THE IMPACT OF ADDITIONAL PASSENGERS ON AIRPORT EMPLOYMENT - THE CASE OF GERMAN AIRPORTS

Richard Klophaus

Centre for Aviation Law and Business, Trier University of Applied Sciences
Umwelt-Campus Birkenfeld , D-55768 Neubrücke, Germany
Phone: + 49 67 82 17 - 12 20, Fax: + 49 67 82 17 - 14 54
mailto: klophaus@umwelt-campus.de

Keywords: air transport policy, airport economics, airport employment

Abstract

The paper analyzes the relationship between air traffic and on-site employment for seventeen German airports categorized as international airports. The empirical analysis includes several regressions using data on passenger numbers and workload units handled as well as employment data structured into different job categories. The paper suggests a rule of thumb that one million additional passengers per annum generate 500 on-site jobs at German airports.

INTRODUCTION

One of the most controversial transport policy issues in Germany is the future development of airport infrastructure. The supporters of further airport extensions in line with increasing air traffic demand refer to the significant employment potential. For instance, the Air Traffic for Germany Initiative formed by Lufthansa, Fraport, München Airport and the German air traffic control under the patronage of the German Federal Minister for Transport emphasizes that air traffic is and will remain an employment generator. In December 2006, the initiative released a master plan pointing out that one million additional passengers per annum create 1,000 jobs at German airports.

This paper examines whether the direct employment generated on-site at German airports through additional passengers actually corresponds to the employment impact

suggested by the aforementioned master plan. This is a question of particular importance for German air transport authorities as the relationship between direct airport employment and passenger numbers stated in the master plan is also often used as a rule of thumb in planning the further development of airport infrastructure in Germany. Examples are the airport policy plan ('Flughafenkonzept') of the German government (BMVBW 2000) and the air traffic concept ('Luftverkehrskonzeption') issued by North Rhine-Westphalia, the federal state of Germany with by far the highest population (NRW 2000).

This paper defines the direct employment impact of additional passengers as the number of jobs located on the premises of an airport that are closely connected with air traffic measured in terms of handled passengers. Hence, employees at the registered office of Lufthansa in the city centre of Köln are not considered as direct employment. Likewise the employees of aircraft manufacturers and maintenance facilities using office or industrial space on airport grounds.

The paper is structured as follows: Section 2 contains some basic methodological considerations for instance on the workload unit as a measurement of airport throughput that combines passengers and freight. Section 3 describes the results of several regressions on the dependence of direct employment on air traffic at German airports that are categorized as international airports by German authorities. Special features of individual airports are recognized, for example the hub function of Frankfurt/Main and München, the market positioning of Frankfurt/Hahn as low-cost airport or the importance of air cargo at Köln/Bonn Airport. In the political debate, future employment effects are of higher priority than current effects. Hence, section 4 discusses the increasing labor productivity at German airports. The closing section 5 summarizes the paper's results and concludes for future airport planning in Germany with a new rule of thumb that one million additional passengers per annum generate 500 on-site jobs at Germany's international airports.

METHODOLOGICAL CONSIDERATIONS

Passengers (PAX), air cargo and workload units (WLUs)

At German airports like Frankfurt/Main, Köln/Bonn, München and Frankfurt/Hahn the handling of air cargo significantly contributes to direct employment. If the average relationship between direct employment and PAX is applied to all airports in Germany than the number of on-site jobs is overrated at airports with limited freight volumes. For this reason, the regressions in section 3 also consider models with WLUs as independent variable besides PAX to explain the number of on-site jobs. WLUs combine passengers and freight in one performance measure. A WLU is defined either as one passenger or 100 kg of freight.

In a more detailed analysis for individual airports the employment effect of passengers and freight would require further specification. For instance, long-haul passengers are more labor-intensive than short-haul passengers. In the same way, flown air cargo is more labor-intensive than trucked air cargo on road feeder services.

