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Study on the economic developments of the EU Air Transport Market

FINAL REPORT

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Study on the economic developments of the EU Air Transport Market

Final Report

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Disclaimer

The information and views set out in this study are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein. The information and views of this study do not reflect the impact of COVID-19 on the structure and operation of the aviation market. The longer-term impact of COVID-19 on the aviation market is still unknown and any forecasts or anticipated trends presented in this report are therefore uncertain and need to be treated with caution.

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GLOSSARY OF TERMS

African Caribbean Pacific countries (ACP)

A group of countries in Africa, the Caribbean, and the Pacific that was created by the Georgetown Agreement in 1975. In December 2019, the ACP's Council of Ministers endorsed a revision of the Georgetown Agreement that will transform the current ACP Group of States into the Organisation of African, Caribbean Pacific States (OACPS). The group's main objectives are sustainable development and poverty reduction within its member states, as well as their greater integration into the world's economy. All of the member states, except Cuba, are signatories to the Cotonou Agreement with the European Union.

Alliance

An **airline alliance** is an agreement of cooperation between groups of airlines, essentially. Airline alliances offer airline members more flexibility and larger networks, while giving travellers such conveniences as the ability to earn frequent flier miles on a partner program of the airline flown.

Application programming interface (API)

An application programming interface (API) is a computing interface exposed by a particular software program, library, operating system or internet service, to allow third parties to use the functionality of that software application. Basically, an API specifies how software components should interact.

Application programming interface matrix (API)

The Distance Matrix API is a service that provides travel distance and time for a matrix of origins and destinations, based on the recommended route between start and end points.

Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

COSIA is an emission mitigation approach for the global airline industry, developed by the International Civil Aviation Organization (ICAO) and adopted in October 2016. Measures include primarily offsets and "alternative" fuels. CORSIA addresses only emissions from international air travel that exceed the baseline of 2020 levels.

Catchment area

An airport's catchment area is the geographic area from which your airport can reasonably expect to draw commercial air service passengers. It is defined by several factors, including geographical and access considerations and proximity of alternative aviation facilities. In this study, an airport is considered to compete with another airport if it is located within 2 hours driving time.

Central and Eastern Europe (CEE)

CEE countries are EU member states which were part of the former Eastern bloc. The following countries are included: Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia, Slovakia.

Closed-circuit television (CCTV)

A television system in which video signals are transmitted from one or more cameras by cable to a set of monitors, used especially for security purposes.

Common use passenger processing systems (CUPPS)

CUPPS is the range of services, specifications, and standards enacted to enable multiple airlines, service providers, or other users to share physical check-in or gate podium positions (simultaneously or consecutively). By using the CUPPS standard, airports have a detailed technical specification that supports current hardware and software, providing a framework for data privacy, consumer privacy, and standards-based statutory and regulatory compliance.

Common use self-service (CUSS)

Common-use self-service or CUSS is a shared kiosk offering airport check-in to passengers without the need for ground staff. The CUSS can be used by several participating airlines in a single terminal.

Common use terminal equipment (CUTE)

CUTE stands for Common Use Terminal Equipment and applies to the sharing of traditional check-in desks and the software platform to generate the bag tags. They enable airport operators to take space that has previously been exclusive to a single airline and make it available for use by multiple airlines and their passengers.

Computerised reservation systems (CRS)

Computerised reservation systems, or central reservation systems (CRS), are computerized systems used to store and retrieve information and conduct transactions related to air travel, hotels, car rental, or other activities. Originally designed and operated by airlines, CRSs were later extended for use by travel agencies. global distribution systems (GDS) to book and sell tickets for multiple airlines. Most airlines have outsourced their CRSs to GDS companies, which also enable consumer access through Internet gateways.

Data Lake

A data lake is a system or repository of data stored in its natural/raw format, usually object blobs or files. A data lake is usually a single store of all enterprise data including raw copies of source system data and transformed data used for tasks such as reporting, visualisation, advanced analytics and machine learning. A data lake can include structured data from relational databases (rows and columns), semi-structured data (CSV, logs, XML, JSON), unstructured data (emails, documents, PDFs) and binary data (images, audio, video). A data lake can be established "on premises" (within an organisation's data centres) or "in the cloud" (using cloud services from vendors such as Amazon, Google and Microsoft).

Earnings before interest and taxes (EBIT)

Earnings before interest and taxes is an indicator of a company's profitability. One can calculate it as revenue minus expenses, excluding tax and interest. EBIT is also referred to as operating earnings, operating profit, and profit before interest and taxes.

Earnings before interest, taxes, depreciation and amortisation (EBITDA)

A measure of a company's operating performance and is used as an alternative to simple earnings or net income. Essentially, it's a way to evaluate a company's performance without having to factor in financing decisions, accounting decisions or tax environments. EBITDA is calculated by adding back the non-cash expenses of depreciation and amortization to a firm's operating income.

Economies of scale

Economies of Scale refer to the cost advantage experienced by a firm when it increases its level of output. The advantage arises due to the inverse relationship between per-unit fixed cost and the quantity produced. The greater the quantity of output produced, the lower the per-unit fixed cost. Economies of scale also result in a fall in average variable costs (average non-fixed costs) with an increase in output. This is brought about by operational efficiencies and synergies as a result of an increase in the scale of production.

EU+ countries

Consists of the 27 EU Member States together with the United Kingdom, Iceland, Norway and Switzerland.

European emission trading system (EU ETS)

The EU emissions trading system is a cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively. The EU ETS works on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances, which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value. After each year a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances.

Extensible Markup Language (XML)

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. The design goals of XML emphasize simplicity, generality, and usability across the Internet. It is a textual data format with strong support via Unicode for different human languages.

Full service network carrier (FSNC)

A “legacy” or “full service network carrier” is an airline that focuses on providing a wide range of pre-flight and on-board services, including different service classes, and connecting flights. Since most FSNCs operate a hub-and-spoke model, this group of airlines are usually also referred to as hub-and-spoke airlines. In most European countries, the (former) national carrier operates as an FSNC. Examples are Air France/KLM, Lufthansa, British Airways, Iberia, Austrian Airlines, LOT or the multi-national airline Scandinavian (SAS).

