The role of regional airports in a future transportation system

seo economic research

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Summary

The European Commission has recognized that transport and its infrastructure is fundamental to the European economy and society. Therefore all of the European regions need to be fully and competitively integrated in the European, as well as world economy. This long term goal is ambitious, as today still considerable bottlenecks and barriers exist in the provision of access to European regions. Despite the bottlenecks mentioned, regional airports in Europe have an important role in the quality of access by air between the regions they serve and the rest of Europe (or even the world).

This study, commissioned by the Assembly of European Regions (AER) addresses how European regions are connected by air to other regions in Europe. It observes large differences between European regions, based on several distinguished regional and airport characteristics, like population density, GDP, low cost carrier (LCC) domination and airport size.

Western Europe is the densest populated area and hence has the most connections by air to the rest of Europe. However, Western Europe's growth in air connectivity has been very moderate in the last decade. Annual growth figures in the order of 1% were typical for these regions. This is in sharp contrast with the air connectivity growth of the lower density peripheral European regions, which show annual growth rates of around 5%. This was not only the case for the lower density regions, but – possibly more relevant – also for the lower GDP regions. The latter slowly seems to catch up with the higher GDP regions.

The strongly increased connectivity by air has significant implications for regional economic growth. More connections by air, particularly if these connections serve new destinations or provide more competition, lead to consumer welfare and hence to more economic activity and jobs in the region. Firstly, by attracting internationally-orientated businesses and, secondly, by stimulating incoming tourism. The lower GDP regions have particularly benefited from this incoming tourism.

While more connections by air stimulate the economy, economic growth stimulates aviation demand and connectivity as well. The latter effect is particularly strong in the less developed regions (mainly (south)Eastern Europe), which results in a spin-off between economic growth and air connectivity, particularly in those regions. Partly by the expansion of the EU and the increased trade with the less developed regions, the economic growth of those regions has been significantly higher than in the established European regions. Combined with the low saturation levels with regard to aviation this has resulted in a more than proportional growth of aviation demand and hence of connectivity by air. This process has been strengthened by the progressing liberalization in aviation and by the influx of low-cost carriers (LCC's), which has brought more competition and lower air fares.

Looking at the future developments, the developing regions in the Eastern part of Europe can potentially expect increasing LCC activity in the coming years. This results in increasing consumer welfare and incoming tourism, which in turn triggers employment and GDP growth.

LCC's, however, are footloose and increasing environmental costs and governmental taxation can easily cause LCC's to change operational schedules and take away the abovementioned regional economic benefits.

New services of full-service carriers to their hub airports is a promising opportunity for a regional airport (and the regions it serves) to substantially increase its (intra-European) indirect connectivity. Having a direct link to a major European hub airport often offers a broad pattern of additional European destinations beyond that hub airport.

Additional opportunities for regional airports are related to public service obligations which EU-member states can impose. This is the case if road and rail access to the concerning regions is lacking and aviation is strongly contributing to access to and from the region. Similar considerations are relevant for 'state-aid' that can in specific cases and at specific conditions be granted to small regional airports, with a passenger turnover of less than one million passengers. While this can be seen as opportunities, it can equally be seen as a threat, as the development of such airports and their regions is strongly depending on EU-regulation, which may change over time.

Rather than looking at the opportunities concerning public service obligations, airports, including the smaller ones, may assess to what extent their airports may be (or become) commercially feasible. Additional revenue sources may be found in the non-aviation category, but airports can also be proactive in identifying their market opportunities and providing new airlines with information on possible business cases of serving their airports.

High-speed trains have had their effects on airline networks already and will most likely continue to do so. In general, high-speed trains compete with (ultra) short-haul airline networks. Network analyses show that on several domestic markets with high-speed train connections connectivity by air has significantly dropped. While such a competitive environment may be affecting the airline networks, it is by no means affecting the concerning regions, as additional competition generally increases consumer welfare. Additionally, high-speed train networks can also contribute to airline networks, as they can function as a feeder for existing and new (intra-European) airline operations, expanding existing catchment areas substantially. To achieve this, better and more connections between airline and rail networks are crucial. It should be noted however, that high speed trains need dense markets, and hence the high speed train issue is less relevant for the peripheral en scarcely populated regions.

1 Introduction

In the White Paper "*Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*", the European Commission has set ambitious goals for the period up to 2050 for a single European Transport Area (European Commission, 2011). It has done this in the recognition that transport and its infrastructure is fundamental to the European economy and society. Therefore all of the European regions need to be fully and competitively integrated in the European, as well as world economy. The goal is ambitious, as today still considerable bottlenecks and barriers exist in the provision of access to European regions. All transport modes, including aviation and high speed trains must contribute to this ambition. Another challenge – together with further improvement of infrastructure – is the significant reduction of greenhouse gas emissions: the aim for 2050 is to have emission levels 80 to 95% below the levels of 1990.

Despite the bottlenecks mentioned, still today, regional airports in Europe have an important role in the quality of access by air between the regions they serve and the rest of Europe (or even the world). Particularly peripheral regions benefit from connections by air with other (European) regions, since direct flights from nearby regional airports have positive effects on consumer welfare (lower costs and shorter travel times), but also stimulate economic activities in the given region. After all, being connected by air makes a region more attractive as a place of business and increases incoming tourism flows.

The future for regional airports, however, is uncertain. The growth of other travel modalities and the consolidation in the aviation sector are possible threats for the growth, or even the right to exist, of regional airports. In order to have a clear view on the (future) role of European regional airports, the current condition, the latest developments and the possible future developments of regional airports and their threats have been analysed.

This study, commissioned by the Assembly of European regions (AER), looks specifically at the importance of connectivity by air for European regions and analyses the developments of different types of regions and airports in the last decade, focusing on differences in population density, GDP, LCC domination and airport size. In addition, the impact of high-speed train networks has been assessed. Finally, based on future economic developments and expected developments in the aviation industry, the future threats and opportunities for regional airports and European regions are presented.

2 Regions and connectivity

Every part of Europe has its own characteristics. In general, Western European regions are denser, while the regions in Scandinavia and South-eastern Europe are less dense populated. In turn the largest airports are situated in Western Europe, but also in Southern Europe. Airports in and around the region contribute to connectivity by air to the rest of Europe. The closer an airport is to the regions centre, the bigger is its contribution to the regions connectivity.

2.1 Introduction

This section presents the role airports – and regional airports in particular – have for European regions. The section addresses specifically how well regions are connected by air to other regions in Europe. For this purpose different types of regions with regard to population density are distinguished. Furthermore – to assess the quality of connectivity – also for airports distinct typologies are identified, as this is particularly relevant in the context of future developments in aviation networks.

How well two airports are connected by air with each other is quantified by introducing the concept of *connectivity* (Veldhuis, 1997). It measures the number of weekly connections between two airports, not only the direct connections, but also indirect ones with specific weights with regard to their elapsed travel times.

How well regions are connected with the rest of Europe is further quantified by taking to account the distance between these regions and the airports in their catchment areas.

2.2 European regions: characteristics

The results of the study are based on an analysis of the NUTS-2 regions in Europe. The analysis has included all European countries. The larger European countries are subdivided into more NUTS-2 regions. Germany and the United Kingdom have the most NUTS-2 regions (39 and 37 respectively), while the smaller populated countries have no further subdivision into NUTS-2 (such as Luxemburg and the Baltic States). In general it shows that the populated Western European countries are divided in more regions than the less populated countries located eastwards. In total the analysis includes 300 NUTS-2 regions and table 2.1 shows all the countries involved in the study, together with the number of regions as well as airports of these countries.

Table 2.1 includes also a column with the number of airports located in the specific country. This issue is further elaborated in the subsequent paragraph. Furthermore the table provides indicators on population and population density. For the purpose of further analysis all 300 regions have been divided by density in three different categories:

- *High density*: regions with a density higher than 300 inhabitants per square kilometre

- *Medium density*: regions with a density between 100 and 300 inhabitants per square kilometre
- *Low density*: regions with a density lower than 100 inhabitants per square kilometre

Table 2.1 Country characteristics

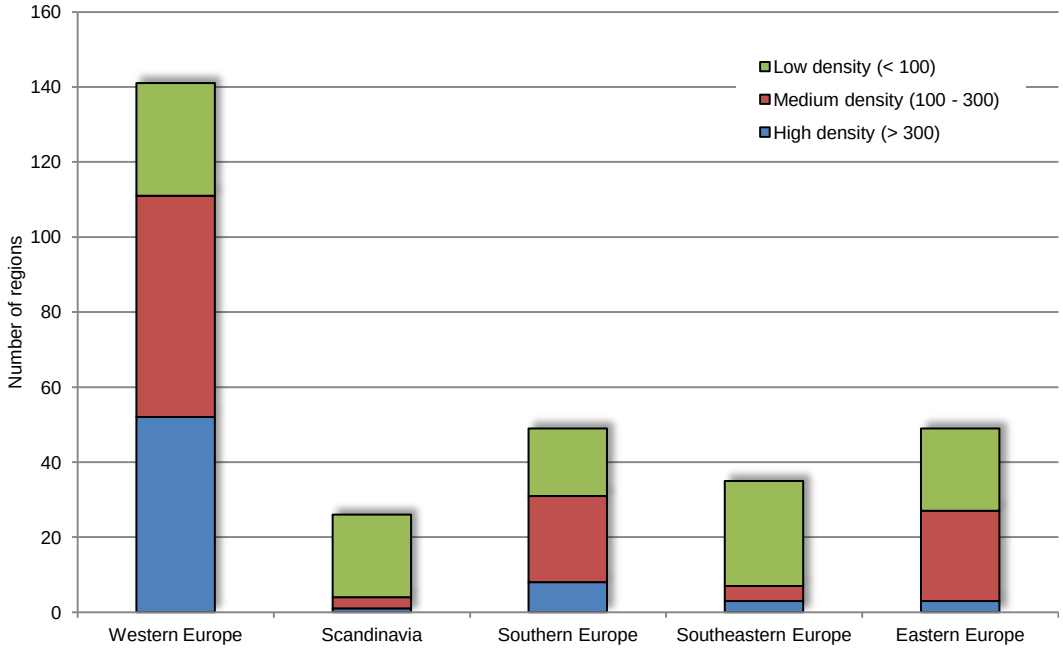
Country	Number of regions	Number of airports	Population	Density
WESTERN EUROPE				
Austria	9	6	8.224.250	99
Belgium	11	5	10.476.836	346
France	22	67	60.942.350	112
Germany	39	51	82.435.740	234
Ireland	2	9	4.168.198	60
Liechtenstein	1	0	36.010	227
Luxemburg	1	1	500.000	195
Monaco	1	0	35.352	17.501
Switzerland	7	7	7.453.535	184
The Netherlands	12	5	16.426.043	469
United Kingdom	37	74	60.213.659	249
SCANDINAVIA				
Denmark	5	9	5.447.084	126
Finland	5	24	5.253.602	15
Iceland	1	13	300.000	3
Norway	7	53	4.223.875	13
Sweden	8	46	9.063.484	20
SOUTHERN EUROPE				
Andorra	1	0	84.000	180
Gibraltar	1	1	29.431	4.747
Italy	21	44	58.501.155	194
Malta	1	2	409.267	1.266
Portugal	7	15	10.594.935	114
San Marino	1	0	31.918	523
Spain	17	45	43.806.745	86
SOUTHEASTERN EUROPE				
Albania	1	1	3.194.972	111
Bulgaria	6	4	7.655.675	69
Bosnia and Herzegovina	1	3	3.843.126	75
Croatia	4	8	4.494.749	80
Greece	13	40	11.144.005	83
Macedonia	1	2	2.050.691	81
Romania	8	15	21.569.385	91
Serbia	1	5	10.628.395	104
EASTERN EUROPE				
Belarus	3	6	9.783.358	48
Czech Republic	8	5	10.188.060	131
Estonia	1	4	1.340.008	30
Hungary	7	4	10.064.506	109
Latvia	1	2	2.285.118	36
Lithuania	1	3	3.402.512	53
Moldavia	1	1	3.560.400	106
Poland	16	11	38.071.174	124
Slovakia	4	5	5.373.083	111
Slovenia	2	1	2.003.434	99
Ukraine	4	16	46.710.816	79

Source: Official Airline Guides and internal data, edited by SEO

Figure 2.1 shows how the different categories of regions are divided over five aggregated regions. It shows that Western Europe (Germany, UK, France, Ireland, The Netherlands, Belgium, Luxemburg, Switzerland, and Austria) has by far the most high density regions: 80% of all high density regions is located in Western Europe. This corresponds with the fact that Western

Europe has a relatively small amount of low density regions. Especially in Scandinavia (Denmark, Sweden, Norway, Finland, and Iceland) and Southeastern Europe (Greece, Romania, Bulgaria, and the Balkan countries), low density regions are dominant. Regions in Southern Europe (Spain, Italy, Portugal, and Malta) and Eastern Europe (Belarus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Slovakia, Slovenia, and Ukraine) have similar shares of low and high density regions.

Figure 2.1 Western Europe consists of denser regions than the other parts of Europe



Source: Official Airline Guides and internal data, edited by SEO

The table lists also the number of airports in each country. In total there are 430 airports providing commercial flights and these airports provide the access by air to all regions specified in the analysis. Next section addresses a further categorization of these airports

2.3 European airports: characteristics

Connectivity from and to these 300 European regions is provided by 430 airports in their catchment areas. It is observed that these airports have significantly distinct characteristics and for the purpose of the analysis below they have been distinguished according two criteria: size and whether the airports can be characterized as hubs or non-hubs. Starting with the latter category, the non-hubs, they are solely depending on the market potential of its own catchment area, which is the traffic it can generate (by its local residents) and it can attract (visitors to the region).

In contrast to this there are the hubs, which do not only attract traffic from their own catchment areas, but also connecting traffic between third regions. For instance, the hub Frankfurt attracts

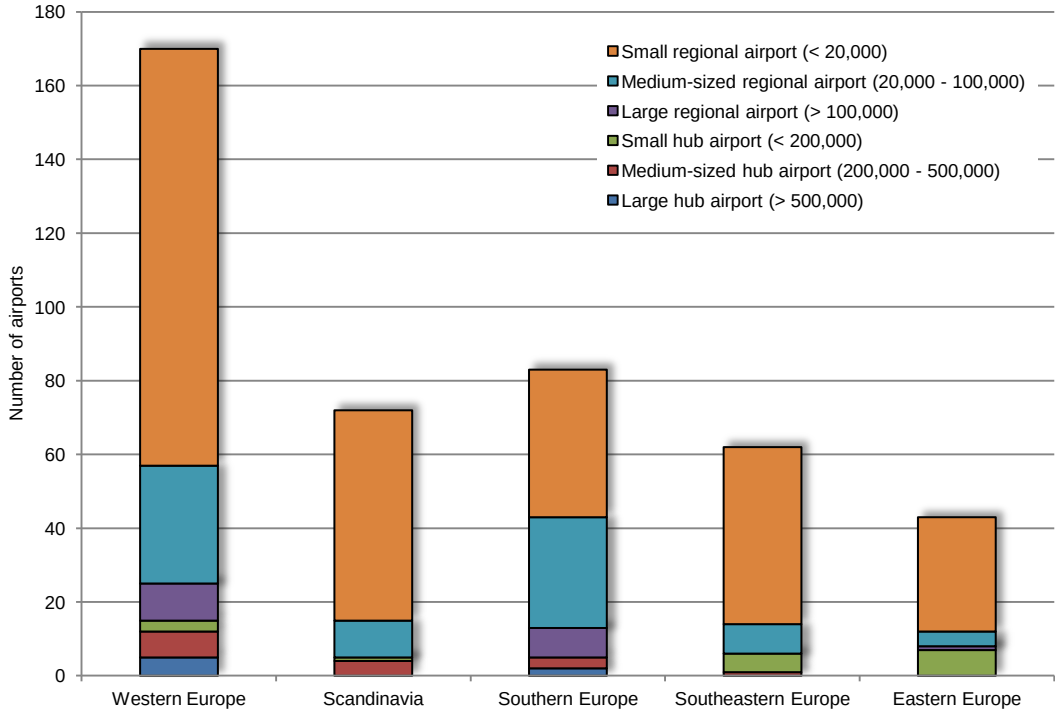
traffic between the UK and Eastern Europe. For the larger hubs the connecting traffic share is even significant, for Amsterdam it is little over 40% and for Frankfort even close to 50%.