Average and marginal employment

The subject of this paper is not the average relationship between direct employment and PAX or WLUs at the seventeen international airports in Germany. In 2004, 158,869 employees at these airports handled a total of 155.7 million PAX and 185.5 million WLUs respectively (ADV 2005). Hence, one million PAX p.a. correspond to 1.020 on-site jobs and one million WLUs p.a. to 860 on-site jobs respectively. A study by the Airports Council International Europe (ACI) on the social and economic impact of European airports suggests that European airports on average support 925 on-site jobs per million WLUs in 2001 (ACI 2004). There should be no straight conclusion that the marginal employment effect of additional air traffic equals the average effect. Such a false conclusion can be found in the air traffic concept by the German federal state of North Rhine-Westphalia (NRW 2000).[1]

[1] 'If the approx. 25.6 million passengers at the six most important NRW airports are related to the approx. 25,000 employees, the popular formula is affirmed: 1 million passengers p.a. = 1,000 jobs. An increase of

Categories of employment effects

The overall employment impact of airports can be divided into four categories:

- ***Direct***: Employment generated on-site of airports,[2]
- ***Indirect***: Employment generated in companies providing input for the direct activities,
- ***Induced***: Employment which results from consumer spending by the direct and indirect employees,
- ***Catalytic***: Employment generated by the wider role of airports in improving the productivity of business and in attracting economic activities, such as inward investment and inbound tourism.

Direct, indirect and induced effects result from producing services and products at airports, the catalytic effects from the use of these services and products. Studies on the economic impact of airports often use multipliers to describe the relation between the sum of indirect and induced employment to direct employment. According to the German environmental protection association multiplier values between 1.6 and 2.0 are admissible (BUND 2000).

Economies of scale, traffic function and capacity utilization

The relationship between direct employment and air traffic depends among other things on airport size. European airports with less than five million WLUs have a higher average employment density (= direct jobs per million WLUs) than airports with more than five million (ACI 2004). Table 1 indicates economies of scale for six airport categories. Airports handling between five and nine million WLUs show the lowest average employment density.

---

15 million passengers p.a. in the year 2010 will therefore generate an increase of 15,000 on-site employees.'

[2] The definition of direct employment by ACI (2004) also includes jobs in the surrounding area that are largely related to the operation of an airport. As reliable data for these jobs is not available for all German international airports, this paper considers only direct on-site jobs.

WLUs	Direct jobs per million WLUs
> 50 million	985
20 – 49 million	867
10 – 19 million	934
5 – 9 million	793
1 – 4 million	1,034
< 1 million	1,724
Total	925

Table 1: Average employment density at European airports in 2001 (ACI 2004)

The increase of average employment density at airports handling more than 50 million WLUs indicates that employment density depends on additional factors besides the size of an airport. For example, the employment density of Germany's largest airport Frankfurt/Main with 69.8 million WLUs in 2004 is largely influenced by its traffic function as the leading hub for Lufthansa and its Staralliance partners. Saarbrücken, Germany`s smallest international airport with 0.5 Million WLUs in 2004, has underutilized capacities leading to a high employment density of 1,564.

Source of employment growth at airports

Employment growth at airports often follows from increasing passenger or freight traffic but also from other sources. Additional direct jobs due to growing traffic are created at airport operators, air traffic-related authorities (police, security, immigration, customs, air traffic control) and airlines. Further employment results at restaurants, shops, travel agencies, car rentals, etc. In contrast, on-site jobs at airport-related companies like manufacturers or sales and maintenance facilities of aircraft with office or industrial space on airport grounds are largely independent of traffic growth. This holds to an even greater extent for companies located at airports but with no direct relation to aviation.

These different sources of employment can be approached with two types of methodology. Total on-site employment can be analyzed as outcome of air traffic. This approach rests on the implicit assumption that the growth in employment with limited or

no relation to aviation is proportional to the growth in on-site jobs that largely depends upon traffic volume. The alternative approach considers only jobs directly related to air traffic. This creates the problem of attaching airport employees to their main business purpose which cannot be solved without detailed knowledge about airport-specific conditions.

AIR TRAFFIC AND DIRECT EMPLOYMENT AT GERMAN AIRPORTS

The relationship between direct employment and air traffic in terms of passengers and freight is analyzed with simple regression. Data source are statistics by the German Airports Association (ADV 2005) with regard to the seventeen German airports that are categorized as international airports. The relevant data are the volume of passengers and freight (Table 2) and the numbers of employees (Table 3) at these airports for 2004.