Global distribution systems (GDS)

A global distribution system (GDS) is a computerised network system owned or operated by a company that enables transactions between travel industry service providers, mainly airlines, hotels, car rental companies, and travel agencies. The GDS mainly uses real-time inventory (for e.g. number of hotel rooms available, number of flight seats available, or number of cars available) to service providers. Travel agencies traditionally relied on GDS for services, products and rates in order to provide travel-related services to the end consumers. Thus, a GDS can link services, rates and bookings consolidating products and services across all three travel sectors: i.e., airline reservations, hotel reservations, car rentals.

Greenhouse gas (GHG)

Any gas that has the property of absorbing infrared radiation, emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases.

Herfindahl–Hirschman Index (HHI)

A common measure of market concentration and is used to determine market competitiveness. The HHI is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.

High-speed rail (HSR)

The International Union of railways (UIC) gives the following definition of high-speed rail (HSR): "*HSR is still a grounded, guided and low grip transport system: it could be considered to be a railway subsystem. The most important change comes from the speed. As travel times had to be reduced for commercial purposes, speed emerged as the main factor. HSR means a jump in commercial speed and this is why UIC considers a commercial speed of 250 km/h to be the principal criterion for the definition of HSR.*

However, a secondary criterion is admitted on average distances without air competition, where it may not be relevant to run at 250 km/h, since a lower speed of 230 or 220 km/h or at least above 200 km/h (since under this speed conventional trains can do) is enough to catch as many market shares as a collective mode of transport can do. This also applies in very long tunnels whose construction cost depends on the diameter linked to the square of the speed, at least. For such speeds above 200 km/h, the infrastructure can be categorized in 'High-Speed' if the system in operations, complies with:

- *track equipment,*
- *rolling stock (generalisation of trainsets),*
- *signalling systems (abandonment of trackside signals),*
- *operations (long-range control centres),*
- *the geographical or temporal separation of freight and passenger traffics,*
- *and more globaly with the standards for High-Speed."*

Hub

Airline hubs or hub airports are used by one or more airlines to concentrate passenger traffic and flight operations at a given airport. They serve as transfer (or stop-over) points to get passengers to their final destination. A hub is often referred to as a connecting platform.

Information technology solutions (ITS)

Are different types or applications of information technology that support processes in organisations. In terms of supply chain, information technology solutions are aimed to support customer and supplier relations, as well as internal processes in single organizations involved in the supply chain.

Intermodality

Intermodality is defined as combining different modes of transport in a seamless travel experience.

Lean business model

A lean business model is a business strategy that strives to eliminate waste in products and processes while satisfying what the customer wants. By satisfying what the customer wants, the business will receive more positive returns like increased sales and goodwill. A traditional lean business model includes lean business practices like continuous improvement, total quality management, and just-in-time inventory systems. All three of these practices help companies to cut wasteful spending and increase quality and productivity.

Low-cost carrier (LCC)

A low-cost carrier or low-cost airline, occasionally referred to as *no-frills*, *budget* or *discount carrier*, is an airline that is operated with an especially high emphasis on minimizing operating costs and without some of the traditional services and amenities provided in the fare, resulting in lower fares and fewer comfort on board.

Market-based measures (MBM)

Market-based measures are instruments designed to address the climate impact of aviation, beyond what operational and technological measures or sustainable aviation fuels can achieve.

Metropolitan area

A major city together with its suburbs and nearby cities, towns, and environs over which the major city exercises a commanding economic and social influence.

New distribution capability (NDC)

NDC is a travel industry-supported program **(NDC Program)** launched by IATA for the development and market adoption of a new, XML-based data transmission standard **(NDC Standard).** The NDC Standard enhances the capability of communications between airlines and travel agents and is open to any third party, intermediary, IT provider or non-IATA member, to implement and use. Furthermore enables NDC the travel industry to transform the way air products are retailed to corporations, leisure and business travellers, by addressing the industry's current distribution limitations.

Passenger name record (PNR)

A passenger name record is a collection of data pertaining to an individual traveller or a group of individuals travelling together. **Furthermore, PNR can be seen as information** provided by **passengers** and collected by airlines, in the normal course of their business, for enabling reservations and carrying out the check-in process. It may contain information, such as dates of travel, travel itinerary, ticket information, contact details, travel agent, means of payment, seat number and baggage information.

Public service obligation (PSO)

A public service obligation means an obligation imposed on an organisation by legislation or contract to provide a service of general interest within the European Union territories. In order to maintain appropriate scheduled air services on routes which are vital for the economic development of the region they serve, Member States may impose public service obligations on these routes. Therefore, they must respect the conditions and the requirements set out in Articles 16-18 of the Air Services Regulation 1008/2008. In case no air carrier is interested in operating the route on which the obligations have been imposed, the Member State concerned may restrict the access to the route to a single air carrier and compensate its operational losses resulting from the PSO. The selection of the operator must be made by public tender at Community level.

Regional greenhouse gas initiative (RGGI)

The Regional Greenhouse Gas Initiative is the first mandatory market-based program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector.

Renewable identification number (RIN)

A Renewable Identification Number is a serial number assigned to a batch of biofuel for the purpose of tracking its production, use, and trading as required by the United States Environmental Protection Agency's Renewable Fuel Standard (RFS) implemented according to the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007.

Request for proposal (RFP)

A request for proposal is a business document that announces and provides details about a project, as well as solicits bids from contractors who will help complete the project. Most organizations prefer using RFPs, and, in many cases, governments only use requests for proposal. A request for proposal for a specific program may require the company to review the bids to examine their feasibility, the health of the bidding company, and the bidder's ability to do what is proposed.

Secondary airport

A secondary airport is an under-utilised airport that complements a primary airport or airport system in a metropolitan region.

Single-token biometric systems

The single token concept means that a passenger's identity is verified and authenticated by matching their passport and their biometrics only once throughout a travel journey. This can for example be done via a trusted and secure app on their smart phone or at an airport kiosk. A single token is then established within a secure platform and the passenger's identity can be verified in the following steps at the airport via biometrics.