The other criterion of classification is size of the airport, measured in weekly seat capacity provided. It is observed that the distribution in size is very un-even. The four large hubs (London Heathrow, Paris Charles de Gaulle, Frankfurt and Amsterdam Schiphol) generate already 15% of intra-European seat capacity of all 430 European airports. The majority of these 430 airports are therefore small and hence they have therefore a limited role in providing connectivity to the 300 distinguished regions.

The analysis distinguishes six types of airports (based on 2011 data):

- *Large hub airports*: airports which function as a hub and offers more than 500,000 departing intra-European seats on a weekly basis
- *Medium-sized hub airports*: airports which function as a hub and offers between 200,000 and 500,000 departing intra-European seats on a weekly basis
- *Small hub airports*: airports which function as a hub and offers less than 200,000 departing intra-European seats on a weekly basis
- *Large regional airports*: airports without a clear hub function and offering more than 100,000 departing intra-European seats on a weekly basis
- *Medium-sized regional airports*: airports without a clear hub function and offering between 20,000 and 100,000 departing intra-European seats on a weekly basis
- *Small regional airports*: airports without a clear hub function and offering less than 20,000 departing intra-European seats on a weekly basis

Figure 2.2 Large airports are mainly situated in Western and Southern Europe



Source: Official Airline Guides and internal data, edited by SEO

Figure 2.2 presents the distribution of the different types of airport over the different aggregated regions. It shows that most airports are located in Western Europe and that in all main regions, even in Western Europe, the majority of the airports are small regional airports. Large and medium-sized regional airports mainly exist in Western and Southern Europe. Hub airports are dominant in none of the regions in terms of numbers. In terms of traffic they obviously play a more important role. Large and medium-sized hub airports are mainly found in Western Europe, Scandinavia and Southern Europe, while small hub airports mainly exist in the developing regions of South-eastern and Eastern Europe.

2.4 NetScan: measuring connectivity

While the above analysis has categorised airports, it was together concluded that most of the airports are small and hence they have a marginal role in connecting the 300 regions to the rest of Europe. Therefore it is relevant to attach to the airports a measure of network quality: how well is the airport connected to other airports in Europe?

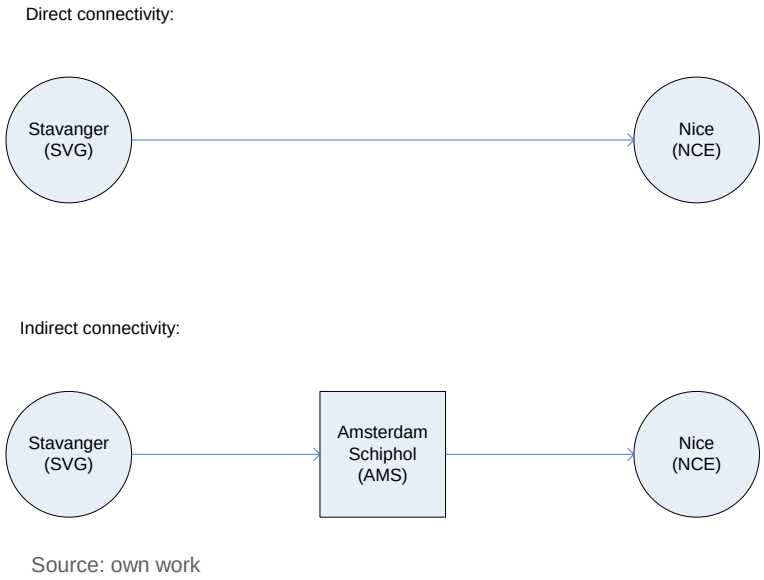
The quality of airline networks may be assessed using distinct types of indicators. Most analyses use relative simple, easy to communicate indicators, such as number of destinations and frequencies of direct connections to particular destinations. But also indirect connections contribute significantly to the accessibility by air between airports and regions. Moreover, the large hubs and their airlines focus particularly to indirect connections, as these are indispensable to retain particular market shares.

The size and quality of networks, including indirect connections, are less easy to communicate. The *NetScan* model is developed to monitor this by looking at "*connectivity*": a representation of the physical characteristics of connections: number of frequencies weighted by their *quality*. In a wide range of industry, government and academic studies, including the IATA Connectivity Monitor, NetScan has been applied. Airline schedules from the *Official Airline Guide* (OAG) form the input for the model. Quality is defined here as how fast the connection is and this quality is represented by an index. This *quality index* ranges from 1 (one) for direct connections with the shortest possible travel time, to 0 (zero) when travel time (of indirect connections) exceeds particular predefined limits. Multiplying the quality index with the weekly frequency results in the *number of connectivity units* between two airports.

The measure is illustrated by an example of the connection between Stavanger (SVG) in Norway and Nice (NCE) in France. There is only one weekly direct connection, the one leaving on Sunday early morning of Norwegian Air Shuttle. Its quality index is 1, as it is a direct and non-stop flight with the shortest possible travel time. Besides these direct connections there are several indirect options. Most of them (21 per week in total) are provided by KLM via Amsterdam. However, these connections take longer time and hence their quality index is lower: 0.29 only. Multiplying the number of travel options (21) with their quality index results in a connectivity value of all KLM-connections via Amsterdam from Stavanger to Nice of 6.08 weekly. Furthermore, there are additional options via Frankfurt, Oslo and Copenhagen, representing a total connectivity value of 3.36 weekly. All connections together between Stavanger and Nice (direct as well as indirect) represent a connectivity value of 10.44 *connectivity*

units weekly. Finally all connections from Stavanger to all other European airports represent a connectivity value of 732 connectivity units (525 direct, indirect 32 via Oslo, 31 via Copenhagen, 77 via Amsterdam, 60 via Frankfurt, 7 via London and finally 1 via Riga).

Figure 2.3 Direct and indirect connectivity



Source: own work

2.5 Connectivity of a region

In the previous paragraph the connectivity of airports has been defined. Connectivity of airports is obviously determining the connectivity of the surrounding region to the rest of Europe. The methodology used is illustrated by an example, which is found in the "Agder og Rogaland" region in Norway. The corresponding NUTS-2 region is coded with NO04 (comprising the three NUTS-3 regions "Aust-Agder", "West-Agder" and "Rogaland").

The connectivity of this region to the rest of Europe depends on the connectivity of all airports in its catchment area. To assess the benefits these regions have, we have determined firstly for each of the European regions central node points and made the implicit and simplifying assumption that the connectivity of the region equals the connectivity of its main population center. For the region NO04, the node point is Stavanger City.

Furthermore, the catchment area of a region is defined as the surface within a circle with a radius of 150 kilometers around its node point: the city of Stavanger. There are more airports within that circle and hence they add also to the connectivity of that region in addition to Stavanger (SVG) alone. These other airports are Stord (SRP) and Haugesund (HAU) and Farsund (FAN). The latter airports are however much smaller than Stavanger (SVG) and hence their contribution to connectivity of the region is lower than Stavanger Airport. Moreover, the latter two airports are located more far away from Stavanger City (61 and 55 kilometers respectively), being another reason of the lower contribution of the connectivity of the region.

In general, the benefits this region has of the connectivity performance of airports depend on two factors: (1) how fare airports are located from its population and economic centers as well as (2) the connectivity these airports generate themselves.

In practice, the assumption has been made that the contribution of an airport is highest is the airport is located near the city centre (which in reality is obviously never the case). If an airport is located more than 150 kilometers from the city centre, the assumption is made that its contribution is zero. For airports located in between an interpolation is made: a contribution of 80% at 30 kilometers distance and 20% at 120 kilometers distance. Table 2.2 illustrates how these three specified airports contribute to the connectivity of this specific Norwegian region.

Table 2.2 Connectivity of the Agder og Rogaland region in Norway (NO04, 2011)

Airport	Code	Connectivity	Distance to Stavanger City	Weight	Contribution to Connectivity
Stavanger	SVG	732	10	0.93	681
Stord	SRP	12	61	0.60	7
Haugesund	HAU	81	55	0.63	51
TOTAL					**739**

Source: Official Airline Guides, edited by SEO

Regions can therefore enjoy connectivity benefits from more airports, even from those in adjacent countries. This is particularly the case for regions in densely populates areas. Generally these regions are relative small in surface and hence also airports outside the region at a distance less than 150 kilometers from its center contribute to the regions connectivity. An example is the Utrecht region in the Netherlands (NUTS-2 code NL31). It has no airports in the region, but connectivity from the region is only provided by airports outside the region, such as Amsterdam (AMS), Eindhoven (EIN) and even in Germany (Dusseldorf, DUS). Table 2.3 below illustrates the connectivity of the Utrecht region.

Table 2.3 Connectivity of the Utrecht region in the Netherlands (NL31, 2011)

Airport	Code	Connectivity	Distance to Utrecht City	Weight	Contribution to Connectivity
Amsterdam	AMS	3.891	33	0.78	3.035
Rotterdam	RTM	123	50	0.67	82
Eindhoven	EIN	189	75	0.50	95
Maastricht	MST	34	140	0.07	2
Antwerp	ANR	36	111	0.26	9
Brussels	BRU	2.426	141	0.06	146
Niederrhein	NRN	155	90	0.40	62
Dusseldorf	DUS	2.521	144	0.04	101
TOTAL					**3.532**

Source: Official Airline Guides, edited by SEO

3 The regional benefits of airline networks

Regions benefit from airline networks offered from their (regional) airports. One of the obvious benefits is the increase of consumer welfare if the number of travel options increases. In addition, air links create regional accessibility and social inclusion, and improves the business location of the area. Finally, it possibly stimulates incoming tourism and leads to increasing employment.

3.1 Introduction

The availability of airline networks provides substantial economic and social benefits. Connections between European regions are vital for the development of those regions. Establishing new airline routes enables the region's residents to travel to different (European) destinations against reduced travel costs, which increases consumer welfare. In addition, air links increase a region's accessibility and its social development. Furthermore, new links with other European regions can attract (internationally oriented) businesses and can stimulate incoming tourism. In turn, this leads to additional positive employment effects in the region.

Moreover, the European Commission (2004) points out that connecting Europe by improving transport links is an important condition for *"becoming the most competitive and dynamic knowledge-based economy in the world, capable of sustained and sustainable economic growth with more and better jobs and closer social cohesion."* A goal the European Union sets itself at the Lisbon Summit in March 2000.

3.2 Consumer welfare

In the above chapter the concept of connectivity was introduced. This variable measures in effect the total number of connections (weighted by its quality). Although every new direct connection adds equally to connectivity, the effect of these additions to consumer welfare may be different. Consumer welfare of new connections is measuring by which amount the total travel costs by air decrease by a new service by air.

In that context it is observed that a new connection to a destination which was not served earlier may reduce travel costs significantly, as this destination had only indirect connections before (or was only served from more far away airports). Hence in such cases the contribution to consumer welfare may be large, particularly if it is a destination with a large market potential.

If the new connection is however only just an additional frequency to an existing destination, that had already several flights a day before, the contribution to lower travel costs and hence to cosumer welfare is lower, although the extra frequencies provide more flexibility and hence also lower travel costs. In both cases however the contribution to connectivity is equal.

Another relavant aspect is whether the new connection is a connection by a new entrant carrier. Even in case the destination was directly served, a new carrier me add to competition and hence to lower fares, lower travel costs and also to consumer welfare.

Establishing new airline routes increases also consumer welfare by lower travel costs. Decreasing travel costs can be caused by lower travel time, lower air fares, lower access time and costs, and higher frequencies.

In general, positive effects on consumer welfare are highest if the new route serves a new direct destination. In that case substantial lower travel time causes significant positive effects on consumer welfare. If a new route is served from another nearby airport, then the decrease in access time and costs for residents who live closer to that airport cause an increase in consumer welfare as well. Furthermore, new routes can have a decreasing effect on air fares. This is especially the case if the new route will be operated by a low cost carrier (LCC) or if the route has not been operated directly before.

Reducing travel costs with increasing consumer welfare have aclear impact on the economic potential of the region. This is illustrated by Rasker et al. (2009), who shows that the smaller the distance to the nearest major airport (at least 15,000 departing passengers per year) the higher the avarage earnings per job, the higher the per capita income, and the higher the share of employment in services and professional jobs. In short, this implies that in general living in the proximity of commercial airport increases consumer welfare through the availability of high quality jobs and high earnings.

3.3 Regional accessibility and social development

York Aviation (2004) points out that *"the social and economic importance of air transport in Europe will grow with enlargement of the EU. Air transport provides accessibility to the global economy and enables remote and island communities to participate more fully in Europe, thus promoting social inclusion."*

Especially the more remote regions with limited alternative transport links with other regions highly depend on air transportation. Those areas often need air links to have access to essential services like heath care, education, and governmental institutions. This is supported by the fact that people living – for instance - in a remote region in Northern Norway have a very high frequency of (domestic) air travel compared to the national average (Halpern & Bråthen, 2011), suggesting that people living in remote areas are far more depending on air travel than people living in less remote or central areas.

In more detail, Halpern & Bråthen (2011) present that the availability of air services in remote areas enables residents to have better contact with friends and relatives, have better access to health services, have better holiday opportunities, and do their jobs better. The results show that this is particularly the case for more remote areas, except for the holiday opportunities, which is caused by the often limited offer of holiday flights from small regional airports.

To conclude, air services to (remote) regions are essential for regional accessibility and, in turn, for the social development of people living in those areas. Having no access to air services will make it more difficult for (remote) regions and its residents to participate in todays modern world, which has profound impacts on the quality of life.

3.4 Attraction to businesses

Having international transport links is essential for many businesses considering new locations. Airports provide easy access to suppliers and customers, especially over medium and long distances. Therefore, global accessibility is a key factor for business location and success in all regions of Europe (York Aviation, 2004).