Airport	PAX (million)	Cargo (1000 tons)	Mail (1000 tons)	WLUs (million)
Berlin (THF/TXL/SXF)	14.9	28.9	11.3	15.3
Bremen	1.7	0.9	0.0	1.7
Dortmund	1.2	0.1	0.0	1.2
Dresden	1.6	0.4	0.0	1.6
Düsseldorf	15.3	56.7	0.1	15.8
Erfurt	0.5	4.0	0.0	0.6
Frankfurt/Main	51.1	1,751.0	117.8	69.8
Frankfurt/Hahn	2.8	66.1	0.0	3.5
Hamburg	9.9	24.4	12.7	10.3
Hannover	5.2	6.1	10.4	5.4
Köln/Bonn	8.3	613.3	10.4	14.6
Leipzig/Halle	2.0	5.7	4.6	2.1
München	26.8	177.0	21.4	28.8
Münster/Osnabrück	1.5	0.5	0.0	1.5
Nürnberg	3.6	13.3	0.7	3.8
Saarbrücken	0.5	0.0	0.0	0.5
Stuttgart	8.8	18.2	8.7	9.1
Total	155.7	2.766.9	198.0	185.5

Table 2: Passengers and freight at Germany's international airports 2004 (ADV 2005)[3]

[3] Traffic figures include transit. Freight without trucking tonnage.

Airport	Airport	Authorities	Airlines	Other	Total
Berlin (THF/TXL/SXF)	1,594	1,801	6,040	3,455	12,890
Bremen	373	295	195	1,645	2,508
Dortmund	335	91	397	411	1,234
Dresden	337	234	209	718	1,498
Düsseldorf	2,273	1,071	4,638	5,004	12,986
Erfurt	126	153	65	174	518
Frankfurt/Main	12,900	3,222	32,405	13,052	61,579
Frankfurt/Hahn	294	310	163	1,720	2,487
Hamburg	1,749	572	1,158	2,200	5,679
Hannover	1,171	629	1,462	2,983	6,245
Köln/Bonn	1,919	1,895	1,652	6,021	11,487
Leipzig/Halle	283	379	206	1,539	2,407
München	7,182	1,299	5,695	9,044	23,220
Münster/Osnabrück	449	130	200	750	1,529
Nürnberg	1,353	193	982	1,488	4,016
Saarbrücken	151	51	349	231	782
Stuttgart	1,143	750	1,080	4,831	7,804
Total	33,632	13,075	56,896	55,266	158,869

Table 3: Employees at Germany's international airports 2004 (ADV 2005)[4]

The average employment density resulting for the seventeen airports is 856. Frankfurt/Hahn with 711 and Köln/Bonn with 787 have significantly lower densities. Frankfurt/Hahn as low-cost airport has a special position among Germany's international airports. At Frankfurt/Hahn intra-European traffic operated by Ryanair dominates the schedule, which as point-to-point-traffic is less complex than the handling of intercontinental flights or transit traffic at hubs. Airport infrastructure and handling processes at Frankfurt/Hahn are therefore cost-saving and allow a high handling productivity. Calculating the employment effect of increasing air traffic at Frankfurt/Hahn, Intraplan (2003) assumes that one million additional passengers create 500 additional jobs, 100,000 tons express freight by integrators 350 additional jobs and standard air cargo including trucking further 200 jobs. The differentiated direct

[4] Job figures in Table 3 for authorities also contain employees working for private companies but with public assignment, e.g. within the field of responsibility of the German police.

employment effect of passengers and freight also contributes to the low employment density at Köln/Bonn. This airport even ranks above Frankfurt/Hahn with regard to passengers flying with low-cost airlines, but its low employment density mainly results from the special importance of freight in Köln/Bonn being the European hubs for two integrators, UPS and DHL, and for freighter operations of Lufthansa Cargo.