Standard operating procedure (SOP)

A standard operating procedure is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine operations. SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations.

Standards and recommended practices (SARPs)

SARPs are technical specifications adopted by the Council of ICAO in accordance with Article 37 of the Convention on International Civil Aviation in order to achieve "the highest practicable degree of uniformity in regulations, standards, procedures and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation".

Subsidiary

A subsidiary is a company that belongs to another company, which is usually referred to as the parent company or the holding company. In the European Air Transport Industry is Brussels Airlines for example a subsidiary of the Lufthansa Group.

Sustainable alternative fuels (SAF)

SAF is a clean substitute for fossil jet fuels. Rather than being refined from petroleum, SAF is produced from sustainable feedstock such as waste oils from biological origin, agri residues or non-fossil CO_2.

Ultra low-cost carrier (ULCC)

An ultra-low cost carrier, also known as ultra-low cost airline or abbreviated to ULCC, is an airline that operates with a low cost business model. Although both cheap, ULCC are not to be confused with a low cost carrier (LCC) as they operate a different business model, with unbundled fares and the result being cheaper prices of flights for customers. For example, on an ULCC, you will get a seat on a plane from one destination to another, but any extras such as baggage, selecting your seat or food are subject to an additional fee. These ultra-low cost carriers typically have fewer amenities than simple low cost carriers, and therefore have a greater range of add-ons for a fee.

UN sustainable development goals (SDG)

The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future. They address the global challenges faced, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. The 17 Goals are all interconnected, and it is important to achieve them all by 2030.

Wet lease

A wet lease is a leasing arrangement whereby one airline (the lessor) provides an aircraft, complete crew, maintenance, and insurance (ACMI) to another airline or other type of business acting as a broker of air travel (the lessee), which pays by hours operated. The lessee provides fuel and covers airport fees, and any other duties, taxes, etc. The flight uses the flight number of the lessee. A wet lease generally lasts 1–24 months. A wet lease is typically used during peak traffic seasons or annual heavy maintenance checks, or to initiate new routes. A wet-leased aircraft may be used to fly services into countries where the lessee is banned from operating. Examples are Iran Air of the Islam Republic of Iran or Saurya Airlines of the Republic of Nepal.

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EXECUTIVE SUMMARY

Introduction

The European Commission launched a **study to examine the economic developments of the EU Aviation Market** and, consequently, to serve as a supporting document for the development of the new Aviation Policy pursued in the European Union.

Its main goal is to **examine the main developments in the EU aviation sector during the period 2016-2019, including the identification of important events and trends having an influence on aviation**, so as to provide the European Commission with an explanatory view on the ongoing evolution of the EU Aviation Market. The key points examined in the course of this investigation are as follows:

- The evolution of the European air transport market between 2016 and 2019;
- Assessment of the impact of the Aviation Strategy launched by the Commission in December 2015 on the market;
- Identification of market trends up to 2025;
- Highlighting the factors that could have an impact on this trend.

Throughout the research, it was important to link past developments to the Aviation Strategy launched in December 2015 by the European Commission in relation with the four priority areas:

- To place the EU as leading player in international aviation, on the basis of a level playing field;
- Facilitate growth in the aviation sector and the wider economy;
- Secure high EU standards;
- Support innovation, the spread of digital technologies and investment in the aviation sector.

Egis and SEO have adopted an approach in which close collaboration, clear communication and the combination of both quantitative and qualitative analysis result in obtaining the outcomes that will be described in the following sections. Each section addresses a specific part of the study and assesses the impact of the subject on the aviation sector. The following three volumes form the common thread throughout the research:

- General overview of the European Air Transport Market (2016-2019);
- Key trends;
- Strategic overview.

The examination of past developments in the aviation sector will allow the Commission to further refine its Aviation Policy for the coming years and bring it as closely as possible into line with the needs of European air transport market. Furthermore, the strategic analysis reveals factors which could have an impact on European aviation in the coming years, enabling the European Commission to anticipate and further minimise the impact of these events.

The COVID-19 outbreak came at the final stages of this study and therefore it was not possible to fully include additional analysis covering COVID-19 developments to the work-plan.

Obviously COVID-19 is having a major impact on transport and connectivity in the EU. Measures to contain the outbreak have resulted in a dramatic reduction in transport activity, especially in passenger transport. Air traffic received a major hit since the start of the pandemic and there are still a lot of uncertainty on the extent of effects of COVID to the whole air transport sector.

A. General overview of the European air transport market (2016-2019)

A.1. Viable economic landscape of European Aviation

Between 2016 and 2019, the number of air passenger movements at EU+ airports increased by 17 percent from 1.6 billion to 1.9 billion. The EU has a mature air transport market, with 17 percent growth between 2016 and 2019 compared to 13-33 percent growth in other world regions. A slowdown in traffic growth is observed for the Middle East and Asia-Pacific, although growth rates strongly vary over different countries in these regions.

Air passenger demand has increased in all EU+ countries, varying between 2 percent (Sweden) and 47 percent (Estonia). **Countries in Central and Eastern Europe experience relatively strong passenger growth. In Scandinavia passenger growth is slowing down, due to a combination of environmental concerns, aviation taxes and airline bankruptcies.**

The majority of passenger traffic travels within the EU+, comprising 52 percent of the total. Domestic traffic accounts for 19 percent, while 29 percent of the passengers travels outside the EU+. Over the last four years, the share of extra-EU+ traffic increased, as extra-EU+ passenger traffic increased by 28 percent, faster than intra-EU+ (14 percent) and domestic traffic (12 percent).

LCCs were responsible for 72 percent of the EU+ passenger traffic growth. In many Central and Eastern European countries LCCs are responsible for the majority of air passenger traffic, in the absence of large national airlines. **The largest LCCs – Ryanair, easyJet and Wizz Air – form the top three airlines in terms of absolute passenger growth between 2016 and 2019.**

Cargo volumes at EU+ airports increased by 6 percent between 2016 and 2019. Global growth in air cargo is slower than global passenger growth. Between 2018 and 2019 air cargo growth has stalled, fuelled by international trade tensions and slower economic growth. Developments in cargo traffic show strong variation across countries, varying between 40 percent growth (Portugal) and a 31 percent decrease (Sweden). EU+ cargo transport is concentrated at a limited number of airports. As airport catchment areas for air cargo tend to stretch over large parts of Europe, air cargo demand can easily shift from one country to another.