Rasker et al. (2009) also point out that the role of airports is generally seen as a necessary condition for the competitiveness of cities in a global economy. The researchers claim that nowadays access, rather than location, is the most important determinant of the ability of a company to compete. Brueckner (2003) agrees by saying that frequent service to a variety of destinations facilitates easy face-to-face contact with businesses in other cities, which attracts new firms to the metropolitan area.

The same holds for the competitiveness of regions. General accessibility and connections with other European regions attract businesses and increase the region's competitiveness. This is confirmed by Graham & Guyer (2000), stating that regional airports function as a catalyst to attract businesses. However, they emphasize that if jobs related with those businesses are transferred from elsewhere in the region, this can be a zero-sum game.

The accessibility of regions by air mainly attracts businesses in high value sectors, like financial services, business services and high tech (Brueckner, 2003; York Aviation, 2004).

3.5 Incoming tourism

Incoming tourists cause economic activities by spending money. Lian et al. (2005) state that incoming tourists in Norway stayed for 10 million nights in total, spending € 1.6 billion. This implies that incoming tourism potentially can boost regional economies, however some regions are more profound tourist regions than others.

In addition, between 1995 and 2007 the share of tourist to Norway arriving by air has increased from 14% to 34% (Denstadli & Rideng, 2010), which shows the growing importance of air links for incoming tourism.

Obviously, airports play an important role in making inbound tourism possible. Many destinations will not be accessible and profitable as a tourist destination if air links are not in effect. Especially islands heavily rely on regional airports to bring in tourists, but also tourist-oriented regions like the Provence and Tuscany receive many tourists via regional airports like Nice and Pisa. Furthermore, also city trip destinations like Prague and Krakow annually receive significant numbers of incoming tourists by air spending money in the region.

Bieger & Wittmer (2006) stress the interlinkedness of air transport and tourism. They state that air transport can stimulate incoming tourism and that, in turn, profound tourist destinations can also stimulate the supply of air services to the region. This means that after a region has been

established as a tourist destination through accessibility by air, the region's role of being a tourist destination can be strengthened further because more airlines are eager to serve that region.

In short, incoming tourism substantially contributes to regional economy and employment. The growth of LCC's the last decade accelerates the development of incoming tourism to established, as well as to new tourist destinations.

O-regions and D-regions

While better connectivity may stimulate incoming tourism, with the inherent economic benefits, it is together stimulating outgoing tourism in other areas, with similar adverse effects on the economy in the latter areas. The economic resources spent in the tourist destinations are not spent in the origins. In this context it is relevant to distinguish between regions with predominantly outgoing tourism and regions with predominantly incoming tourism.

This first category of regions have a strong local potential, either by population size, either by its spending power (so-called tourist "O"(rigin)-regions). The attraction to foreign tourists is low and hence the outgoing tourism outweighs incoming tourism. For such regions it can be claimed that better connectivity to other tourist destinations have negative effects in this context.

The second category are typical tourist destinations, however with limited local potential. These are the "D"(estination)-regions, where incoming tourism outweighs outgind tourism. Such regions benefit by better connectivity, particularly if connections are developed to strong O-regions.

Current data on the O- and D-balance for the distinguished regions are lacking. But the hypothesis can be made (however not adequately tested), that there are particularly new EU-, such as the Baltic States, Prague, Budapest, with still limited O-potential, but with attractive cities for weekend breaks have much benefitted from incoming tourism, brought by LCC's, such as Ryanair and Wizzair.

3.6 Employment

Worldwide the air transport industry generated 5 million direct jobs in 2004, with a further 5.8 million indirect, 2.7 induced, and 15.5 million catalytic jobs (Air Transport Action Group (ATAG), 2005). For Europe ATAG finds 1.5 million direct, 1.8 million indirect, 0.8 million induced, and 3.4 million catalytic jobs. Hence, establishing new airline routes results in additional employment. In the literature four types of employment are distinguished (see table 3.1): direct, indirect, induced, and catalytic. Direct employment is mostly seen as employment related to airline and airport operations, like technical support, catering, fuel, security, and cleaning[1]. Employment in shops, restaurants, car rental, and parking is often also viewed as direct. Indirect employment covers the jobs at sub contractors of businesses offering direct employment. Induced employment is the employment resulting from spending by employees working in direct or indirect employment suppliers. Finally, catalytic employment is caused by increased activities

[1] York Aviation (2004) states that 64% of the on-site employment comes from airlines, handling agents, and aircraft maintenance.

in tourism and trade, productivity and investment, and by improving locational attractiveness of the region (Bråthen, 2011).

Obviously, indirect, induced, and catalytic impacts are hard to determine in detail. Moreover, some theoretical caution should be applied, as sometimes these effects are double counted. Also there may be displacement effects: jobs at the airport are taken away from other sectors and these effects are particularly relevant in periods of booming economies with threts of labor shortages in particular sectors.

Nevertheless, it is proven that an increase in air traffic has positive effects on those types of employment, next to the more evident impact on direct employment effects.

Table 3.1 Different type of employment effects

Type of impact	Description
1 Direct	Operation of airlines and airports (technical support and handling, catering, fuel, security, cleaning), commercial activities (shopping, restaurants, car rental, parking), land transport and air cargo.
2 Indirect	Sub supplies (goods and services) to direct activities (covered in the region)
3 Induced	Spending by employees in activity 1 and 2
4 Catalytic	a- Location impacts (firms and labour) b- Tourism and trade (demand side) c- Productivity and investment (supply side)

Source: Bråthen (2011)

Several studies have tried to estimate multipliers for employment effects of increasing air traffic volumes. York Aviation (2004) distinguishes four types of airports with direct employment effects varying from 350 to over 1,200 jobs per 1,000,000 workload units[2]. York Aviation points out that airports with much charter and domestic traffic, high utilisation, no aircrafts based, and limited development have the most limited employment effects. In contrary, airports with low utilisation, airline headquarters and acting as an airline maintenance base have the highest employment effects. In reality, this means that pure LCC airports probably have the lowest direct employment effects, while the effects of additional passenger traffic at major hubs and low utilized regional airports are highest. In general, York Aviation finds that smaller airports, airports functioning as airline bases, and airports with large development opportunities have the highest employment effects.

In turn, York Aviation (2004) finds that every 1,000 direct jobs support 1,100 indirect/induced jobs on a regional level. On national level this figure should even be doubled. From ATAG's (2005) figures we derive a multiplier for indirect/induced employment of 1.8. In addition, Bråthen (2011) points out that there are huge differences in the field of indirect/induced employment multipliers. He finds figures ranging from 1.3 to 8.5, with an average of 2.6. In contrary, Bråthen finds substantially lower multipliers for Norway, ranging from 0.3 to 0.9, with the highest multipliers for the largest airports.

[2] A workload unit is the annual movement of either one passenger or 0.1 tonnes of freight/mail (York Aviation (2004).

Finally, estimations of catalytic employment effects are scarce. From the ATAG (2005) study we can derive the relationship between direct employment and catalytic employment in Europe. The multiplier is 2.3, which means that the catalytic employment effects are 2.3 times bigger than the direct employment effects. ATAG figures show that relationships between direct and catalytic effects differ largely between the different continents.

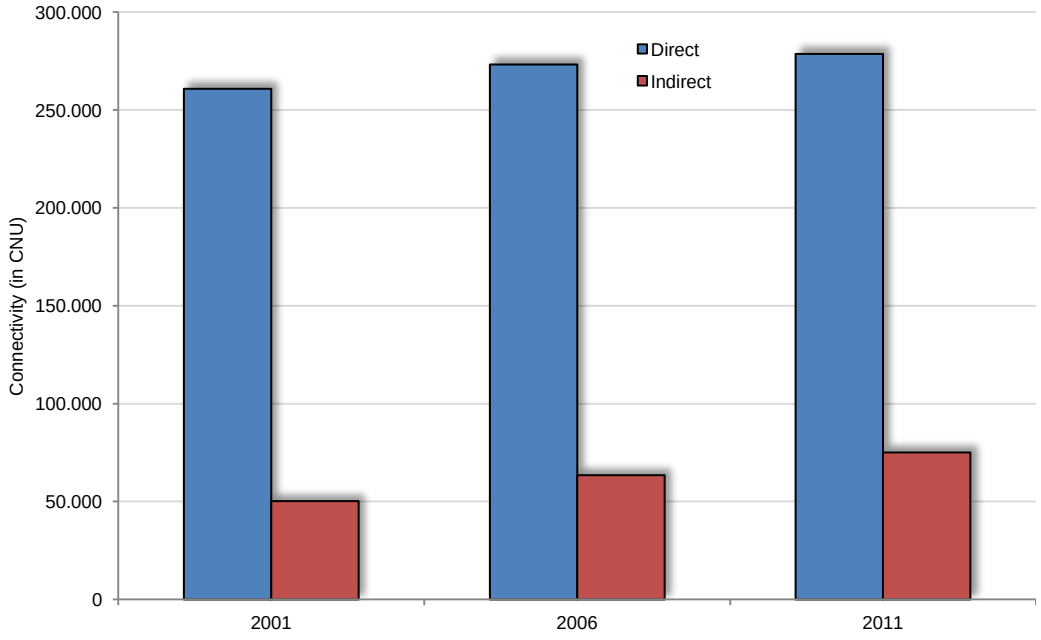
4 The evolution of airline networks in different types of regions

Regions with different characteristics follow different development patterns. While having relatively low connectivity figures, the results show that regions in Spain/Portugal, Southeastern Europe and Eastern Europe have the highest connectivity growth between 2001 and 2011. In addition, regions with low density and low GDPs follow the same pattern: low absolute connectivity figures, but highest growth figures. For airports, the ones with most LCC traffic have the highest growth rate.

4.1 Introduction

The connectivity development of airports and regions is influenced by specific characteristics. This chapter shows to what extent those characteristics cause remarkable differences in developments in connectivity. Examples of factors possibly influencing the evolution of airline networks are the share of LCC's, the centrality of a region's location, GDP, and the availability of high-speed trains in the region. Besides that, interregional differences will most likely occur as well.

Figure 4.1 Around 80 % of the intra-European connectivity is direct



Source: Official Airline Guides, edited by SEO

As outlined earlier, not only direct, but also indirect connections contribute to connectivity. Figure 4.1 shows that indirect connectivity within Europe accounts for about 20% of the total connectivity. The low share is not surprising since indirect travel options for relatively short distances (intra-European) often have a low quality relative to the non-stop flight distance,

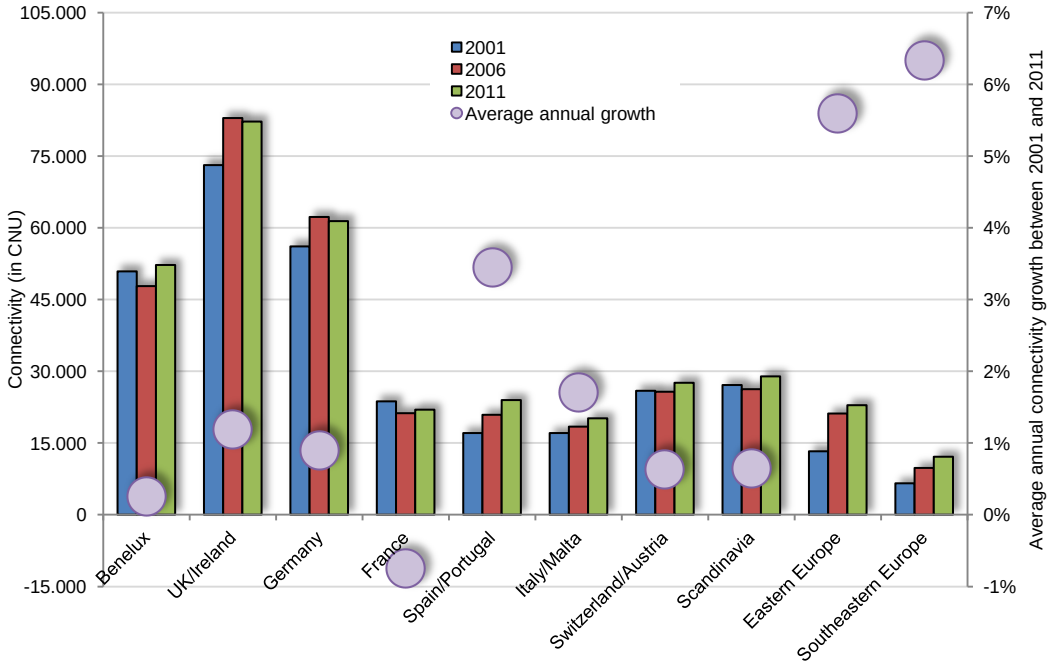
because of the relatively high additional travel time in most cases. Nevertheless, the contribution of indirect connections has increased between 2001 and 2011, which indicates that the role of intermediate hubs en route has increased in the last decade. The remainder of this chapter has however abandoned this distinction and presents only total connectivity figures.

4.2 Connectivity of region typologies

Regional differences

Airline networks have developed differently across the different European countries and regions between 2001 and 2011. Figure 4.2 shows that the connectivity from Spain/Portugal, Eastern Europe and Southeastern Europe has increased in this period. In the Western and Northern European regions the connectivity growth has been more limited. In France the total connectivity to other European regions has even decreased between 2001 and 2011.

Figure 4.2 Germany, United Kingdom/Ireland and Benelux have the highest intra-European connectivity; relative growth is highest in Spain/Portugal, Eastern Europe, and South-eastern Europe[3]

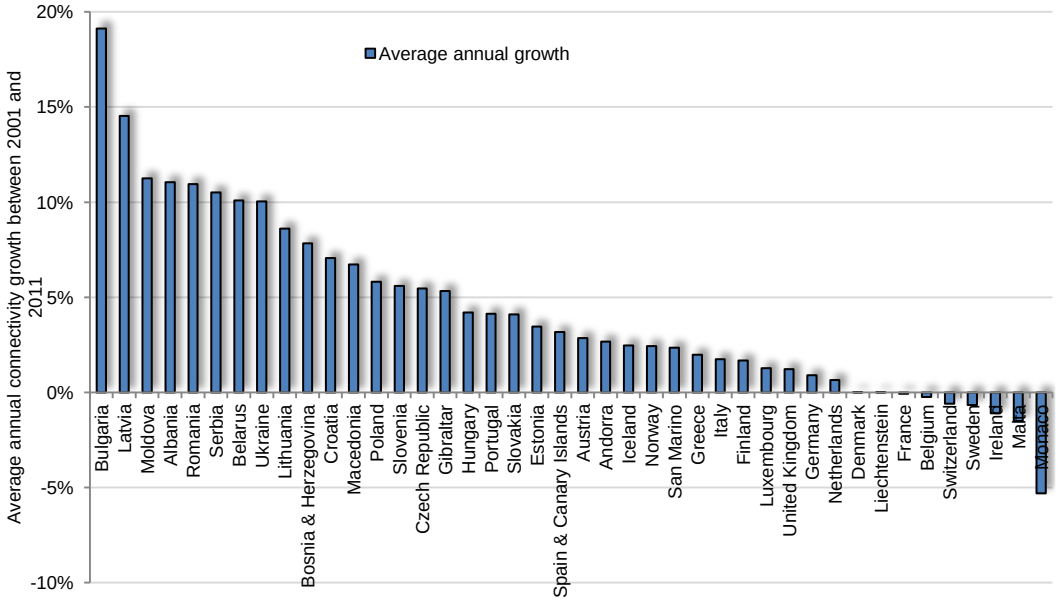


Source: Official Airline Guides, edited by SEO

At the country level, solely Southeastern and Eastern European countries show high relative connectivity growth figures (see figure 4.3). Declining connectivity figures are only visible in some more developed European countries like France, Belgium, Switzerland, Ireland, and Sweden. Except for France, the reason for these declines is the bankruptcy of the home carrier (Sabena and SWISS) or the network rationalization of the home carrier (Aer Lingus and SAS).

