leisure market in Hanover. Their parent company TUI has its corporate headquarter in the city. Previous experiences show that the importance of TUI for the city and the airport give the company significant countervailing power at the airport, which is still mainly publicly owned. TUI was for example capable of preventing market entry of low-cost carrier easyjet in Hanover by

threatening to relocate its aircraft to other airports and thus forcing the airport operator to abandon talks with easyjet.[40]

IV. Conclusion

This paper is part of an ongoing research project concerned with measuring market power in the German airport market. We have calculated a substitution coefficient for 35 German airports that indicates the degree of inter-airport competition an individual airport is confronted with, complemented by an assessment of intermodal substitutability of airport services and countervailing power of airlines. The study gives strong indication that 23 airports do not possess relevant market power. In contrast to this, four airports (HAM, FRA, MUC, STR) and Berlin Airport System are believed to have strong, five (BRE, DRS, LEJ, NUE, HAJ) to have modest market power. Competition derives from three different sources: There are some airports that are confronted with strong spatial competition from other airports (AGB, AOC, CGN, DTM, DUS, FDH, FMO, FNB, KEL, LBC, NRN, PAD, MGL, HHN, SCN). There are others that are constrained by substitution from surface transportation (GWT, HDF, HOQ). Finally, there are some airports that face significant countervailing power (ERF, FKB, RLG, MHG, ZQW). These results provide a basis for the construction of an efficient regulatory framework for the German airport market.

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[40] See Handelsblatt (2004a).

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Annex 1: Aircraft Classification Number of selected aircraft

Aircraft	Weight	ACN							
		Flexible surface and subgrade strength category …				Rigid surface and subgrade strength category…			
		A	B	C	D	A	B	C	D
A380-800	MTOW	71	79	99	136	53	61	76	94
	OWE	29	31	35	48	25	26	30	35
A340-300	MTOW	62	68	79	107	54	62	74	86
	OWE	37	39	44	57	34	36	42	48
B747-400	MTOW	59	66	82	105	54	65	77	88
	OWE	23	24	27	35	20	23	27	31
A330-300	MTOW	55	60	70	94	46	54	64	75
	OWE	41	44	50	66	36	39	46	54
B757-300	MTOW	36	41	51	64	35	42	49	56
	OWE	16	17	20	27	15	17	21	24
A320-200	MTOW	39	40	45	51	42	45	48	50
	OWE	20	21	22	26	22	23	25	26
B737-500	MTOW	33	35	39	43	38	40	42	43
	OWE	16	16	18	21	18	19	20	21
Bae 146-200	MTOW	22	23	26	29	24	26	27	29
	OWE	11	12	13	15	12	13	14	15
CRJ 700	MTOW	18	19	21	24	21	22	23	24
	OWE	10	10	11	13	11	12	12	13
ATR 72	MTOW	11	12	14	15	13	14	14	15
	OWE	6	6	7	8	7	7	8	8
Dash 8-300	MTOW	9	9	11	12	10	11	11	12
	OWE	5	5	6	7	5	6	6	7
ERJ-145	MTOW	12	13	15	16	14	15	15	16
	OWE	5	6	6	7	6	7	7	7

Source: Transport Canada (2001).

Annex 2: Aircraft classification

Category	Aircraft type (selection)
1	B 747-400, A 340-600
2	B 767-300, B 777-300, A 340-300
3	B 757-300, A 330-300
4	B 737-800, A 321-200, A 320-200, A 319-200
5	B 737-500, Fokker 100, A 318-100, CRJ 200/700, ERJ 145
6	ATR 42-500, ATR 72-500 , Dash 8-400, Bae 146-200, Do 328-110

Annex 3: TODR and LDR of selected aircraft

	Dry runway					Wet runway	
	15 ° C, sea level		24° C, sea level	22° C, 500 metr. above sea level		sea level	500 metr. above sea level
	TODR	LDR	TODR	TODR	LDR	LDR	LDR
B 747-400	3,320	2,130	3,619	4,087	2,379	2,450	2,735
A 340-300	2,765	1,830	3,014	3,404	2,044	2,105	2,350
B 757-300	2,550	1,748	2,780	3,139	1,952	2,010	2,245
B 737-800	2,315	1,600	2,523	2,,850	1,787	1,840	2,055
A 330-300	2,270	1,660	2,474	2,795	1,854	1,909	2,132
A 320-200	2,190	1,440	2,387	2,696	1,608	1,656	1,849
CRJ 700	1,565	1,509	1,706	1,927	1,685	1,735	1,938
ERJ-145	1,550	1,290	1,690	1,908	1,441	1,484	1,657
B 737-500	1,518	1,362	1,655	1,869	1,521	1,566	1,749
ATR 72-500	1,223	1,048	1,333	1,506	1,170	1,205	1,346
ATR 42-500	1,165	1,030	1,270	1,434	1,150	1,185	1,323

Source: Own compilation based on Fraport AG (2003) and aircraft manufacturer data.

Annex 4: Airport Classification concerning traffic structure

WG:	**Overall number of flights**
Cat	**Thresholds**
1	at least 2,000 flights per week, at least 150 destinations
2	at least 1,000 flights per week, at least 75 destinations
3	at least 400 flights per week, at least 50 destinations
4	at least 100 flights per week, at least 15 destinations
5	at least 14 flights per week, at least 3 destinations
6	less
BU:	**Importance of holiday traffic on the airport**
Cat	**Thresholds**
1	at least 60 % share of weekly flights
2	at least 40 % share of weekly flights
3	at least 15 % share of weekly flights
4	less
BLC:	**Importance of low-cost traffic on the airport**
Cat	**Thresholds**
1	at least 60 % share of weekly flights
2	at least 40 % share of weekly flights
3	at least 15 % share of weekly flights
4	less

Annex 5: Current and potential runway usage on German and foreign airports

Airport	AF	FP	Airport	AF	FP
German airports			PAD	4	4
AGB	6 [a)]	6 [a)]	RLG	4	4
AOC	5	5	SCN	5	5
BRE	4	4	SGE	-	5
BWE	-	5	STR	3	2
CGN	3	1	SXF	4	2
DRS	4	4	SZW	-	3
DTM	4 [a)]	4 [a)]	THF	5	5
DUS	3	2	TXL	3	2
ERF	4	4	ZQW	4	3
ETSI	-	3	**Foreign airports**		
FDH	4	4	AMS	-	1
FKB	4	4	BLL	-	2
FMO	4	4	BRU	-	1
FNB	5	4	BSL	-	2
FRAU	1	1	CRL	-	4
GWT	6	5	EIN	-	2
HAJ	3	1	ENS	-	2
HAM	3	1	ETZ	-	4
HDF	6	4	INN	-	5
HHN	4	3	LGG	-	2
HOQ	6	6	LNZ	-	3
KEL	6	6	LUX	-	1
LBC	5	5	MST	-	4
LEJ	3	1	PRG	-	2
MGL	6	6	RTM	-	4
MHG	6	6	SXB	-	4
MUC	1	1	SZG	-	4
NDZ	-	4	SZZ	-	4
NRN	4	4	ZRH	-	1
NUE	4	4			

Notes: Only AF-values for basis airports are shown. [a)] Restrictions on maximum permissible tire pressure.