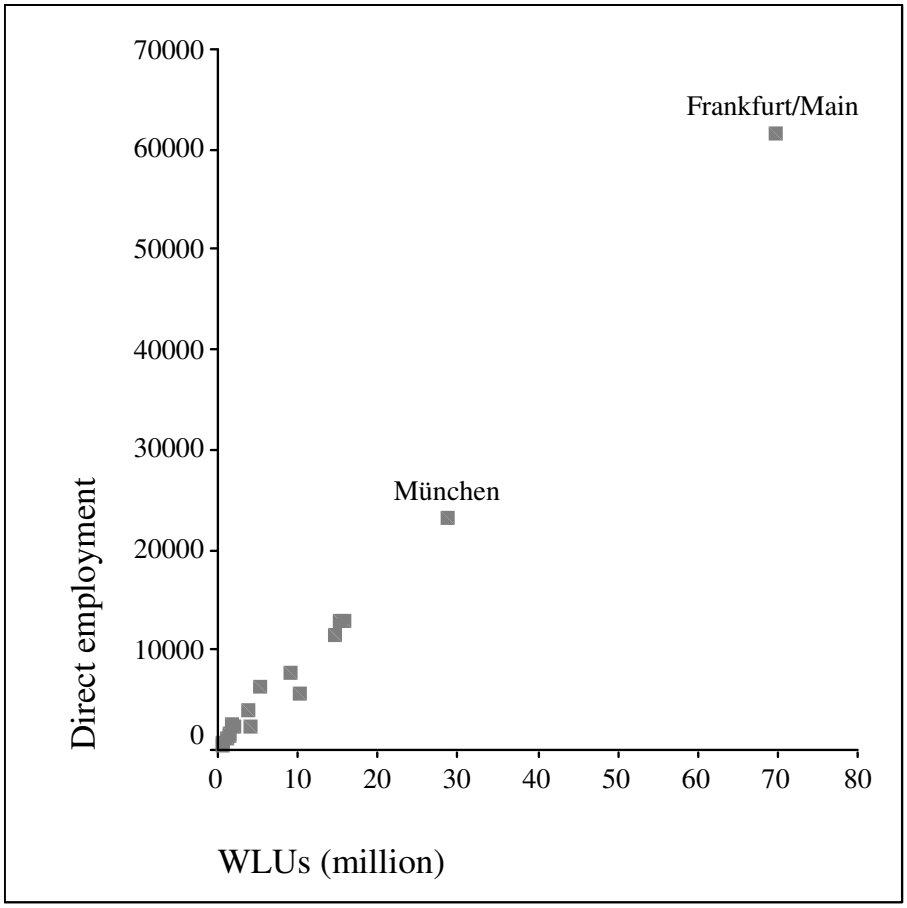

Figure 1: Relationship between direct employment and WLUs for Germany's international airports in 2004

The scatter diagram in Figure 1 shows a linear correlation between the number of on-site jobs and WLUs for Germany's international airports and supports the analysis of the available ADV data using linear regression. The clarity of Figure 1 suffers from the inclusion of Frankfurt/Main and München with 69.8 million and 28.8 million WLUs. Because of their dimensions and their high percentage of long-haul flights these two hub airports can hardly be compared with other German airports. Without Frankfurt/Main and München a new scatter diagram results (Figure 2) that also contains a regression line.