In general large EU+ airports have similar profitability figures as large non-EU+ airports, with an operating profit margin (ebitda) of 46.6 percent versus 47.6 percent at non-EU+ airports. The profitability development of the selection of non-EU+ airports is slightly better. Smaller airports tend to be less profitable.

Large EU+ airlines are performing better than smaller ones in terms of profitability. Compared to other regions, large EU+ airlines show a similar financial performance. Profitability remains high for most EU+ LCCs, despite a drop in recent years.

A.2. Rising connectivity levels

At the EU+ level, direct connectivity increased by 12 percent between 2016 and 2019. Central and Eastern European countries have shown the strongest direct connectivity growth between 2016 and 2019, largely driven by LCCs. Environmental concerns, airline bankruptcies and aviation taxes inhibited connectivity growth in some countries, including Norway, Sweden and Belgium.

Extra-EU+ connectivity increased the sharpest, by 22 percent. This is mainly caused by strong connectivity growth to Africa (36 percent), and to extra-EU Europe (27 percent). Intra-EU+ direct connectivity increased by 14 percent, while domestic connectivity showed a limited growth of 5 percent over the last four years.

Indirect connectivity from the EU+ airports increased by 17 percent between 2016 and 2019. Again, Central and Eastern European countries experienced strongest indirect connectivity growth, through improved connections via both EU and non-EU hub airports. Large EU hub airports play an important role as gateway to other world regions.

The relative growth of indirect extra-EU+ connectivity (17 percent) is slightly higher than that of direct intra-EU+ connectivity (16 percent). The majority of indirect connectivity (75 percent) is to destinations outside the EU+, as indirect travel options are more attractive for long-haul flights.

In 2017 and 2018 European airlines opened substantially more new routes than they closed. LCCs were responsible for the majority of route openings. In 2019, on the other hand, the number of route closures outnumbered the number of route openings, indicating market saturation. The majority of new route openings are intra-EU+ routes (68 percent). Domestic route openings account for 11 percent of the total, and the remaining 21 percent are route openings to non-EU+ destinations. The same holds for route closures, where intra-EU+ comprise 69 percent of the total closures, domestic route closures 14 percent and extra-EU+ routes 17 percent.

A.3. Airline bankruptcies reduce competition on air routes

The level of airline competition in the EU+ slightly decreased over the last four years. This decrease is mainly attributable to airline bankruptcies, reducing competition in some countries. The strongest reduction in competition is observed in Germany, mainly a result of the bankruptcy of Air Berlin. Similarly, competition reduced in Iceland and Switzerland due to the bankruptcies of the Icelandic LCC WOW Air in 2019, and the defaults of Darwin Airline and SkyWork Airlines in Switzerland. The bankruptcies mainly led to a reduction of competition on domestic and intra-EU+ routes. On extra-EU+ routes, the competition level remained relatively stable between 2016 and 2019.

Airline competition remains strongest on routes to non-EU+ destinations. Although less airlines compete directly on intercontinental routes, the vast availability of indirect connections to non-EU+ destinations intercontinental passenger markets are less concentrated than intra-EU+ and domestic markets.

A.4. Stabilisation of the competitive airport market

Airport competition strongly varies across EU+ countries. Especially in Central and Eastern European countries airport competition is relatively limited, as there is generally one airport serving the majority of traffic. In some countries the lack of airport competition is mainly related to their geography: airports located at islands or isolated by mountain ranges. For the other countries, the low level of airport competition may be caused by a relatively small market size, for which the co-existence of multiple airports is unviable. In more densely populated regions in Western Europe, airports face more competition from other airports, either in the same country of across the border.

Between 2016 and 2019 the level of airport competition remained relatively stable. Competition between airports is stronger for intra-EU+ and domestic traffic than for traffic outside the EU+. Intercontinental traffic is more concentrated at larger European airports.

B. Trends & Developments

B.1. Environmental policies

Pre-COVID-19 predictions were that CO_2 emissions from EU aviation would increase by at least 21% over the next two decades. At the same time, EU citizens, in particular younger generations, are becoming increasingly sensitive to the climate impact of aviation. **An adverse shift in public attitude towards air travel could eventually put into question aviation's "social license".**

In addition to sustainable aviation fuels (SAF), ATM modernisation and more fuel-efficient aircraft, market-based measures (MBMs) can make a significant contribution to help decarbonise EU aviation in line with the 2050 climate objectives, whilst maintaining its competitiveness.

Amongst the various types of MBMs, emissions trading schemes are generally considered more cost-effective than taxes, especially where revenues can be used to support the deployment of other climate measures. Whilst the use of emissions trading is growing in other parts of the world (including China, Japan, Mexico, Thailand and the US) the EU ETS is currently the only scheme to include aviation activities.

With respect to carbon reduction and offsetting, EU Member States have been early supporters and adopters of CORSIA rules, together with G7 countries, whereas several other major economies (including Brazil, China, India) have so far declined. Voluntary offsetting of flight emissions is also emerging as a trend amongst airlines.

Introduction of an aviation fuel tax for intra-EU flights is possible only when agreed amongst EU member states on a bilateral basis, or as part of a comprehensive transport agreement negotiated between the EU and a third country. While fuel taxes for domestic aviation do exist in some non-EU countries (including India, Japan, Mexico, Thailand and the U.S.), the applicable rates are relatively modest.

While operational and modal changes can make essential contributions towards reducing aviation's climate impact, an accelerated introduction of innovative new aircraft designs combined with a sharp rise in SAF use would appear to be indispensable for achieving mid- and long-term aviation climate goals. The adoption of more ambitious and wide-spread policy incentives can be expected to stimulate SAF uptake across Europe.