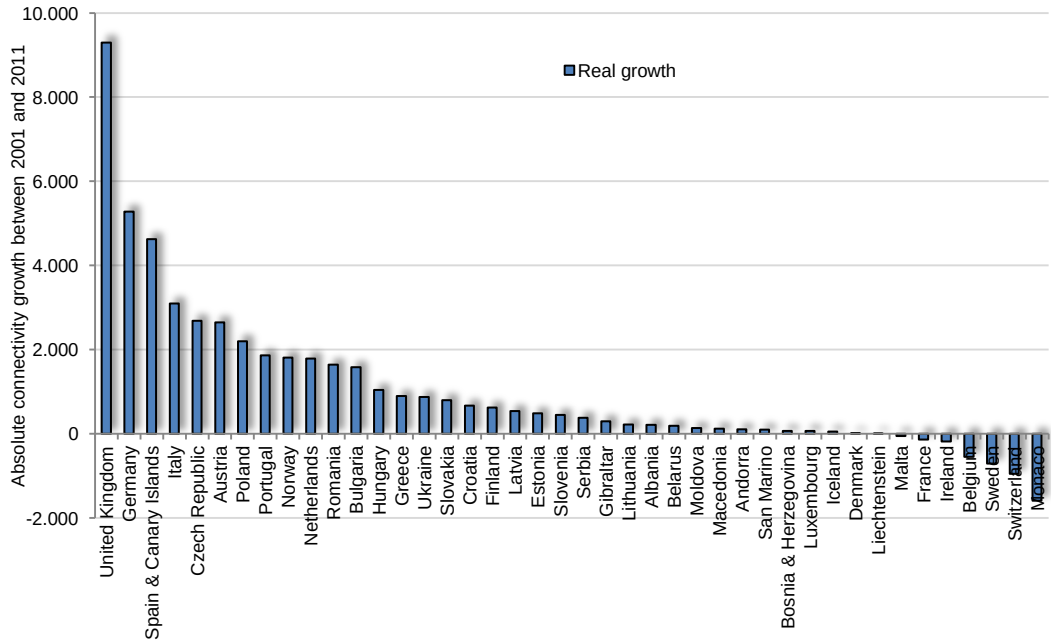
3 Figures for tiny states like Monaco and San Marino are included in the relevant regions

Figure 4.3 Especially Eastern European countries experienced a huge relative connectivity growth between 2001 and 2011



Source: Official Airline Guides, edited by SEO

Figure 4.4 In absolute terms United Kingdom had by far the highest connectivity growth between 2001 and 2011



Source: Official Airline Guides, edited by SEO

A different picture pops up in terms of absolute connectivity development (see figure 4.4). Large European economies like United Kingdom, Germany, Spain, and Italy show high connectivity

growth, while most Eastern and Southeastern European countries stay behind. Poland, Romania, and Bulgaria are the countries from those regions which show the highest absolute growth figures.

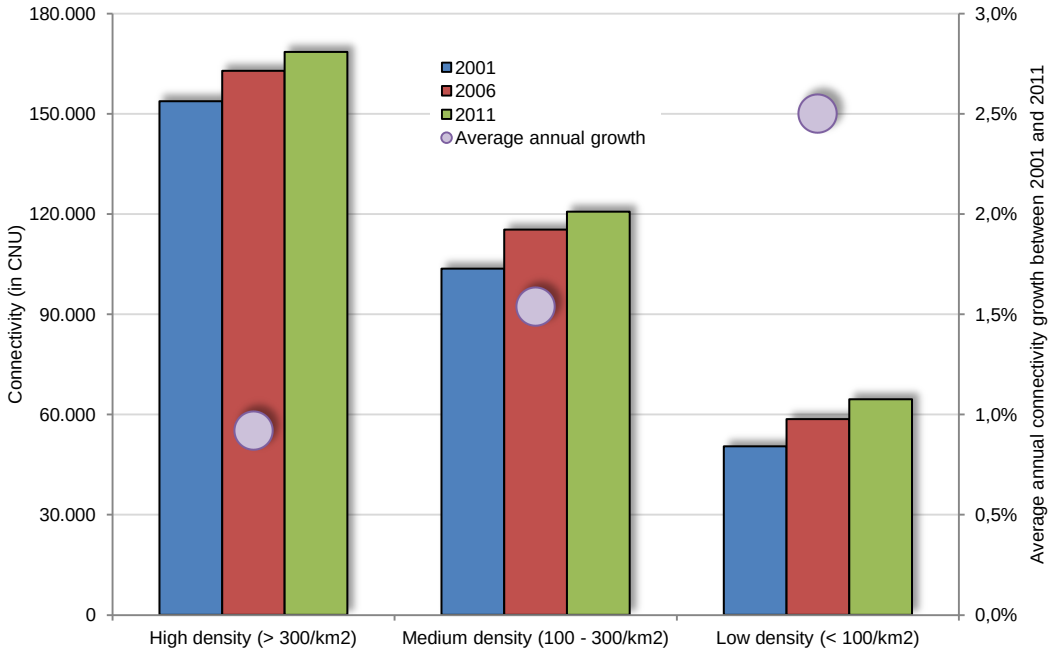
To conclude, relative growth is highest in the eastern developing countries as well as Spain. Still, the absolute connectivity levels of the Eastern and Southeastern European regions are rather limited. Looking at absolute connectivity growth the last decade, the larger European economies show the highest absolutegrowth figures.

Density differences

It may be argued that regions with low population have less developed airline networks. After all, population is one of the main predictors of demand for air services (Liu et al., 2006). This study distinguishes three different degrees of density to analyze the level and development of connectivity for central and peripheral regions.

Figure 4.5 shows the connectivity figures for 2001, 2006, and 2011 for high density, medium density, and low density regions as well as the average annual growth rate of the total connectivity between 2001 and 2011. From the figure it is obvious that in general high density European regions are better connected to the rest of Europe than regions with a lower density.

Figure 4.5 High density regions have most intra-European connectivity, however low density regions show the highest growth rate



Source: Official Airline Guides, edited by SEO

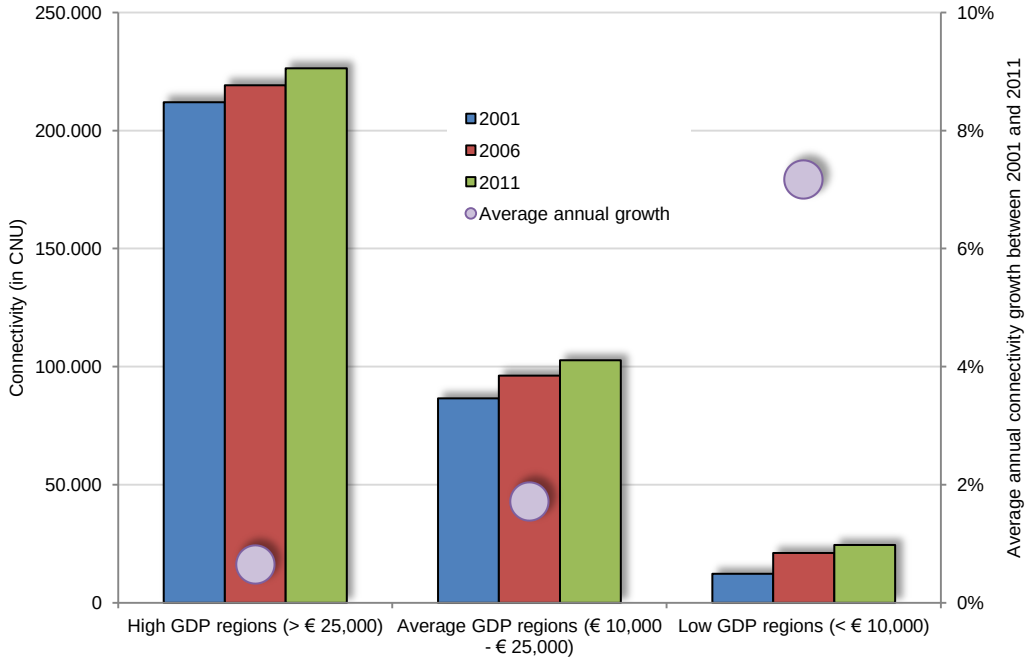
However, the average growth figures between 2001 and 2011 show a contrasting image: relative growth figures are highest for the low density regions (2.5%), while lowest for the centrally

located regions (0.9%). In absolute terms, the connectivity growth of regions with a medium density is highest, however the differences between the region types are small.

GDP differences

It is expected that the number of air trips per head of population, the "propensity-to-fly" is higher in regions with a high GDP, since the residents of such regions can better afford to travel by air. For that reason, the demand for air travel is higher in regions with a relatively high GDP (Dobruszkes et al., 2011). In line with this, one expects that intra-European connectivity in European regions with a high GDP-level is higher than in regions with a relatively low GDP-level. It is, however, the question how the connectivity of the different regions has developed between 2001 and 2011.

Figure 4.6 High GDP regions are significantly better connected to Europe, while the relative growth is highest in regions with a low GDP



Source: Official Airline Guides, edited by SEO

Connectivity from high GDP regions in Europe to other European regions is indeed the majority of the intra-European connectivity, as shown by figure 4.6. In 2011 64% of the total intra-European connectivity originated in a region with a GDP per capita of over € 25,000. In 2001, this share was even 68%.

In contrary, between 2001 and 2011 the average annual connectivity growth was highest in low GDP regions, with connectivity increasing with more than 7% on annual basis. In high GDP regions the annual growth the last decade was below 1%. In absolute terms, the regions with an average GDP show the highest growth figures, however differences between the region types are limited.

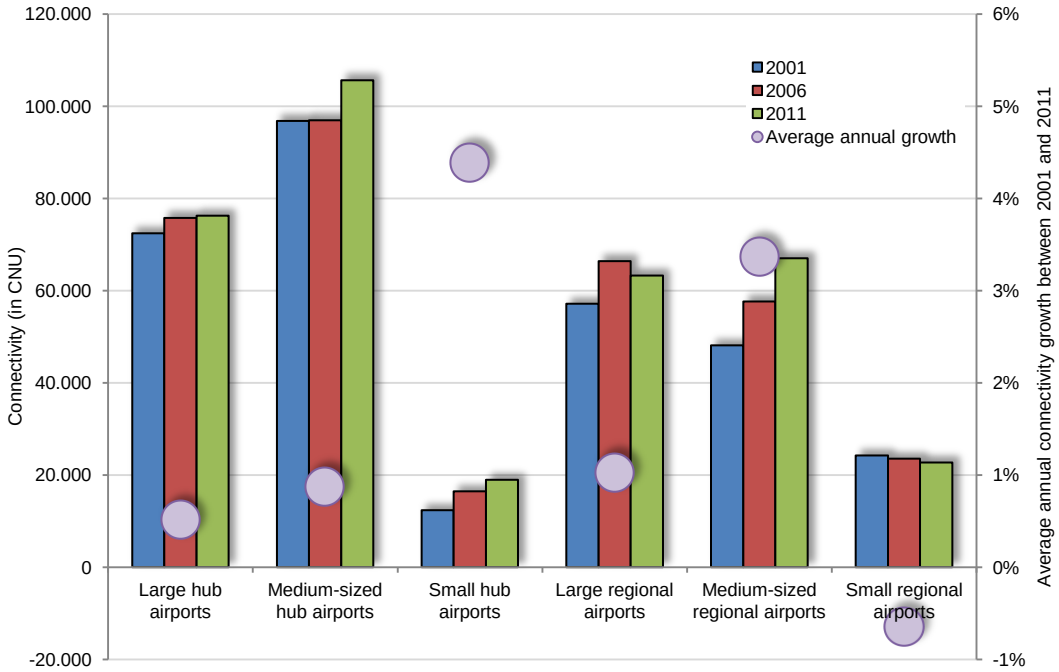
4.3 Connectivity of airport typologies

Airport size

A case study of traffic growth at regional airports in the United Kingdom at the end of twentieth century already shows that in general regional airports have higher relative growth figures than the big hub airports, like London Heathrow (Graham & Guyer, 2000). However, one should bear in mind that development in absolute traffic figures will most likely show substantial different outcomes.

More recently, Fuelhart & O'Connor (2011) state that "*second-ranked cities are attracting increasing airline services, as measured here by the seats available on departing flights. This outcome reflects shifts in global economy which have brought more nations and regions into global trade and production networks*." The results imply that second-ranked (regional) airports have higher growth rates in terms of departing passengers than the established primary airports. Furthermore, Lian & Rønnevik (2010) show that the main regional airports in Norway, like Trondheim, have grown substantially faster in terms of passengers than the more remote regional airports.

Figure 4.7 Small hub airports and medium-sized regional airports show the highest annual connectivity growth figures

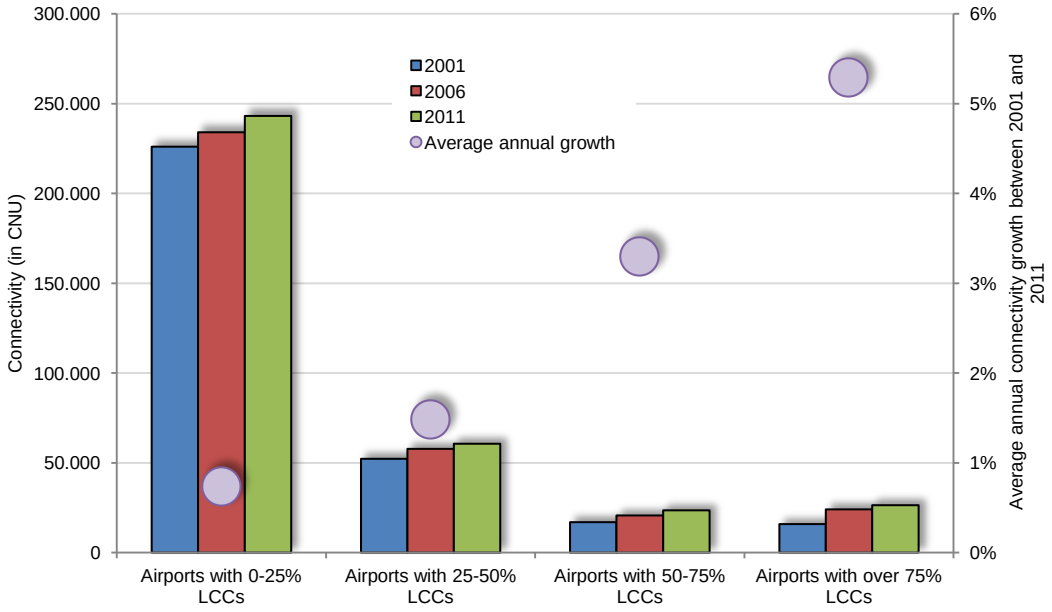


Source: Official Airline Guides, edited by SEO

The results of the connectivity analysis of different airport types show similar results. Figure 4.7 shows that most connectivity is generated at the large and medium-sized hub and regional airports, however growth rates are especially high at small hub airports (4.4%) and medium-sized

regional airports (3.4%). The small hub airports, like Warsaw, Budapest, and Zagreb, are mainly located in the developing economies in the Eastern part of Europe. Important bases for low-cost carriers, like Brussels-Charleroi and Valencia, represent a substantial part of the medium-sized regional airports. In addition, absolute connectivity growth figures between 2001 and 2011 are by far highest at medium-sized regional airports, which is a sign of the considerable increase of activity of LCCs at such airports.