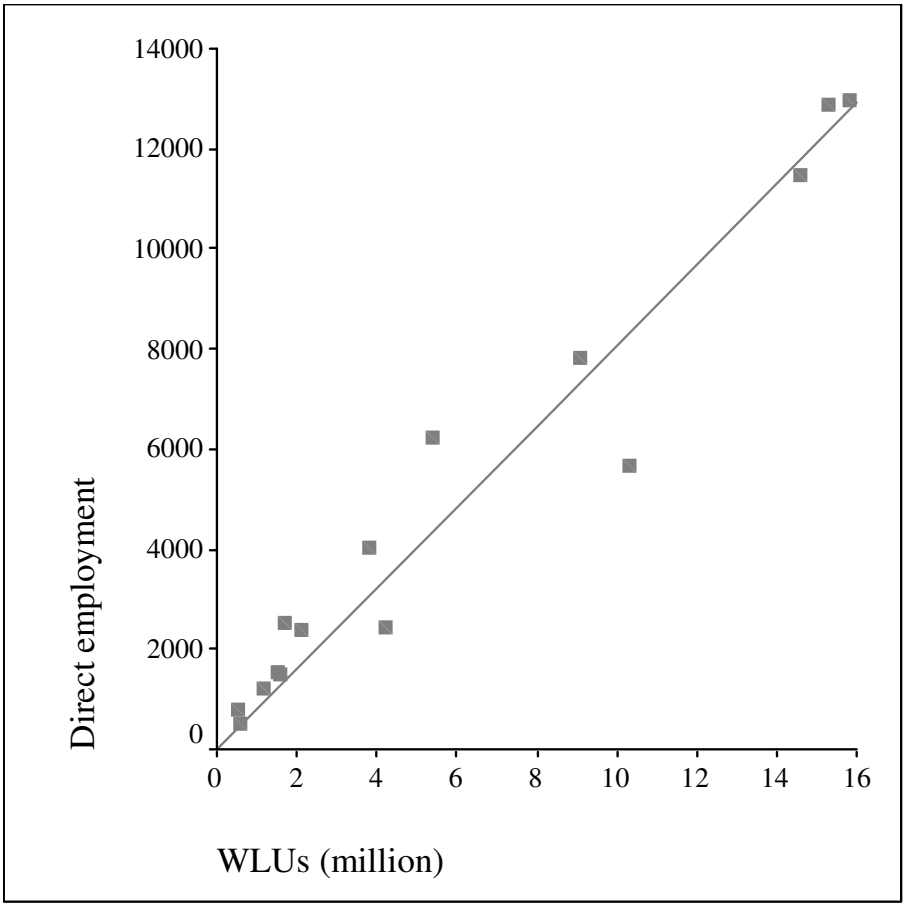

Figure 2: Relationship between direct employment and WLUs for Germany's international airports in 2004 (without Frankfurt/Main and München)

Figure 2 shows the linear relationship between the number of direct jobs and WLUs, the data points tend to be close to the regression line.

Eight regression models A − H are analyzed with the ADV data (Table 4). The models A − D relate traffic volume with all on-site jobs at the airports. That creates the aforementioned problem that only a percentage of all jobs located at airports is closely connected with air traffic. This percentage also varies considerably between airports. Hence, the models A − D overstate the direct employment impact of additional air traffic. Therefore, the regression models E − H consider only jobs directly related to the volume of air traffic, i.e., employees at airport operators, air traffic-related authorities and airlines located on-site. All models specify traffic volume either as PAX or WLUs.

The models A and B as well as E and G put direct employment in relation to PAX. This overstates the employment impact as a percentage of employees is working in the freight business. This percentage also differs between the airports. Hence, models C, D, F and H use on-site jobs as dependent variable and million WLUs as independent variable. Four models (A, C, E and F) include Frankfurt/Main (FRA) and München (MUC), airports with a high employment density because of their particular traffic function. To gain a clearer picture of the average international airport in Germany, the regressions B, D, G and H do not include FRA and MUC.

Table 4 shows the results of linear regressions through the origin, i.e., the value of the intercept of the regression line is not included. The reason is that the constant does not contribute to the explanation of the numbers of airport employees as negative values have no economic interpretation. The regression model D in Table 4 represents the regression line in Figure 2.

In order to indicate the quality of the linear regressions, Table 4 shows values of the coefficient of determination r^2 that represents the proportion of the total variation in the dependent variable (y) explained by the independent variable (x). For all models high r^2`s are obtained, the lowest still has the high value of 0.94. $F$ tests are used to examine if the $r^2$`s of the sample is more than the result of a sampling error. The F tests lead to highly significant results for all models, i.e., the regressions explain a significant portion of the variance in y. The same holds for the t test that examines the influence of x on y. Accordingly, the independent variable (PAX or WLU) is statistically significant to explain the number of on-site jobs.