B.2. Aviation Agreements bolster standards and market opportunities

This section highlights the importance of comprehensive aviation agreements between European market players and their international partners since aviation is seen as a strong driver of economic growth.

Hence, it is important to invest in the development of European air traffic in growing markets and to gain market access to emerging regions. The establishment and enforcement of comprehensive agreements is essential to curb restrictions on growth and access in order to achieve sustainable growth of European air traffic while ensuring a level playing field.

In addition to the European Common Aviation Area (ECAA), the emergence of comprehensive agreements signed with neighbouring countries ensures further growth of European air traffic and a wider economy. The countries with whom the agreements have been concluded are:

- Morocco (2006)
- Jordan (2010)
- Georgia (2010)
- Moldova (2012)
- Israel (2013)

During the past four years, air traffic between Europe and the following three countries experienced the biggest growth:

- Israel (average growth of 12% per year)
- Jordan (from 5% in 2017 to 27% in 2018)
- Ukraine (average annual growth of 30%)

These cases show that **comprehensive agreements are not the sole cause of growth in air traffic**, prosperous socio-economic conditions contribute equally to the establishment of a diversified and free market development. Nevertheless, the adoption of comprehensive agreements is also a key driver for the further development and expansion of LCC's network.

It can be concluded that the combination of comprehensive agreements and market liberalisation ensures that air traffic can continue to grow and therefore boost the European economy. Furthermore, it also leads to a more intense level of competition, lower costs, increased demand and overall traffic growth. In addition, it brings advantages not only to the various market players, but also to consumers, who benefit from better connectivity, market access and lower air fares. Nevertheless, further liberalisation of the aviation market is necessary, e.g. only 45% of European related air traffic was covered by comprehensive agreements in 2017. Moreover, negotiations of the agreements have been difficult over the last five years and the most growing markets are still regulated. Concluding agreements with third parties is an efficient way to achieve economic growth and can contribute in making European aviation as a leading player in the aviation industry.

B.3. Shift in European airport trends

This section analyses the past evolution and trends of the different types of airports in Europe. The strong growth of low-cost carriers (LCC) in recent years has been at the basis of the development of secondary airports. This success was mainly due to LCC offering low air fares, which gave many consumers access to air travel. As a result, if fares remain low, the priority of optimal airport access becomes lower, causing secondary peripheral airports to gain traffic. The following European airports benefited most from the development of low-cost airlines such as WizzAir and Ryanair and consequently experienced a significant growth in traffic:

- Allgäu Airport Memmingen
- Brussels South Charleroi Airport
- Milan Bergamo Airport

On the other hand, some secondary airports have experienced a huge drop in air traffic, partly due to the shift of low-cost airlines to primary airports:

- Barcelona-Girona Airport (-63% between 2008 and 2018)
- Frankfurt-Hahn Airport (-47% between 2008 and 2018)
- Glasgow-Prestwick Airport (-71% between 2008 and 2018)

From these facts it can be concluded that the **evolution of traffic distribution within the same airport system is also largely dependent on the development policy pursued by the operators**. What is beyond question is that low-cost carriers have fostered regional metropolitan airports in terms of air traffic and have significantly expanded the catchment areas around these airports.

The expansion of LCC did not only bring advantages for regional airports but also increased the competitive level between airlines. This resulted in the convergence of business models in which full service network carriers (FSNC) streamlined their models and offered low airfares. Furthermore, hub airports started to adapt their cost structure and operations, for example by developing low-cost dedicated passenger terminals, in order to attract low-cost airlines. Therefore, some European airports have lost their main low-cost carriers, as well as their main source of revenues, as these have shifted from regional airports to the larger hub airports. However, there are still major differences between the two business models, inter alia in terms of frequency and capacity.

Whereas regional airports have the means to support new routes and therefore obtain induced economic effects, such as a boost to local tourism, smaller airports (less than 1 million passengers per year) do not have the volume of demand to attract low-cost carriers and therefore lose traffic. Furthermore, the fierce

competition threatens the survival of certain regional airports in Europe, especially in small and medium-sized cities.

From a consumer perspective, the development of low-cost airlines implied the further growth of regional airports and the emergence of low air fares. Nevertheless, this evolution is not favourable for all classes of the population since certain categories (such as students or the elderly) do not have the possibility to travel autonomously.

B.4. Evolving airline strategies

As the European aviation market is highly competitive, particularly in comparison with, for example, North America and China, the European aviation landscape is in a constant state of flux, not only in terms of business models but also in terms of the strategies adopted by the carriers.

In recent years, the aviation market has been consolidated and several mergers with takeovers or bankruptcies have taken place. In 2018, for example, two-thirds of European airlines' passenger traffic was handled by only five operators. Furthermore, some bankruptcies and the increasing share of LCC contributed to a further consolidation of the European aviation market. For example, by 2016, the 25 largest airlines represented slightly more than 65% of the direct connections offered from EU airports. The share then rose to 73.5% in 2019.

The second apparent trend is that low-cost carriers are moving away from the classic LCC business model and consolidating their activities by launching new routes from the primary hubs. In this way they offer additional services such as flex fares and priority lanes. On the other hand, the FSNC converge to the LCC business model, offering no-frills fares and services. Furthermore, FSNC launched (or bought) low-cost subsidiaries to compete with the low-cost airlines in the short-haul segment. Therefore, it can be said that **two variants of the LCC business model emerged over the past period: the LCC model, which is gradually converging with the FSNC, and the ultra-low cost carrier (ULCC), which maintains the initial low cost business model.**

The third identified trend in airline strategies is related to the transfer market. As some routes of the European transport network operate with 90% transfer passengers, airlines are aware of the potential to increase their total number of passengers. Despite the fact that the transfer passenger system is complex and costly, **more and more LCCs, such as Ryanair and easyJet, are entering the transfer market**. This is often done on the basis of an extensive codeshare agreement between the low-cost airline and a third airline company. The implementation of the hubbing strategy and partnering with other airlines will continue in the future as low-cost carriers are aware that the application of an evolving strategy will help them to capture a larger market share and an expanded network. At the EU+ level, the market share of LCCs increased by +5 percentage points between 2016 and 2019.