Figure 4.8 Airports with low LCC shares represent the majority of intra-European connectivity, while relative growth rates are highest at pure LCC airports



Source: Official Airline Guides, edited by SEO

Share of LCC's

LCC's play an important role in the economic development of, mainly, peripheral or remote regions (Graham & Shaw, 2008), which are not or just limited served by full-service airlines. In the first years of this century LCCs rapidly expand their networks roughly in the North-western part of Europe, Spain, and Italy (Dobruszkes, 2006). The last years European low-cost networks have also expand to Eastern Europe.

Still, airports with low LCC shares today represent almost 70% of the total intra-European connectivity (see figure 4.8), which has decreased by only 3% since 2001. Pure LCC airports (> 75% of the departing seats on LCCs) account for only 7.5% of total intra-European connectivity.

LCC dominated airports show, however, the highest annual growth rates between 2001 and 2011 (5.3%). In contrary, airports with less than 25% LCC seats grew by less than 1% annually, but have still the largest increase in absolute connectivity between 2001 and 2011.

4.4 Aggregated connectivity figures

While the earlier paragraphs describes the results based on specific regional or airport characteristics, this paragraph provides an aggregated connectivity analysis of all those specific characteristics. The analysis is summarized in table 4.1 on the next page. For this purpose the categorization into LCC-share has been somewhat simplified: airports with a higher than 50% LCC-share are considered as dominated by LCC's, while airports with less than 50% LCC's are considered as full-service carrier dominated. Another simplification is that this particular analysis is made for 2011, although recent growth indicators are included. The upper part of the table provides the connectivity levels as they are observed in 2011. The middle part shows the average annual growth rates of these levels between 2001 and 2011.

The growth rates show that the lowest density regions have increased most in connectivity by air in the last 10 years. This category of regions has seen their connectivity grown by 2.2% annually, while connectivity of the highest density regions grew by a modest 0.8% only. The airports dominated by LCC's have contributed most to the connectivity growth, even for the highest density regions. Nevertheless, despite the growth and the attention they have attracted in the recent decade, their share in total connectivity is still low, 14% in the densest regions and 6% in the lower density regions. These shares are represented in the lower part of the table.

Furthermore, the table shows that most of the connectivity by air is still provided by the 38 hubs in the catchment areas of the regions. In the high density regions hubs provide even 62% of their total connectivity, but even in the lower density regions this share is still over 50%. This is illustrative for the very uneven distribution of airport size. These 38 airports, little over 10% of all airports, provide for all categories of regions more than 50% of connectivity. There is, however, a marked difference between the low density regions and the other (medium and high density) regions. Large hubs have a limited share of connectivity provision for the low density regions (6%). For this category of regions medium-sized hubs provide most connectivity (38%).

A similar picture is seen if one observes the distribution of regions by GDP-class. The lowest GDP-regions have grown most in the last decade, 7.2% annually, compared to a modest 0.7% for the highest GDP-regions. In addition, the LCC-dominated airports have contributed most to the growth. The other similarity is that large hubs have negligible contribution to the connectivity of the low GDP-regions. For this type of regions, the small hub airport category provides most connectivity.

There are also marked differences between the countries. Starting with the LCC-dominated airports, they have a relatively high share (although 22% only) in the UK and Ireland, the two countries where LCC's have started their operation some ten years ago. The contrast is Scandinavia, where LCC-dominated airports (such as Oslo Rygge (RYG), Stockholm Skavsta (NYO) and Stockholm Västerås (VST)) provide only 1% of connectivity. But also in France this share is still low (4%). In most countries, hubs contribute most to connectivity. Marked examples are the hubs in the smaller countries in the Benelux (Amsterdam (AMS) and Brussels (BRU)) and Switzerland/Austria (with Zürich (ZRH), Geneva (GVA) and Vienna (VIE)). In other (and larger) countries, such as United Kingdom, France and Italy, there are non-hub airports contributing significantly to their connectivity.

Table 4.1 Connectivity development by type of airport and type of region

Total Connectivity by category of region and category of airport, 2011

	Total Connectivity		Hubs				FSC dominated				LCC dominated			
			Large	Medium	Small		Large	Medium	Small		Large	Medium	Small
High density (> 300)	168.478	104.057	47.239	53.765	3.053	40.595	25.164	11.185	4.246	23.826	11.211	10.968	1.647
Medium density (100 - 300)	120.683	62.207	24.987	27.331	9.888	45.869	18.004	21.952	5.914	12.607	4.850	6.051	1.706
Low density (< 100)	64.545	34.478	3.984	24.478	6.016	26.150	3.767	14.092	8.292	3.917	271	2.733	913
High GDP (=1)	226.440	138.921	60.425	72.737	5.759	64.611	28.839	26.424	9.347	22.908	9.826	10.287	2.795
Average GDP (=2)	102.686	48.690	15.785	29.422	3.483	37.422	14.495	17.031	5.896	16.573	6.506	8.926	1.142
Low GDP (=3)	24.582	13.131	0	3.416	9.715	10.581	3.600	3.772	3.209	869	0	540	329
United Kingdom/Ireland	82.209	29.006	17.777	11.230	0	35.257	21.350	11.894	2.013	17.946	8.568	8.825	552
Germany	61.406	35.823	22.424	12.781	618	19.045	9.819	6.865	2.361	6.538	3.310	2.539	689
France	22.003	10.107	6.681	922	2.504	11.089	5.236	3.814	2.039	806	0	584	222
Benelux	52.223	44.881	19.349	24.707	824	1.073	0	0	1.073	6.269	852	4.394	1.023
Scandinavia	28.953	20.403	0	20.015	389	8.122	0	5.750	2.373	427	0	310	117
Switzerland/Austria	27.613	22.008	1.684	17.919	2.405	4.431	906	1.756	1.769	1.174	306	0	869
Spain/Portugal	24.002	11.484	4.366	7.118	0	8.571	1.564	5.190	1.818	3.947	2.785	1.082	80
Italy/Malta	20.205	7.339	3.929	2.784	626	10.952	2.973	7.036	943	1.914	511	1.252	150
Eastern Europe	22.943	12.339	0	5.008	7.330	10.024	5.087	2.578	2.359	581	0	209	371
Southeastern Europe	12.150	7.352	0	3.091	4.261	4.049	0	2.345	1.704	749	0	557	192

Total Connectivity by category of region and category of airport (annual growth in % between 2001 and 2011)

	Total Connectivity		Hubs				FSC dominated				LCC dominated			
			Large	Medium	Small		Large	Medium	Small		Large	Medium	Small
High density (> 300)	0,8	0,7	0,2	1,0	5,6	-0,2	0,2	1,1	-4,8	3,5	0,7	8,3	1,2
Medium density (100 - 300)	1,5	1,1	1,1	0,5	3,0	1,4	1,8	1,7	-0,9	5,1	3,0	7,6	3,9
Low density (< 100)	2,2	1,8	0,5	1,1	6,5	2,0	1,7	2,7	1,0	8,3	6,3	10,9	3,4
High GDP (=1)	0,7	0,6	0,6	0,5	1,7	0,0	0,2	0,9	-2,8	3,7	1,1	7,7	2,0
Average GDP (=2)	1,7	1,3	0,3	1,7	2,9	1,1	1,4	2,1	-1,9	5,0	1,8	8,6	2,8
Low GDP (=3)	7,2	6,0		3,0	7,3	8,3	6,0	11,0	8,6	16,2		22,5	10,5
United Kingdom/Ireland	1,2	0,6	-0,7	3,1		0,7	0,2	1,4	0,6	3,5	0,6	6,8	22,5
Germany	0,9	1,4	1,1	2,0	0,5	-0,4	1,4	0,1	-6,4	2,6	-0,2	6,2	8,6
France	-0,8	-0,1	-0,3	-1,0	0,7	-1,7	-1,3	0,5	-5,5	10,7		18,9	1,7
Benelux	0,3	0,0	0,8	-0,6	0,5	-6,0			-6,0	4,7	-0,2	10,5	-3,6
Scandinavia	0,6	0,3		0,2	8,1	1,3		2,9	-1,7	7,6		39,6	-5,0
Switzerland/Austria	0,6	0,9	1,7	0,7	1,8	-1,5	-0,6	-3,2	0,1	5,6	12,4		4,0
Spain/Portugal	3,4	2,6	1,4	3,4		3,6	4,0	3,7	2,9	5,9	5,2	9,2	-0,8
Italy/Malta	1,7	0,8	1,8	-0,9	3,0	1,5	1,3	1,5	1,3	9,0	12,4	9,4	0,4
Eastern Europe	5,6	4,6		3,2	5,6	6,7	6,0	8,8	6,2	12,3		17,9	10,2
Southeastern Europe	6,3	5,2		1,3	9,4	7,9		8,2	7,5	12,4		14,2	8,3

Contribution to Total Connectivity of Regions by Airport Category, 2011

	Total Connectivity		Hubs				FSC dominated				LCC dominated			
			Large	Medium	Small		Large	Medium	Small		Large	Medium	Small
High density (> 300)	100%	62%	28%	32%	2%	24%	15%	7%	3%	14%	7%	7%	1%
Medium density (100 - 300)	100%	52%	21%	23%	8%	38%	15%	18%	5%	10%	4%	5%	1%
Low density (< 100)	100%	53%	6%	38%	9%	41%	6%	22%	13%	6%	0%	4%	1%
High GDP (=1)	100%	61%	27%	32%	3%	29%	13%	12%	4%	10%	4%	5%	1%
Average GDP (=2)	100%	47%	15%	29%	3%	36%	14%	17%	6%	16%	6%	9%	1%
Low GDP (=3)	100%	53%	0%	14%	40%	43%	15%	15%	13%	4%	0%	2%	1%
United Kingdom/Ireland	100%	35%	22%	14%	0%	43%	26%	14%	2%	22%	10%	11%	1%
Germany	100%	58%	37%	21%	1%	31%	16%	11%	4%	11%	5%	4%	1%
France	100%	46%	30%	4%	11%	50%	24%	17%	9%	4%	0%	3%	1%
Benelux	100%	86%	37%	47%	2%	2%	0%	0%	2%	12%	2%	8%	2%
Scandinavia	100%	70%	0%	69%	1%	28%	0%	20%	8%	1%	0%	1%	0%
Switzerland/Austria	100%	80%	6%	65%	9%	16%	3%	6%	6%	4%	1%	0%	3%
Spain/Portugal	100%	48%	18%	30%	0%	36%	7%	22%	8%	16%	12%	5%	0%
Italy/Malta	100%	36%	19%	14%	3%	54%	15%	35%	5%	9%	3%	6%	1%
Eastern Europe	100%	54%	0%	22%	32%	44%	22%	11%	10%	3%	0%	1%	2%
Southeastern Europe	100%	61%	0%	25%	35%	33%	0%	19%	14%	6%	0%	5%	2%

Source: Official Airline Guides, edited by SEO

Finally, there is the category of small regional airports, a specific focus of the study. Although they provide connectivity to all types of regions and in all countries (see upper part of the table), their relative contribution is significant in the lower density, lower GDP-regions, as well as in Eastern and South Eastern countries. The other observation is that for this type of regions the contribution of LCC-dominated airports is small. This indicates that low density and low-GDP

regions are relative strongly depending on small airports without LCC-dominance. This observation is relevant in the context of the possible future developments.

The connections of the non-hubs of the latter category are in some cases spoke connections to hubs which enable onward connections to final destinations all over Europe (such as the KLM-connection from Stavanger to Amsterdam). In other cases they are independent point-to-point connections of full service non-hub carriers.

5 The influence of high-speed train networks

In many parts of Europe high-speed train networks are in effect. Additionally, many high-speed trails will be added in the (near) future. Today, especially in France and Germany, and to a lesser extent in Spain and Italy, high-speed trains run between the large economic centers. In Spain the domestic airline network has suffered most from competition from those high-speed trains. However, also in France and Italy signs of declining domestic connectivity by air between cities with high-speed train connections are visible. In Germany, there is no clear sign of declining connectivity by air as a result of high-speed train connections, other than on the Frankfurt-Cologne route.

5.1 Introduction

High-speed train networks emerge in Europe as an increasingly popular and efficient means of transport. The first high-speed rail connections were established in the 1980s and 1990s, but the last decade the developments have been wide-spread, including cross-border connections. Still, new tracks are constructed and existing tracks are upgraded in order to expand the intra-European high-speed train network. At this moment, mainly Western and South-western European countries have expansive high-speed train networks. It is expected, however, that this will change rapidly in the years to come.

Figure 5.1 High-speed train networks in Europe

The big question is what the impact of the emergence of this intra-European high-speed train network is for the role of (regional) airports in Europe will be. Will it be complementary or will high-speed trains merely be a substitute for existing airline networks? After pointing out the existing literature, this chapter will show the connectivity developments of regions with and without high-speed train networks (> 200 km/h). Additionally, it will zoom in on some domestic markets in France, Germany, Spain, and Italy with high-speed train connections to see how the airline networks on those networks have developed between 2001 and 2011.

5.2 Literature review

Competition between high-speed train networks and airline networks exists. On some particular markets, like Paris-Lyon and Madrid-Sevilla, rail operators have obtained substantial market shares, partly by attracting price sensitive travellers, who previously travelled by air (Steer Davies Gleeve, 2006). Additionally, Graham & Guyer (2000) point out at the replacement of substantial amounts of domestic air travel in Germany and France. In contrary, especially in Germany and the United Kingdom, the expansion of LCC networks have caused high-speed rail operations to be more expensive or at its best equally-priced as competing LCC operations (Steer Davies Gleeve, 2006).

Other sources point at the possibilities for cooperation between high-speed rail and air services (e.g. Givoni & Banister, 2007). Cooperation often means that high-speed train networks act as feeder for the high-distance airline networks, which is only really possible if there is a high-speed train station at an airport. At this moment, only few airports are directly linked with high-speed train networks (e.g. Paris Charles de Gaulle, Frankfurt, and Amsterdam Schiphol). High-speed train's services acting like feeders mean that some existing feeder services by air will be partly replaced, so cooperation can also lead to cannibalization of airline feeder networks. On the other hand, Tapiador et al. (2008) mention that in Spain air traffic to important economic centres from regional airports like Valladolid and Zaragoza has increased as a result of high-speed train connections.