Model	With FRA/MUC	x	y	Regression equation	r^2
A	Yes	PAX	All jobs	y = 1,088 x	0.97
B	No	PAX	All jobs	y = 894 x	0.95
C	Yes	WLU	All jobs	y = 862 x	0.99
D	No	WLU	All jobs	y = 810 x	0.98
E	Yes	PAX	Jobs with airport operator, authorities and airlines	y = 798 x	0.94
F	Yes	WLU	Jobs with airport operator, authorities and airlines	y = 638 x	0.97
G	No	PAX	Jobs with airport operator, authorities and airlines	y = 530 x	0.95
H	No	WLU	Jobs with airport operator, authorities and airlines	y = 471 x	0.94

Table 4: Regression results for different models

The regression models in Table 4 are arranged in order of their respective employment impact. Models A – D which use traffic volume to explain the number of all on-site jobs at airports lead to the highest employment effects of additional passengers and WLUs respectively. With regard to PAX (models A and B) a relation is obtained that is similar to what is stated in the so-called master plan of the Air Traffic for Germany Initiative, i.e., approx. one million additional passengers create 1,000 new jobs at airports. However, models A – D overstate the direct employment effect of additional air traffic as a percentage of workplaces at airports is only loosely or not at all connected to the number of handled passengers or WLUs. In addition, models A and B use PAX as independent variable, thus ignoring that freight handling significantly contributes to the number of direct jobs at several German airports. Therefore, the use of models A and B lead to a distorted picture of the relation between traffic volume and employment. In order to get a more realistic assessment of the direct employment impact of additional PAX or WLUs, the traffic volume has to be related to the on-site jobs of airport operators, air traffic-related authorities and airlines (models E – H). Further airport

employment not directly related to growing passenger and freight volumes is no longer considered.

The regression results change noticeably once FRA and MUC are not included in the analysis (Table 4). Due to their special traffic function both hub airports increase the average employment effect. Hence, the models G and H consider the employment effect of additional passengers and WLUs respectively for the fifteen other airports. Accordingly, one million additional passengers create 530 direct jobs at airport operators, air traffic-related authorities and airlines (model G). With regards to WLUs the impact reduces to 471 jobs (model H).

As PAX only account for a differing fraction of WLUs depending on the airport, model G displays a generally too high employment effect of additional passengers. However, model G may be considered as the most adequate way to estimate the employment effect of additional air traffic, as besides on-site jobs with the airport operator, air traffic-related authorities and airlines, parts of the other airport employment is also closely linked to passenger volume, for instance at restaurants, shops, travel agencies and car rentals.

The present direct employment effect of additional air traffic at Germany's international airports (without Frankfurt/Main and München) can be best captured through model G of the linear regression. The resulting rule of thumb is '1 million additional passengers p.a. = 530 direct jobs'. To assess the future employment effect of planned projects to develop and extend airport infrastructure, the potential of efficiency gains at airports is considered in the next section.

INCREASE IN LABOR PRODUCTIVITY

Labor productivity is defined as output per employee. At airports output can be measured by WLUs p.a. Due to deregulation of ground handling services in Europe and also due to cost pressure on airlines passed down to airports there were considerable productivity gains at Germany's airports over the last years. This is highlighted by a comparison of labor productivity in 1998 compared to 2004 (Table 5).

Year	Direct employment	WLUs (million)	WLUs per employee
1998	95,859	149.0	1,550
2004	103,603	185.5	1,790

Table 5: Productivity growth at Germany's international airports 1998 – 2004

Accordingly, labor productivity measured as WLU per employee increased by 15.5 % between 1998 and 2004. This represents an average productivity growth of 2.4 % per annum despite additional legal requirements and higher standards, particularly associated with airport security. Further efficiency gains in airport processes can be expected (Hujer et al. 2004). However, the successful efforts at many airports to bring production costs down during the past years limit the potential for further rationalization.

Table 6 shows how employment density (= direct jobs per million WLUs) and hence additional direct employment from increasing air traffic changes up to the year 2010 depending on the annual growth rate of labor productivity. Starting point is an employment density of 530 direct jobs per one million additional passengers in the year 2004 (model G in section 3).

Annual growth rate of labor productivity	Employment density 2010
0.0%	530
1.0%	499
2.0%	471
3.0%	444
4.0%	419

Table 6: Employment density 2010 for different gains in labor productivity

ACI assumes continuous optimization of airport processes and expects an annual labor productivity increase of its member airports of 2 % (ACI 2004). If this growth rate of 2 % is taken for the time period 2004 − 2010, one million additional WLUs in 2010 will generate 470 on-site jobs compared to 530 in 2004.