The concept of long-haul low-cost carriers is still not fully implemented in the European aviation sector. **Nevertheless, a few airlines, such as Frenchbee, Eurowings, Level and Norwegian, have continued to develop in recent years.** The latter achieved a market share of just over six percent in the summer of 2019, compared to one and a half percent in 2015. In spite of the growth experienced, Norwegian will abolish its long-haul flights from Copenhagen and Stockholm airport from March 2020, which will result in a further decline of its market share in the North Atlantic market.

The development of long-haul low-cost carriers in Europe has been rather slow, in part due to the fact that the cost advantage for long-haul flights is lower because of the cost of fuel. Furthermore, hand luggage only fares and high-density seats, offered by FSNC, provide additional grounds to ignore the LHLCC market. However, the development of narrow-body long-haul aircraft may offer new opportunities for low-cost airlines in the future. Such development would also be beneficial for the economy and further growth of the European aviation market.

B.5. Connectivity of remote and peripheral regions

During the last five-year period, the ratio between creation/bankruptcies turnover of regional airlines is higher than for other types of airlines. This resulted in a trend whereby independent regional airlines withdrew from commercial flights and started to operate only on a wet-lease basis. In addition, the number of regional operators able to serve thin routes fell sharply. The public service obligation (PSO) scheme supports development of thin and regional routes. *"PSO was initiated by the European Commission to secure efficient competition among operators and an acceptable service supply to air travellers in the regions to the cheapest possible cost*". In other words, it is a mechanism designed to subsidise the unprofitable thin routes that are essential for the further development of the local economy and the creation of optimal connectivity between European regions. In 2017, a total of 179 routes in 13 different Member States (Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Greece, Ireland, Italy, Portugal, Spain, Sweden and United Kingdom) were covered by the PSO scheme. Furthermore, three different types of routes can be covered by the PSO scheme:

- Routes to an airport serving a peripheral region;
- Routes to an airport serving a development region;
- Thin routes to any airport (< 100,000 passengers per year).

In addition to the PSO scheme, local governments and airports created virtual airlines (i.e. it only holds the commercial part of the company and of which the operations are chartered through a real airline via a wet-lease contract), to ensure connectivity of the region. Other trends that have occurred with regard to regional airlines are:

- Regional subsidiaries of FSNC streamline operations since they are used as hub feeders and work almost exclusively for their parent company, therefore, they are exposed to market fluctuations;
- The business model of some European regional airlines evolves towards the white flag model which is a non-exclusive subcontracting model allowing regional operators to limit risks.

As regards connectivity between the European mainland and remote and peripheral regions, the following subdivision can be made:

- **Outermost regions (ORs) of the European Union:**
  - France: French Guiana, Guadeloupe, Martinique, Mayotte, Reunion and Saint-Martin
  - Portugal: the Azores and Madeira
  - Spain: the Canary Islands

Good connectivity between these regions and the European mainland. Average to highly competitive landscape in which airlines have to operate. The arrival of LCC resulted in a reduction of airfares for these destinations. Nevertheless, economic agreements with neighbouring countries are still limited and bilateral agreements between states offer little opportunity to increase the volume of traffic.

- **Major European island states and regions of the European Union:**
  - Cyprus
  - France: Corsica
  - Greece: Crete
  - Italy: Sardinia and Sicily
  - Malta
  - Spain: Balearic Islands

The main problem in terms of connectivity between these areas and mainland Europe lies in the seasonality of traffic. In the absence of a PSO scheme, some islands are difficult to access during the winter season. The

development of low-cost carriers has improved connectivity but needs more stimulation to further reduce the fluctuation of connectivity throughout the year.

- **Balkans, Central & Eastern Europe Member States:** Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, Slovakia, Slovenia and Poland.

Prior to these countries' entry to EU, the market was regulated; ten years after the liberalisation of the aviation market in question, traffic has increased sharply, with strong connectivity from capitals and large regional cities. Development opportunities for LCC have emerged. New European competitors entered the market and challenged incumbent players.

- **Bordering Countries:**
  - Balkans: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia,
  - Northern Africa: Algeria, Egypt, Morocco, Libya and Tunisia
  - Eastern Mediterranean Countries: Jordan, Israel, Lebanon, Syria, Turkey
  - Former USSR Republics located near EU: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine

Comprehensive air transport agreements between EU and many neighbourhood countries listed above were created in order to develop new economic opportunities and to promote fair competition and the implementation of common high safety, security, environmental and other standards. The establishment and development of low-cost carriers based in these countries could lead to increased traffic and more optimal connectivity.

B.6. About multimodality and intermodality

The following definitions provide a good understanding of the main concepts:

- **Multimodality:** The possibility to cover the substitution of one mode of transport to another;
- **Modal competition:** Describes the level of competition between air transport and other means of transportation. To what extent do other modes of transport pose a threat to air traffic?;
- **Intermodality:** Describes the modal complementarity between air transport and other means of transportation. A smooth transition from one mode of transport to another is essential.

Over the past five years, multimodality has become increasingly important in Europe. Even more so, 2018 was declared "the European Year of Multimodality". The importance of the concept arose from the European Commission's commitment to reduce CO2 emissions and air pollution, thereby improving the sustainability of the transport system and, consequently, the quality of life of European citizens.

Long-distance buses and high-speed trains are considered to be the main substitutes for air transport. For example, in 2018 Eurostar registered a new record year with passenger numbers increasing by 7% and business travellers by 12%. Europe has developed an extensive rail network over the years, some of which include high-speed trains (>250km/h). Particularly for distances of less than 1,000 km, HSR poses a threat to air transport, as a direct connection is provided between city centres, lighter security and luggage regulations are applied and the extra travel time is cancelled out by the waiting time one would otherwise spend at the airport before starting the flight.