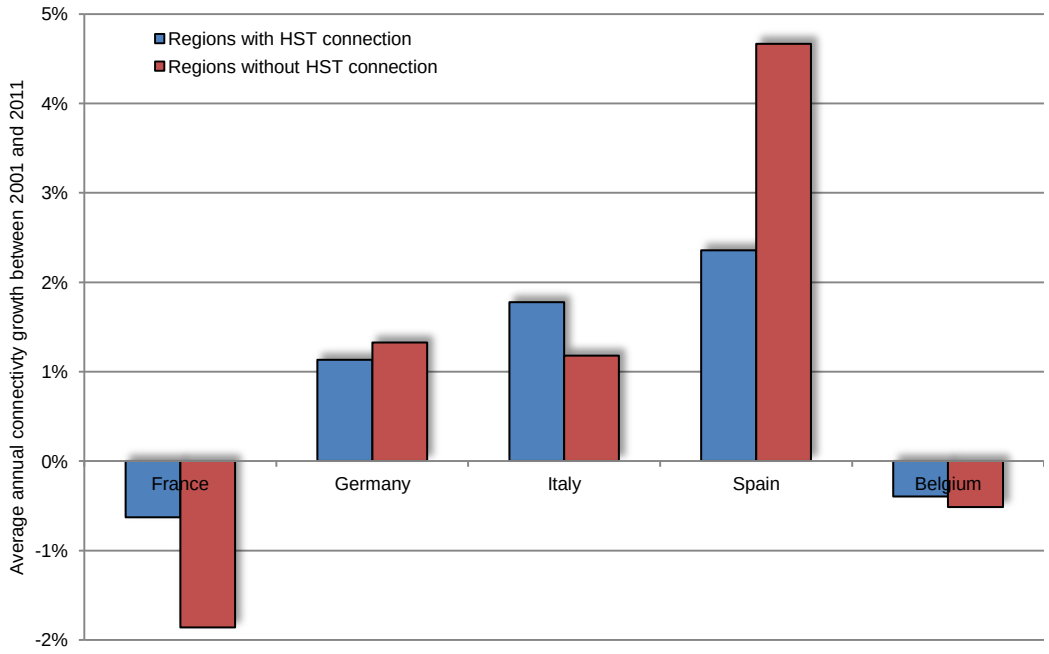
To conclude, high-speed train networks between cities can compete with domestic air operations, but can also increase demand for long haul air services, because of the improvement of the accessibility of airports through high-speed train connections. In reality, mainly primary cities and regions are connected to high-speed train networks. Therefore, the influence of those networks on the role of regional airports in peripheral regions is expected to be rather limited. Additionally, operational complexity, high upfront investment, transaction costs and passenger acceptance seem to limit the scope of the integration of air and rail (Grimme, 2007).

5.3 Development of connectivity by air in regions with a high-speed train connection

In general terms, there is no clear pattern in the difference in air connectivity developments between regions with and regions without a high-speed train connection (see figure 5.2). In Spain regions without high-speed train connection have a higher increase in connectivity by air than regions which are linked to the high-speed train network. France, however, shows an opposing

image, with connectivity decrease being higher in regions without high-speed train connections. Other countries with substantial high-speed train networks, like Germany, Italy, and Belgium, do not show any significant differences between regions with and without a high-speed train connection.

Figure 5.2 No clear differences in connectivity development between regions with and without high-speed train connection



Source: Official Airline Guides, edited by SEO

5.4 Connectivity development on specific domestic city pairs

Table 5.1 shows the connectivity development by air of large domestic markets in France, Germany, Italy, and Spain. Development is measured in annual percentage change. In addition, the table shows whether a particular route is served by high-speed train as well. Analyzing the differences between the different countries shows substantially different images.

The high-speed train network in France is fairly extensive. High-speed trains are operated on many city pairs, however on some parts of the network very high speeds are not allowed. The table shows that on almost every large domestic market, high-speed train operations are offered next to airline operations. Additionally, the table shows that annual connectivity development on some domestic markets is more negative than the average figure presented in figure 5.2, which can stillimply that these domestic airline networks suffer from competition from high-speed trains. This is especially the case for relatively short-distance city pairs, like Lyon-Nice, Paris-Strasbourg, and Paris-Lyon. City pairs with longer travel times, like the Paris routes to many southern cities, have less negative connectivity developments.

German high-speed trains are widespread as well. The largest domestic markets from Frankfurt, Munich and Berlin are also served by high-speed trains. Still, the results do not show clear signs of connectivity loss as a result of that. The only obvious exception here is the ceased low distance air link between Frankfurt and Cologne, which is now solely served by high-speed trains.

Table 5.1 Connectivity development in general more negative on routes with high-speed train competition

France Origin	Destination	Annual CNU development '01-'11	HST
Lyon	Nice	-7,5%	Yes
Paris ORY	Strasbourg	-6,9%	Yes
Paris ORY	Toulon	-6,2%	Yes
Paris ORY	Lyon	-4,9%	Yes
Paris ORY	Perpignan	-4,1%	Yes
Paris ORY	Nice	-3,8%	Yes
Paris ORY	Marseille	-3,8%	Yes
Paris CDG	Strasbourg	-3,7%	Yes
Paris CDG	Nantes	-3,7%	Yes
Lyon	Paris CDG	-3,1%	Yes
Paris ORY	Toulouse	-2,5%	Yes
Paris ORY	Montpellier	-2,1%	Yes
Paris ORY	Brest	-1,5%	Yes
Paris CDG	Marseille	-1,3%	Yes
Paris ORY	Mulhouse	-1,3%	Yes
Paris ORY	Bordeaux	-0,7%	Yes
Paris CDG	Bordeaux	0,0%	Yes
Paris ORY	Biarritz	0,0%	No
Paris CDG	Nice	0,1%	Yes
Paris CDG	Toulouse	1,6%	Yes

Italy Origin	Destination	Annual CNU development '01-'11	HST
Rome FCO	Milan LIN	-4,6%	Yes
Rome FCO	Naples	-3,7%	Yes
Rome FCO	Brindisi	-2,5%	No
Rome FCO	Olbia	-2,4%	No
Rome FCO	Milan MXP	-1,9%	Yes
Rome FCO	Cagliari	-0,1%	No
Rome FCO	Turin	0,3%	Yes
Rome FCO	Venice	0,4%	Yes
Rome FCO	Palermo	0,4%	No
Rome FCO	Bari	1,2%	Yes
Rome FCO	Catania	2,1%	No

Germany Origin	Destination	Annual CNU development '01-'11	HST
Frankfurt	Cologne	CEASED	Yes
Munich	Düsseldorf	-1,2%	Yes
Frankfurt	Düsseldorf	-1,2%	Yes
Berlin TXL	Stuttgart	-1,0%	Yes
Munich	Berlin TXL	-0,9%	Yes
Berlin TXL	Düsseldorf	-0,5%	Yes
Frankfurt	Munich	0,1%	Yes
Munich	Hamburg	0,1%	Yes
Berlin TXL	Cologne	0,7%	Yes
Munich	Cologne	0,8%	Yes
Frankfurt	Berlin TXL	2,5%	Yes
Frankfurt	Hamburg	2,8%	Yes
Munich	Hannover	3,9%	Yes

Spain Origin	Destination	Annual CNU development '01-'11	HST
Madrid	Zaragoza	CEASED	Yes
Madrid	Tenerife Sth	-9,7%	No
Madrid	Malaga	-9,5%	Yes
Madrid	Valencia	-6,7%	Yes
Madrid	Sevilla	-5,7%	Yes
Madrid	Vigo	-2,8%	No
Madrid	Santiago C.	-2,4%	No
Madrid	La Coruna	-1,8%	No
Madrid	Barcelona	-1,7%	Yes
Madrid	Palma M.	-1,5%	No
Madrid	Bilbao	-0,9%	No
Madrid	Oviedo	-0,7%	No
Madrid	Las Palmas	-0,7%	No
Madrid	Pamplona	-0,4%	No
Madrid	Alicante	0,0%	No
Madrid	Santander	3,1%	No
Madrid	Tenerife Nth	4,3%	No
Madrid	Ibiza	5,4%	No

Source: Official Airline Guides, edited by SEO

The high-speed train network in Italy is less complex. The main network (operated by Frecciarossa trains) roughly runs from the Northern city of Turin to the Southern city of Naples, with stops in Milan, Bologna, Florence, and Rome. Secondary high-speed routes (operated with Frecciargento trains) connect Rome with Verona, Bari, Venice and Reggio Calabria. The table shows that high-frequency train routes from Rome, like Milan and Naples have substantially decreased in connectivity by air between 2001 and 2011. The connectivity to Florence and Bologna has decreased as well in the same period (not shown in the table because of limited frequency by air). The high-distance route to Turin has seemingly suffered less, as well as the routes to Bari and Venice, operated by secondary high-speed trains at limited speed. In general, the domestic air routes have performed less than the average shown by figure 5.2. This holds especially for air routes also served by high-speed trains.

Spain also has a clear high-speed train network, with routes from Madrid to Barcelona, Valladolid, Valencia, Malaga, and Sevilla. Other routes, like to La Coruna, Santander, and Alicante, are currently under construction. From the four countries analyzed in this paragraph, Spain has the highest general connectivity growth figures between 2001 and 2011. The results presented by table 5.1, however, show a substantial other image. Especially on domestic routes with competition from high-speed trains connectivity has dropped significantly, with the air link between Madrid and Zaragoza being ceased at all. In contrary, as said, air traffic to economic centres from Zaragoza has increased as a result of its high-speed train link (Tapiador et al., 2008). The relative decrease in connectivity on the Madrid-Barcelona route is rather limited, however the absolute decline in connectivity is still substantial. Routes without competition from high-speed trains show considerable better figures. However, in general domestic routes score worse than the average presented by figure 5.2.

6 Connectivity of specific regions

This chapter presents the connectivity details for five specific regions with different characteristics. The results show varied connectivity situations and developments. However, the results also show similarities and clear patterns. In general, high-speed train connections cause domestic connectivity to decline. Connectivity between Western Europe and Spanish and Eastern European regions increases. On the other hand, intra-Western European connectivity tends to decrease.

6.1 Introduction

Chapter 4 presents aggregated results of different types of regions and airports. This chapter zooms in on five regions with different characteristics. They are located in different geographic regions, have different densities, and different GDPs. Furthermore, there is variation in airport characterics.

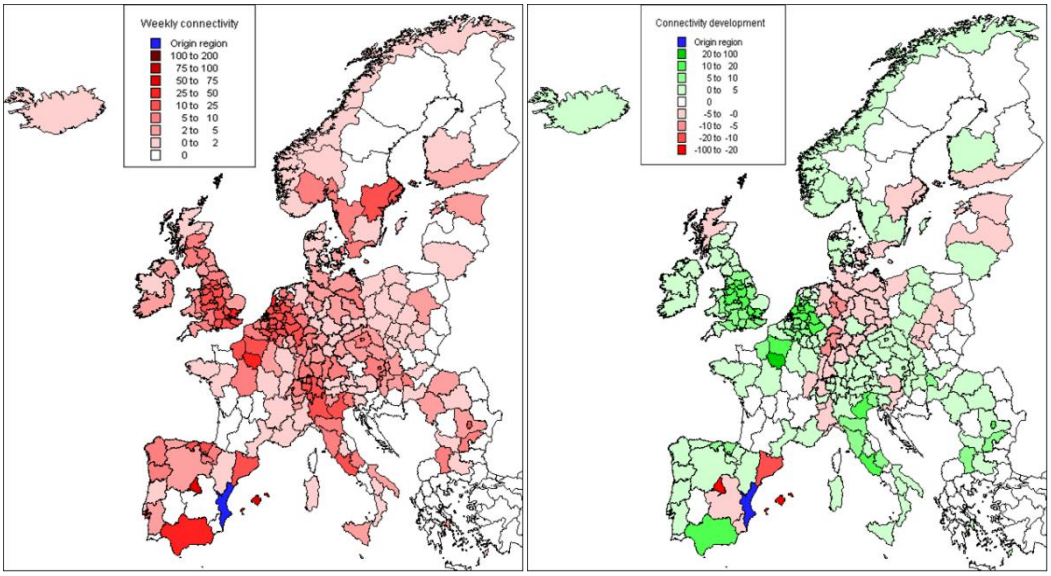
6.2 Valenciana

Region: Valenciana
Country: Spain
Population: 4,701,377
Density (population/sqkm): 200
GDP per capita: 19,600
Type of airports: Mainly medium-sized and large regional airports
Share of LCCs: Mainly airports with 25-75% LCCs
High speed train connection: yes
Total weekly connectivity: 2,342

This Spanish tourist-driven region primarily has connectivity to the Western European countries, like the United Kingdom, Germany, the Netherlands, and France (see figure 6.1). The region depends for quite a large share on LCCs, which operate from the main airports in the area: Valencia and Alicante. A second part of the connectivity lies within its country borders, which focus mainly on the regions of Madrid, Andalucia, Iles Baleares and Catalunya.

The connectivity development between 2001 and 2011 shows an interesting image. Firstly, the connectivity to the tourist-driven markets of Western Europe has increased substantially, sometimes with over 10 weekly connectivity units. On the other hand, the domestic connectivity to, especially, Madrid has decreased significantly. Most likely, this is a result of the high-speed train connection between Valencia and Madrid. The same possibly holds for the decrease in connectivity to Catalunya. Another domestic market with substantial connectivity loss is the one to Iles Baleares.

Figure 6.1 Sharp connectivity drop on some domestic markets, while connectivity growth on markets in Western Europe



Left: connectivity in September 2011; right: connectivity development between 2001 and 2011

6.3 Trøndelag

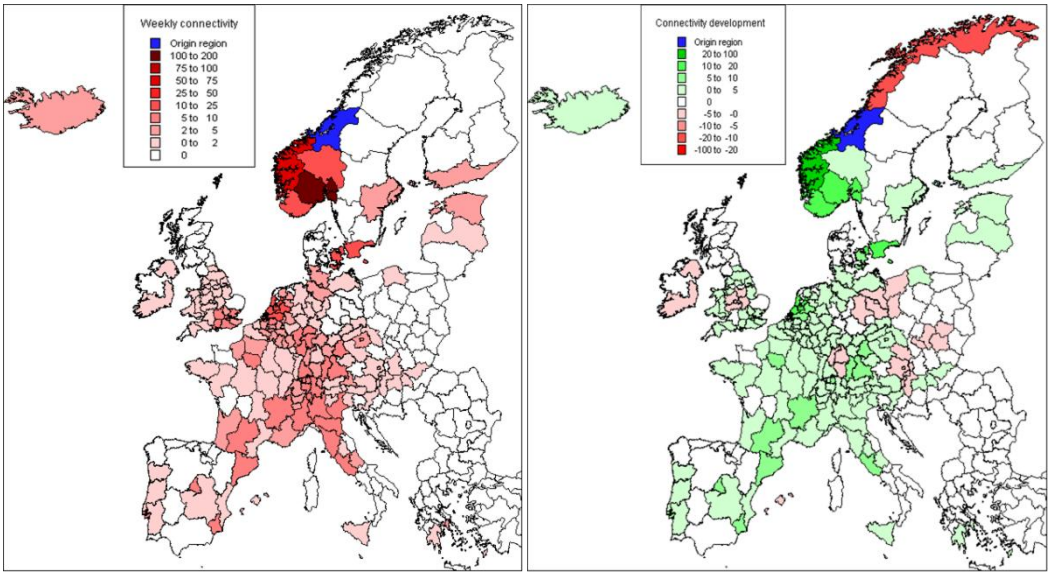
Region: Trøndelag
Country: Norway
Population: 402,539
Density (population/sqkm): 10
GDP per capita: 43,900
Type of airports: Almost all via one medium-sized regional airport
Share of LCCs: Airports with less than 25% LCCs
High speed train connection: no
Total weekly connectivity: 1,875

This secondary Norwegian region depends on Trondheim Airport for all interregional and international air traffic. In addition, some very small regional airports offer short-haul links to neighbouring small regional airports. Figure 6.2 shows that the lion share of the connectivity is to the Oslo og Akershus region. The connectivity to the Vestlandet region with important cities like Bergen and Molde is also substantial. All in all, connectivity is very much focused on domestic routes. Direct air links from Trondheim Airport by network carriers to Amsterdam Schiphol (KLM) and Copenhagen (SAS) create some additional (indirect) connectivity troughout Europe.