CONCLUSION

As public facilities many airports play substantial roles in shaping the economy of their surrounding regions. Considering the accelerating internationalization of production and markets the ability for people and goods to move between distant regions becomes more and more important. There is little doubt that airports have a positive impact on regional economic welfare. For example, Baum et al. (2004) show that European regions with airports and sufficient air services have a better social and economic development with lower unemployment, higher labor productivity and higher per-capita income.

Supporters of further capacity development and extension of airport infrastructure in line with increasing air traffic demand degrade their good economic reason by referring to unrealistic employment effects. The direct employment effect differs between airports due to factors like the airport's size and main traffic function, capacity utilization, the presence of airline bases and productivity growth. The German low-cost airport Frankfurt/Hahn with intra-European point-to-point traffic shows a lower employment density than hubs like Frankfurt/Main and München. Nevertheless, the much cited rule of thumb that one million additional passengers generate about 1,000 on-site jobs at Germany's international airports cannot be maintained and will apply even less in the future due to increasing labor productivity. In addition, estimating the impact of passengers on airport employment leads to overrated results if jobs depending on the airport's freight activities are not adequately accounted for.

Considering the results of the regressions in this paper and likely increases of labor productivity at German airports, the empirical evidence suggests a new rule of thumb for the direct employment effect of passenger traffic at German airports: One million additional passengers per annum generate 500 on-site jobs at the airport operating company, air traffic-related authorities (police, security, immigration, customs, air traffic control) and airlines. The direct employment impact of additional passengers derived in this paper is half as much than what is stated in the master plan on the future development of Germany's airport infrastructure issued by the Air Traffic for Germany Initiative ('Initiative Luftverkehr für Deutschland'). The number of on-site jobs is often immediately used to calculate the number of indirect and induced jobs. The multiplier

value of 2.0 assumed in the master plan now leads to a proportional reduction with 1,000 indirect and induced jobs rather than 2,000. Therefore, the importance of passenger traffic at airports as a source of employment reduces considerably and, hence, a prime economic reason for airport development projects in Germany. Nevertheless, available data should not be ignored when estimating the effect of additional passengers on employment.

References

Arbeitsgemeinschaft Deutscher Verkehrsflughäfen (2005): Beschäftigte der Flughafenunternehmen [ADV 2005].

Airports Council International Europe/York Aviation (2004): The Social and Economic Impact of Airports in Europe [ACI 2004].

Baum, H./Schneider, J./Esser, K./Kurte, J. (2004): Standortfaktor Flughafen Frankfurt/Main. Bedeutung für die Struktur, Entwicklung und Wettbewerbsfähigkeit der Wirtschaft der Region Frankfurt/Rhein-Main, Köln [Baum et al. 2004].

Bundesministerium für Verkehr, Bau- und Wohnungswesen (2000): Flughafenkonzept der Bundesregierung, Berlin [BMVBW 2000].

Bund für Umwelt und Naturschutz Deutschland (2000): Stellungnahme des BUND zum Flughafenkonzept der Bundesregierung, Haan [BUND 2000].

Hujer, R./Rürup, B./Kokot, S./Mehlinger, C./Zeiss, C. (2004): Einkommens- und Beschäftigungseffekte des Flughafens Frankfurt-Main, Frankfurt/Main [Hujer et al. 2004].

Initiative Luftverkehr für Deutschland (2006): Masterplan zur Entwicklung der Flughafeninfrastruktur, Frankfurt/Main [Initiative Luftverkehr für Deutschland 2006].

Intraplan Consult GmbH (2003): Verkehrsprognose für den Flughafen Frankfurt-Hahn im Rahmen des Planfeststellungsverfahrens, Lautzenhausen [Intraplan 2003].

Ministerium für Wirtschaft und Mittelstand, Energie und Verkehr des Landes Nordrhein-Westfalen (2000): NRW-Luftverkehrskonzeption 2010, Düsseldorf [NRW 2000].