In recent years, HSR's share has continued to increase: 65% of the market between Madrid and Barcelona moved to HSR, a HSR market share of 75% between Milan and Rome was obtained and further development of the HSR network between large city pairs in Western Europe was achieved. The increase in the popularity of the train among European travellers is partly due to the effect of Flygskam and the increasing awareness of global warming. Consequently, more and more airlines are considering reducing or replacing air frequencies between the shortest city pairs by rail frequencies. (e.g. Brussels-Paris and Brussels-Amsterdam) Nevertheless, air travel remains a strong competitor for longer distances, and the development of the HSR network in some countries, such as France, is slowing down. This especially since a well-thought-out HSR network requires large investments and the internal rate of return of these projects is decreasing.

Other means of transport considered as substitutes for air traffic are private car, carpooling and long-distance buses. The latter has in recent years increasingly profiled itself as a cheap alternative to air travel. Moreover, the bus is especially attractive for passengers who are highly price-sensitive. The presence of long-distance bus services from airports makes it possible for them to reach final destinations that are two hours or more away from the airport by road. To a lesser extent, the bus is regarded as a direct competitor to long-distance air travel. More and more partnerships are being formed between airlines and train companies in order to effectively use high-speed rail as a feeder to long-haul flights:

- **Germany:** Rail & Fly;
- **Switzerland:** AirTrain;
- **France:** TGV Air;
- **Belgium:** Partnership between KLM, Air France and Thalys;
- **Spain:** Train & Fly.

The following elements limit further development of multimodality and intermodality in Europe:

- Ticket distribution where passengers must book a separate ticket for each mode of transport → offer end-to-end bookings;
- The development of fare comparison platforms allowing customers to book one operator for the inbound leg and another for the outbound leg;
- Lack of physical intermodality at airports.

The opening up of the rail transport market and better integration of distribution can stimulate the emergence of multimodal mobility operators.

B.7. Impact of digitalisation

Information technology and automation have long been a part of the aviation industry, helping to facilitate operational and commercial processes. The internet has led to unprecedented transparency and comparability of offers and changed customer behaviour. The use of mobile devices allows customers to be continuously connected and able to engage with airlines and other travel stakeholders prior and throughout their journey. Airlines and airports alike have started to re-think their customer relations and the service they provide in order to increase customer ownership and maximize revenue opportunities.

Between 2016 and 2019, airlines and airports worldwide have increased their IT spend by 60%, up to 5-6% of their annual revenues, with many European players being at the forefront. Their ultimate goal is to enhance the travel experience for passengers and generating new revenue opportunities while reducing the operational costs in all aspects of the value chain. As such, digitalisation and automation is considered a means to increase the capacity and resilience of airport systems, making it a key driver of future airport economics.

Main developments in recent years include the widespread use of self-services and web-check-in, with 90% of airlines offering web-check-in in 2018; 74% offering to print bag tags at the airport, more than half of airlines providing unsupported bag-drop facilities and 23% using self-boarding facilities. RFID technology has become widely available, whereby, 59% of baggage can be traced in real time.

Airlines consider digitalisation as a driving force for customer satisfaction, with 60% of airlines in 2018 confirming an improvement in passenger satisfaction rates of up to 20% as a result of the use of digital technology and automation of year on year. A more recent innovation at is the use of biometric systems, where passengers are identified by facial recognition at different points throughout their journey. As of 2019, 7% of airlines worldwide have deployed self-boarding gates using only biometric data and a further 33% is planning to implement them by the end of 2022. Moreover, artificial intelligence remains one of the main forms of digitalisation in which airlines invest: 44% of airlines have a major program (up from 32%) and a further 45% are running a pilot.

As regards digitalisation at European airports, investment in the integration of the IT infrastructure of airports has increased by 70% between 2016 and 2019. These investments are reflected in security

processes, self-service devices and the deployment of Common Use Technology. The latter ensures a more direct engagement with passengers and a better operational efficiency. A second trend that has manifested itself in recent years is the use of business intelligence programs. **The vast majority of airports worldwide have business intelligence programs in use or are planning to implement them within the next two years.** Furthermore, approximately 85% of airport operators invest in biometric identification management, 77% in interactive navigation systems and 29% in artificial intelligence.

Through the use of new technologies in the airports, more optimal use can be made of space, which not only benefits the passengers, in terms of customer satisfaction, but also the airport itself. In addition, digitalisation ensures an improved flow of passengers through the airport, which is necessary in view of the predicted growth. However, the downside of the increased digitalisation lies in the fact that airports will have to allocate larger budgets to ensure cyber security, as the risk of cyber-attacks will increase and the safeguarding of sensitive information and passenger safety must be guaranteed at all times.

Digitalisation and automation has a huge impact on consumers, aviation employees and citizens.

- Digitalisation allows consumers to compare all transport-related information such as fares and schedules, creating transparency and increasing the level of competition between airlines. Automation reduces operational costs for airports and airlines. In general, digital implementation has a positive effect on passenger experience and satisfaction, partly due to reduced processing times at the airport.
- The impact of digitalisation and automation on employment is twofold: automation of airport processes leads to a reduction of personnel on the one hand, but creates new job positions that need to be filled on the other. The use of business intelligence and mobile technology results in the creation of opportunities for new services and more customer-oriented employment.
- Information technology allows a reduction of operational costs, especially in the airport sector. Innovative projects such as the use of biometrics make smaller airports more financially stable. Digitalisation in the aviation sector results in cyber security becoming the main area of investment in the future. Risk mitigation is essential both at government and airport level.

B.8. Developments up to 2025

B.8.1. Pre-COVID forecasts

Important: All of these traffic forecasts were published before the COVID pandemic occurred.

This report draws on a several traffic forecasts produced by international and industry organisations.

Each of these forecasts takes into consideration a combination of geopolitical, societal and macro-economic factors that influence industry-specific developments such as demand, operating costs, supply, fares, competition and business strategies.