Connectivity has increased slightly to most European regions. Clearly, this increase is most prolific to the abovementioned domestic regions. Another remarkable development is the disappearance of connectivity to Nord-Norge. This needs some nuancation. Since only direct air links are taken into account in the analysis, the multi-stop routes of regional airline Widerøe are

not included in the picture. In reality, Widerøe offers some indirect connectivity to the Northern parts of Norway.

Figure 6.2 High dependence on domestic traffic



Left: connectivity in September 2011; right: connectivity development between 2001 and 2011

6.4 Pays de la Loire

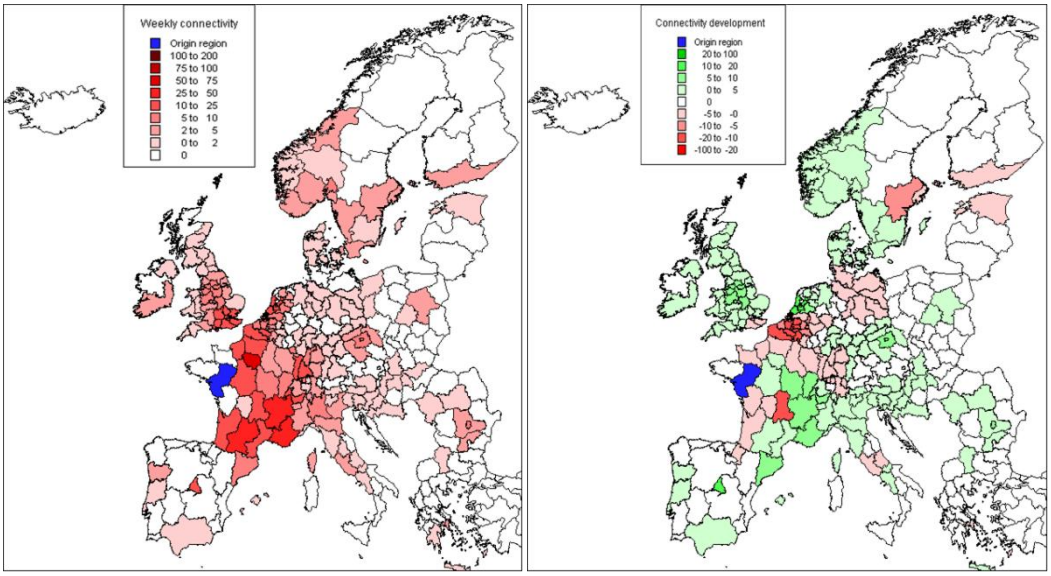
Region: Pays de la Loire
Country: France
Population: 3,385,642
Density (population/sqkm): 106
GDP per capita: 24,600
Type of airports: Small and medium-sized regional airports
Share of LCCs: Mainly airports with less than 25% LCCs
High speed train connection: yes
Total weekly connectivity: 1,286

The Pays de la Loire region is located in the Midwest of France. Its main city is Nantes and the majority of the regions air connectivity runs through the regional airport of Nantes. Figure 6.3 presents the high share of domestic connectivity of Pays de la Loire. Only in the South of the United Kingdom and in the Dutch regions around Schiphol there is substantial connectivity outside France. The connectivity to other regions mostly runs through the hubs of Paris Charles de Gaulle and Amsterdam Schiphol. Additionally some LCCs offer low-frequency services throughout Europe.

The connectivity development shows air connectivity loss to the Rhone-Alpes region of Lyon and the Ile-de-France region around Paris. Most likely, the high-speed train connections from Nantes to these regions play a significant role in this decline. Remarkable connectivity increases are visible in the regions around Amsterdam Schiphol in The Netherlands and in the Madrid

region in Spain, which are caused by the establishing of feeder routes by Air France to Amsterdam Schiphol and by Iberia (Air Nostrum) to Madrid.

Figure 6.3 Mainly domestic connectivity, however sharp declines on some domestic markets



Left: connectivity in September 2011; right: connectivity development between 2001 and 2011

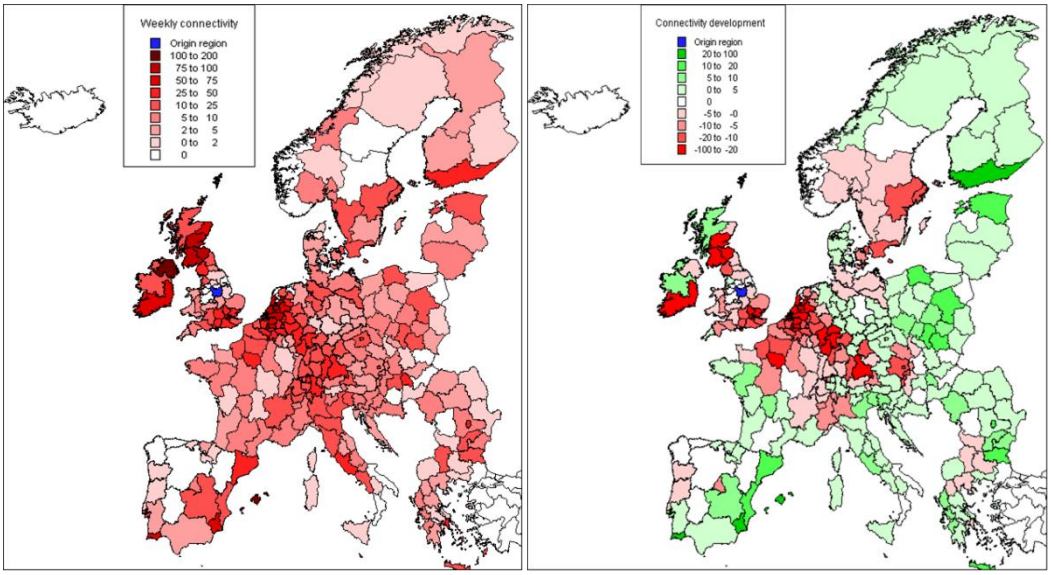
6.5 Derbyshire and Nottinghamshire

Region: Derbyshire and Nottinghamshire
Country: United Kingdom
Population: 2,028,913
Density (population/sqkm): 429
GDP per capita: 26,000
Type of airports: Mainly large regional airports and some medium-sized regional airports
Share of LCCs: Some airports with less than 25% LCCs and some with more than 75% LCCs
High speed train connection: no

Derbyshire and Nottinghamshire is a high density region in the centre of United Kingdom. The region is served by several large regional airports like Birmingham and Manchester and has also access to the rest of Europe through smaller regional airports like East Midlands, Leeds/Bradford, and Liverpool. Figure 6.4 especially shows high connectivity figures to the Northern parts of the United Kingdom and Northern Ireland. Further regions with high connectivity are located in The Netherlands, the Western part of Germany, Switzerland, and the Spanish Mediterranean coast.

The development in connectivity shows a notable pattern. Domestic connectivity as well as connectivity to Western European countries in general has declined sharply. In contrary, connectivity to upcoming Eastern European regions (especially in Poland, Estonia, and Bulgaria) has increased significantly.

Figure 6.4 Widespread network with growth mainly in Eastern Europe and the Spanish Mediterranean coast; sharp connectivity decline to Western European destinations



Left: connectivity in September 2011; right: connectivity development between 2001 and 2011

6.6 Slaskie

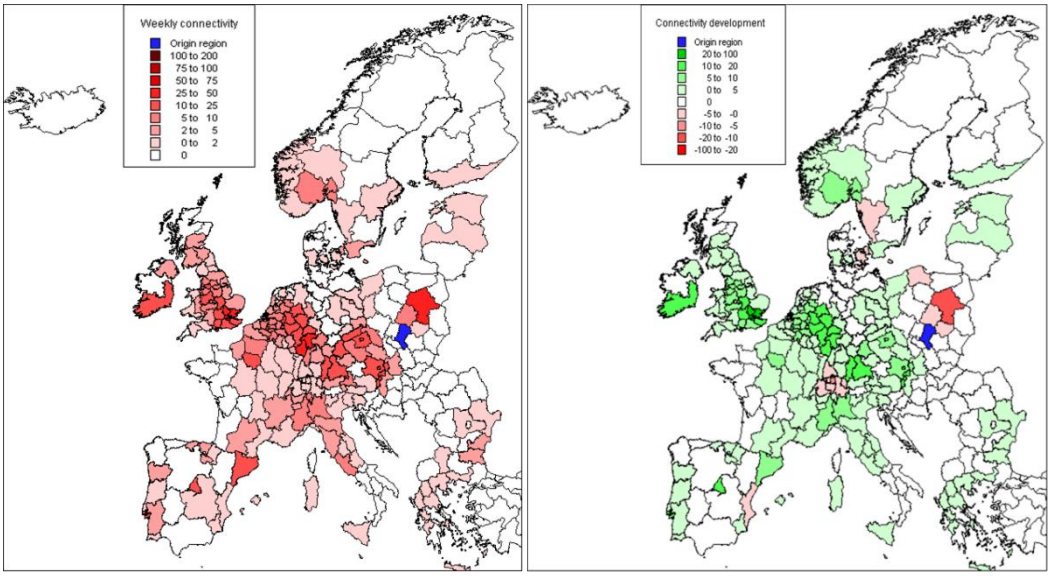
Region: Slaskie
Country: Poland
Population: 4,676,041
Density (population/sqkm): 384
GDP per capita: 6,700
Type of airports: Mainly by medium-sized regional airports
Share of LCCs: Mainly airports with 25-50% LCCs
High speed train connection: no
Total weekly connectivity: 962

Slaskie is the densest region in Poland. Still, total connectivity is quite low comparing to the previous regions. To a large extent this is probably caused by the limited GDP per capita in comparison with Western European regions. After all, a lower GDP results in a lower propensity to fly. Katowice is the most important city in the Slaskie region. A big share of the air connectivity from this region runs through the medium-sized airport of Katowice. Another important airport for the region is the slightly larger Kraków airport, located in the Małopolska region. More than 90% of Slaskie's total connectivity to the rest of Europe originates at one of those two airports. At these airports between 25% and 50% of the traffic is accommodated by LCCs. These LCCs mainly focus on markets in the Western part of Germany and the United Kingdom, to which connectivity from the Slaskie region is largest (see figure 6.5).

Connectivity growth between 2001 and 2011 mainly exists in the areas mentioned above: the Western part of Germany and the United Kingdom. The main explanation for this is the establishing of many Polish cities as popular city trip destinations in the last decade. Another interesting observation is the decline in connectivity to the Mazowiecki region of Warsaw. A

probable reason for this decline is the establishing of a (semi-)high-speed train connection between Warsaw and Katowice.

Figure 6.5 Mainly low-cost connections to Western European markets



Left: connectivity in September 2011; right: connectivity development between 2001 and 2011

7 Recent and future air traffic developments and the impact on European regions

The development of regions and their airports is strongly related. Economic development in regions stimulates aviation demand and hence connectivity. On the other hand connectivity stimulates economic development and therefore significant spin-off effects exist. LCC development in the coming years is most likely to occur in the developing countries, however increasing environmental costs and governemtal taxation can easily cause footloose LCC's to change their networks instantly. Full-service links with major hub airports can increase a region's connectivity substantially. High-speed train networks will increasingly compete with short-haul airline networks, but will potentially function as feeder for existing and new intra-European air links as well.

7.1 Introduction

The previous chapters describe connectivity developments of European airports and European regions and analyzed the competition intensity of high-speed train networks. It shows that "strong regions" (densely populated, high GDP) have – not surprisingly – most of the connectivity by air, but also have the strongest absolute connectivity increase in the last decade. In contrary, the "weaker regions" (scarcely populated, lower GDP) have grown relatively more.

This chapter focuses on the recent and future developments in air traffic and shows the mutual relationship between regional developments and development in air service demand. Spin-off effects exist, as regions have an impact on their airports and airports have an impact on their regions. Therefore it is necessary to describe (1) their mutual relationship and (2) to identify specific recent and future trends in the regional economic siutation as well as future developments in (European) aviation and which impact these developments have on regions and its airports.

7.2 A mutual relationship: market segments and air service demand

In chapter 3 it is illustrated how connectivity by air stimulates regional economic development. The relationship is, however, also reverse: regional economic development also stimulates aviation demand to and from these regions and hence stimulates demand to and from the airports serving these regions. Generally, the impact of economic development on aviation demand is strong. In this context, we may distinguish several market segments: outgoing leisure demand, incoming leisure demand and business demand.

The **outgoing leisure demand** is generated by the local residents, who make non-business leisure trips (such as holidays or visiting friends/relatives (VFR) traffic) by air. The most important driving factor is the spending power of local residents, for which the average GDP-

level is an excellent proxy. After all, a higher GDP leads to a higher propensity to fly and therefore to an increase in air service demand. Moreover, the income elasticity of outgoing leisure demand (the percentage demand increase as a result of a 1% income increase) is higher than 1, which says that outgoing leisure demand is growing faster than the GDP. This is particularly true for the lower GDP-regions, where aviation is still far below its saturation levels. GDP-growth in those regions therefore results in a more than proportional effect on demand for air services from the outgoing leisure segment.

Another relevant market segment is the **incoming leisure demand**. This is not generated by the local residents of the region, but by the attractiveness of the regions for foreign visitors (tourists). This demand can be significant, even for low GDP-regions, particularly for attractive regions in favourable climate zones with beaches or other tourist features (such as specific regions in Spain, France or Italy). Other attractive regions (including the 'new' developed areas in Central Europe) are cities with cultural heritage or other attraction points they may have to offer. While this segment is significant for quite a few low GDP-regions, many high GDP-regions have rather limited attractiveness for tourists visiting by air.

Especially for leisure traffic (both holiday and VFR) price is a driving factor for air service demand. The gradual European liberalization process has had a significant impact here. Not only it opened the way to more competition, it also caused the influx of LCC's with a new business model and hence significant lower air fares. This business concept was partly copied by the incumbent full service carriers and one of the results is that the average air fares within Europe today are significant lower than ten to fifteen years ago. This has resulted in significant market generation in the non-business segment, particularly in the market segments that were not able to afford travel by air before (such as in the low GDP-regions).

The final market segment is the **business demand**. This is not related to the spending power of local residents, nor to tourist attractiveness. It is related to the economic structure of the region, its sectoral composition and international orientation of business. Therefore the most important driver for increase in air service demand from the business segment is international trade, of course closely related to GDP-development.

The conclusion from this is that both regional economic development and connectivity development by air have a mutual spin-off relationship with each other: Economic development, resulting in a higher GDP, stimulates air service demand. While increasing connectivity, resulting from increasing air service demand, makes a region more attractive for (internationally-orientated) businesses, leading to regional economic growth and, in turn, to additional air service demand.

7.3 Possible future trends and opportunities

Several possible future developments will have serious effects on the connectivity of European regions and its airports, with overall economic development in Europe possibly being the most important indicator. In addition, the development of LCC- and full-service carrier networks and

the further emergence of high-speed train networks can have profound influences on the connectivity of regions and its airports.

Economic developments

The recent decade has shown remarkable differences in economic development between regions. In 2004 the EU had the new member states in Eastern Europe, followed by Bulgaria and Romania in 2007. These new member countries have shown significantly higher economic growth rates than the 'old' member states. This has stimulated aviation demand and hence connectivity to these regions, as is illustrated in table 4.1, where connectivity to Eastern European regions increased by 5.6% and South Eastern European regions by even 6.3% annually between 2001 and 2011.

Clearly the extent to which this will continue is uncertain. Today, Europe is in the middle of a crisis, which may have an impact not only on the Eurozone states, but regarding their increased economic dependence, also on the non-Euro member states. But regardless what the outcome of the crisis will be, there are relative more opportunities for relative less developed (measured in GDP-level) regions. In such regions the mutual spin-off effects are higher. Every single percent of economic growth will have there a stronger impact on aviation demand than in the more saturated higher GDP-regions. Hence the opportunities of connectivity growth by air are higher, with a further stimulus again to economic growth. If this is combined with a strong(er) economic growth in these regions, the regions as well as their airports will take maximally advantage of the spin-off effect described. This in fact is a continuation of the trend also seen in the last decade.

Development of LCC networks

Another relevant development is a possible further influx of LCC's. This has been particularly the case in the last decade between 2001 and 2011. This type of carriers seek airports, where they can realize quick turn-around times and which are not or to a limited extent used by other (full-service) carriers. This results in the emergence of LCC-dominated airports, which has clearly benefit all regions, except the lowest density and lowest GDP-regions, where the contribution to their connectivity is still limited. For these regions there may be still an opportunity to attract LCC's to their airports, but on the other hand the question is to what extent this type of regions provide a suitable business case for LCC's, looking to the relative scarcely populated catchment areas and low GDP-levels.

This question can possibly be answered by Ryanair, which has the image of serving very low-density regions, which is illustrated by the fact that it serves places like Lappeenrantaa (LPP) in Eastern Finland, one of the most remote areas of Europe. Such places are often not served by other carriers, as they choose to operate most of their schedule on a daily basis, for which a critical market size is needed. Ryanair, however, has sought the low density end of the market, which they can not serve every day, but where they can attract 100% of the market.

Nevertheless, even though some regions have not been (or will not be) able to attract LCC's, they still may enjoy benefits if such LCC's serve an airport at some distance from a regional centre. In

contrast to full-service carriers, LCC's have significantly larger catchment areas as longer travel times over land are accepted by the passanger in return for lower air fares. Particularly lower density (and lower GDP-) attractive tourist regions may still find opportunities in attracting such LCC's, even beyond the earlier indicated circle of 150 kilometres.

For the concering LCC's it is the question whether LCC's will be able to realize similar market share growth as they have done in the recent decade. In fact, there are factors which prevent further market share gains of LCC's, which indicates that a further influx of LCC's will not continue. One of the factors is that full-service carriers (including hub carriers) have copied elements of the LCC business concept and hence also the full-service carriers are able to charge low fares in most of the markets. Furthermore, environmental costs, such as the introduction of the emission trading scheme (ETS) affect LCC's relatively more, as the related cost increases are a higher proportion of the LCC net air fares.

A specific risk of regional airports and their regions is a too large dependency of LCC's. This type of airlines is extremely footloose, and they "may come today" and "leave tomorrow". Moreover, it is also the queston whether regional airports find attractive business cases by attracting solely LCC's. Because of their footloose character, they have a strong negotiating power to the airports, claiming that they bring passengers and all their expenditures to the regions and the airports. In return for this they are often able to negotiate considerable landing fee discounts.

While LCC's may not find suitable business cases to increasingly serve the smaller airports and regions, one of the reactions of LCC's may be that they will concentrate on the higher density and higher GDP-regions, to seek larger catchment areas and higher income markets. This can affect the low and the medium density and GDP regions if LCC's cut capacity in those regions as a result of this. Of those, the medium density and GDP regions will probably suffer most, as they depend most on LCC's.

The conclusion of this is that low density and low GDP regions have until now insufficiently been able to take full advantage of the LCC's. The LCC growth potential in these regions is probably highest, but because LCC's are footloose and potential profits may be higher in unserved high-end markets, it is uncertain whether LCC's are extensively going to operate routes to those peripheric regions.

Full-service carrier network alterations: rationalization or expansion?

Another development is network rationalization of the full-service carriers. The recent decade has shown a gradual process of consolidation. At the start of the 90's European aviation was characterized by flag carriers who operated networks from their respective hub airports. The aviation networks were subject to strong aeropolitical regulation, and bilateral agreements between European member states determined the capacity, frequency and even air fares of each of the airlines. That system has now come to an end. The aim was more competition and enabling entrance of new carriers. Although this has definitely been the result, the established airlines answered by consolidation into worldwide alliances. To a certain extent this limited competition, but another effect has been a concentration of traffic to fewer alliances. Today,

most of the European full-service carriers have joined one of the three main alliances, SkyTeam, STAR or oneWorld. Few have stayed independent.

It is uncertain whether this will result in a further concentration at fewer hubs. It is plausible to assume that the large hub airports will keep their role, assuming that all three alliances will keep its share in European air traffic. This means that their primary hubs Paris Charles de Gaulle, Frankfurt and London Heathrow keep their role. In addition, it is unknown to which extent the alliances choose for further network rationalization and concentrate their networks at fewer hubs. The trend to hub rationalization may be stronger for long-haul networks than for European networks. As an example, SAS has since it entered the STAR alliance significantly reduced its long-haul network at Copenhagen, but has maintained its European network. Nevertheless, if also European networks will be rationalized, the smaller hub airports have the highest risk to loose connectivity. Relatively, this will have the most severe implications for the lower density and low GDP regions.

In contrary, there are significant opportunities for smaller airports (and the regions they serve) to increase intra-European connectivity by attracting full-service carriers. Having a full-service carrier link to that carrier's hub provides connectivity to destinations beyond that hub. The KLM-connection from Stavanger to Amsterdam is a clear example of this: The Stavanger region gains substantial (intra-European) connectivity through all the indirect connections offered by KLM via its Amsterdam hub. In terms of connectivity, a single connection with a hub airport can be very valuable for a (regional) airport. Neverthless it will probably be more difficult to attract such a spoke connection by a full-service carrier than to attract a new LCC-connection, as the catchment areas around the airport for a full-service carrier normally is smaller than for an LCC.

Other development opportunities for regional airports and their regions are the attraction of a second carrier on a route where one other carrier already has a service. As it operates this route alone, it is expected that high fares are charged and hence the entrance of a new carrier may provide lower fares and significant consumer benefits, together with the economic effects expected.

Development of high-speed train networks

In an earlier paragraph, as well as in the case studies, it was concluded that on city pairs with strong high-speed train network development connectivity by air has decreased in most cases. Most of the high-speed train connections are domestic and are operated in larger and densely populated countries, like France, Germany, Italy and Spain. It is expected that the high-speed train network will be further developed, however mainly in the larger city pair markets, at less than 1,000 kilometers. This may have negative implications (cannibalization for air services) for (ultra) short-haul connectivity by air in the high density regions. But – even though the relationship is competitive and cannibalization occurs – the concerning regions are not affected, as they can take advantage of more competing providers.

On the other hand, it is acknowledged that the relation between train and air services may be highly complementary. Regions may find opportunities to connect by (high-speed) train to a near

airport or hub airport, other than the public transport services in their own metropolitan area. Although it was concluded that today only few airports have (high-speed) train terminals, good train connections to airports may provide similar opportunities as described above in relation to spoke connections by a full-service carrier to its hub. After all, high-speed train links to airports can significantly increase an airport's catchment area. To achieve integration of airline and rail networks, better and more connections between high-speed train networks and airports are crucial.

A relevant observation in this context is that high-speed train services need dense markets to be commercially viable. The high costs of the "line infrastructure" as well as - on average - the large number of seats in one train movement needs large passenger volumes. This is in sharp contrast with air services that can be made viable, even in lower density markets. Aviation is provided by "point infrastructure", which need only investments at the 'points' (in fact the airports). Moreover aircraft movements can be provided with much lower seat capacity. The conclusion from this is that the high-speed train issue is not (and most likely never will be) relevant for less dense and peripheral regions, like Northern Scandinavia and island regions. Relatively, such regions (which in some cases have limited road access) highly depend on air services.

Air fare development

Air fares within Europe have decreased significantly in the recent years. This was not only due to the influx of LCC's, but also full-service carriers have followed by decreasing their fares in most of the markets where they compete with LCC's. It is expected that environmental costs, such as the emission trading scheme to be introduced in January 2012, is affecting the LCC's relatively more, as the related cost increased are a higher proportion of the net air fares. If countries are introducing additional national government taxes on aviation, this will further increase costs of air travel, again to the relative disadvantage of LCC's and the airports where they are dominant.

Slot trading

Lacking airport capacity is one of the future threats to the aviation markets in Europe. Today, many European airports, particularly the larger ones, are slot coordinated. Slots are granted, based on the IATA grandfather system: once an airline has historic slot rights, it will keep them in the period to come, unless it chooses not to use them. This system has its inefficiencies, as it is not necessarily the case that airlines with the highest willingness to pay for the slots obtain these rights, which would be preferred from an economic point of view.

Today, a change in this system is considered towards a more market oriented approach: enabling airlines to trade slots with each other, which is unofficially already the case at London Heathrow. This will be particularly effective at the large and most slot constraint hubs, including London Heathrow and Frankfurt. In that context it is also observed that long-haul slots have a higher value than short-haul slots. If a more market oriented approach would be chosen, it may have the result that short-haul (European) connections will be substituted by long-haul connections, which has significant implications for European connectivity of the larger hubs and consequently for the higher density and higher GDP regions.

Regulatory developments

It is acknowledged that access by air to peripheral regions may not be possible to be provided by commercial feasible operations, as the market size to specific destinations is too low. Nevertheless, access by air may be indispensable, as road and rail access to and from the regions is insufficient. For such cases it is possible for member states to impose public service obligations[4] to a designated airline to serve these regions and its airport(s) at particular conditions, such as with respect to minimum frequency and maximum price. The airline is compensated for its costs by the member state, taking into account the revenues of ticket sales and a reasonable profit. Obviously, this provides an opportunity for the regions concerned, as this provides the necessary access, together with the benefits described. On the other hand, it can be seen as a threat, as quality of access mainly depends on such regulations, which may change over time.

Another possibility from EU-regulation[5] for airports is state aid to airports smaller than 1 million passengers per year. Generally, this number is seen as a 'break-even' point. Airport operations below this number are difficult to operate on a commericially viable basis. State aid may be granted if the airports serve general economic interest and comply with certain conditions. Again, this may be seen as an opportunity, but together as a threat, as the airport operations depend mainly on this regulation and possible unforeseen change over time. Lowering the threshold of 1 million passengers is a particular threat, but even the current level forms a threat for the development of regional airports. This is especially the case for small airports which are particularly depending on low cost carriers, in which cases the 'break-even' point may be substantially higher than 1 million passengers.

7.4 Airport Strategy

From the above, it may be concluded that airports may encounter significant challenges, despite the 'escapes' addressed above regarding public service obligations and state aid. In practice, this is the case for relatively few and small airports in peripheral regions and most of the airports are challenged with the need for commericial viable operations.

In fact the White Paper of the EU states that regions 'should be fully and competitively' integrated in the world economy and a sound and commercial aviation system contributes to this (EU, 2011). Therefore, rather than seeking the compliance with public service operations and/or state aid, airports should seek a sound commercial basis.

There are two financial resources for airports, where they can generate revenues from: the *aviation* and *non-aviation* revenues. The first category includes airport charges, which are directly related to the number of passengers and aircraft movements. The latter category of revenues includes other businesses, such as car parking, shops and restaurants at the airport, as well as real estate development. Most of the latter revenues are also (at least indirectly) related to the traffic volumes, although real estate may in particular cases be developed independent of traffc volumes.

4 EC Regulation 1008/2008, Article 16 (see European Union, 2008).
5 EC Regulation 2005/C 312/01 (see European Union, 2005).

Non-aviation revenues have been an increasing source of revenues, making airports commercially sound, even with relatively low passenger turnover.

Regarding the aviation revenues, airports are challenged with finding new opportunities for airlines serving their airports. Although the business risk of airline operations is obviously with the airlines, airports may more pro-actively target airlines to start new (or extending existing) operations and provide airlines with information on the future market prospects of such services.

In making such *business cases* for airline operations, airports should be aware of their markets: size, composition by segment (business/leisure), competition/complementarity with services at nearby airports et cetera. Another consideration for airports is monitoring their portfolio of services, which is of particular interest for their surrounding regions. Rather than seeking maximum revenues/profits, the regional interest is a diverse network to a wide range of destinations, rather than high frequent services to few destinations. A competitive environment (more airlines serving the same destination) adds further to the business climate.

7.5 Concluding remarks

Regarding the opportunities and threats for the distinct types of region, there are especially economic opportunities for the lower GDP regions. The economic growth potential and, with that, the spin-off mechanism between economic development and air service increase is strongest in those regions.

In addition, LCC development is under pressure. Firstly, by taking over parts of the LCC business concept by full-service carriers and the inherent overall fare decrease. Secondly, by the possible increase of external costs (environmental as well as taxation costs). Both trends are to the disadvantage of LCC's and the airports where they dominate. If, as a response, LCC's decide to focus on the unserved high-end markets, low and medium density and GDP regions can be severely affected if LCC's cut capacity in those regions as a result of this. Of those, the medium density and GDP regions will probably suffer most, as they depend most on LCC's.

Hub rationalization of full service carriers may reduce the number of European hubs. Long-haul connections are at higher risk than short-haul connections, but if this trend is continues, possible overlaps in the European networks may also be rationalized. This is particularly affecting the lower GDP regions, as their connectivity is mainly depending on the smaller hubs. On the other hand, establishing direct connections with large hub airports can substantially increase a regional airport's intra-European connectivity.

High-speed train networks can have negative impact on (ultra) short-haul airline networks, but can also function as a feeder network for existing and new (intra-European) airline operations.

Finally, a more market oriented approach to face lacking airport capacity, such as the introduction of slot trading, will probably affect European connectivity of the larger hubs.

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