Considering the analysis presented in this report, the following developments should be highlighted as they may impact the development of air traffic in the next five years:

- **European economies are mature and GDP growth in its biggest economies is naturally low.** Risks to the long-term growth prospects exist in terms of demography, competitiveness and political and fiscal stability. As a result of an economic slowdown, air traffic could develop slower than forecasted by ICAO or aircraft manufacturers, more akin to the Eurocontrol low-case scenario.
- **Commercial aviation in Europe is mature.** The market penetration and additional demand created by low-cost carriers on intra-European routes is likely to have reached its peak, with low-cost carriers now moving to primary airports and withdrawing from non-profitable markets. Full-service carriers (network airlines and flag carriers) have responded and adjusted their business models in order to remain competitive. Therefore, low-cost travel is unlikely to create significant new demand and air traffic.
- **The level of technology deployment and automation among airlines and airports in Europe is relatively high and unlikely to alter traffic dynamics significantly.**

- **Market consolidation can lead to reduced connectivity and less competition on specific routes or in individual countries.** This could locally slow down or even reverse traffic growth.
- **Strong growth rates into Asia, Africa and South America reflect economic growth in emerging countries**, with traffic in some cases being channelled through hubs in the Middle East. The single biggest intercontinental traffic flow is from Europe to North America. Changing dynamics and risks in international trade translate into changes in these air traffic flows.
- **Recently, environmental considerations have created a negative connotation associated with flying. This contrasts with a more positive view in the past, which was driven by consumer experience and lifestyle, especially for private travel.** There is limited evidence so far that change in perception would have led to a significant decline in demand for air travel across Europe; however, the industry seems to take the potential risk serious and is taking marketing action and identifying options to address environmental concerns in the longer term.
- **In the context of an increasing environmental awareness in society, governments are pledging to accelerate the development of rail transport and potentially being less likely to engage in large airport development projects.** This may lead to a decline in domestic and short-haul travel in the longer term, i.e. post-2025. The trend may be reinforced by an increase in airport taxes or the introduction of carbon taxes, e.g. the CORSIA scheme.
- **Changes in the use of digital and communication technologies can affect the demand for travel in the future**, both by replacing the need for physical travel (negative impact on traffic) or by fostering international trade and social relations (positive impact on traffic).

B.8.2. The impact of the COVID pandemic: first estimates

At the beginning of 2020, the emergence of a new strain of coronavirus, SARS-CoV-2, has led to the COVID-19 pandemic and affected countries around the world severely. The resulting travel restrictions and macro-economic shock is causing an unprecedented decline in air travel and affected the entire aviation industry.

- IATA estimates released at the beginning of May 2020, suggest that **global air travel in 2020 is likely to decline by almost half, causing a revenue shortfall of over USD 300 Million to airlines**. Assuming that domestic lock-downs in most European countries last about three months and international travel restrictions remain in place for a longer period during the summer, the output of European air traffic would be reduced by 55% in RPK, corresponding to a revenue loss of USD 89 Million.
- The IATA estimates for Europe are aligned with analysis released by ICAO at the end of April which quantify the **impact in terms of international RPK in Europe with –40 to 74 per cent**, for different scenarios. Airports in Europe would therefore be impacted by a decline in passenger numbers of almost -900 Million (-35 per cent), representing a revenue loss to airports of USD 24.6 Billion in 2020.
- On 24 April 2020, Eurocontrol published a model of how flight volumes would be affected by the epidemic, depending on the re-opening scenario of international travel. The analysis suggests that following **a decline of air traffic by -89 per cent of flight movements at the peak of the outbreak**, recovery could be sped up the introduction of coordinated reopening measures between governments.

The consequences of COVID-19 will become clearer over the course of 2020 and will ultimately depend on the length of travel restrictions, the depth of the recession caused and the time for recovery of the national economies of Europe and worldwide. By May 2020, many airlines have engaged in talks with shareholders, governments and creditors about additional cash injections in the face of a near-total loss of income. Many thousand professionals at airlines, airports and in the wider aviation industry have lost their employment as a result of the immediate financial duress on the industry and in anticipation of the recession to come. In this context, the expectation among industry observers is that many airlines will face bankruptcy in the foreseeable future.

As of May 2020, airlines, airports, industry bodies and governments are only starting to draw out the roadmap towards normalisation. This may include guidelines to ensure "social distancing" on board aircraft and at airports, loss of demand, a changed competitive landscape and lower fuel prices. Fares, demand and supply may change significantly in the future from what has been known over the recent past. As a result, the world of aviation could change significantly and the traffic forecasts developed before the year 2020 may be of little meaning.

C. Strategic overview

C.1. PESTEL Model

The PESTEL model was used to analyse the external factors affecting the European aviation market. By identifying the political, economic, social, technological, environmental and legal factors that have an impact on the structure of the European aviation industry, it is possible to analyse and minimise their effect on overall performance.

Political factors is the overarching term for influences such as political instability in a country, the role of the government or taxes and fiscal policy. The most important trends that were distinguished are the following:

- The importance of traffic rights to increase market liberalisation and the level of competition;
- Discrepancies of environmental regulation creating an asymmetry of standards with competing airlines and airports located in less environmentally constraining States;
- Resurgence of protectionism as a potential destabilising factor for the economy;
- Increasing mobilisation of local communities in airport extension projects;
- Importance of State aids for regional airports.

As regards the **economic factors**, firms have to investigate how the current economy influences their activities. Factors arising are economic cycles, inflation rate, variation in demand and exchange rates. The following trends could be distinguished:

- Potential slowdown of the Chinese economy and its direct and indirect effects on the European air transport market;
- Volatility of oil prices and its impact on airlines;
- Drastic impact of the sanitary crisis (COVID-19) on airlines;
- The consequence of the COMAC C919 breaking through the oligopolistic market of Airbus and Boeing;
- The impact of US import taxes on cargo traffic.

Social factors include cultural aspects and health consciousness, population growth rate, age distribution, career attitudes and emphasis on safety. High trends in social factors affect the demand for a company's products and how that company operates. The most important evolutions are as follows:

- The strong development of middle-class in the world and its direct impact on tourism;
- Growing awareness of climate impact of aviation;
- New consumption behaviour of the millennial generation;
- Change in travel and tourism habits (off-peak travel, shorter duration of stays, etc.);
- Evolving mentality of companies with respect to the climate;
- Retirees' ability to travel;
- Emergency of new labour contracts and profound changes in employment schemes.

Technological factors take into account research and development expenses by the government, property rights, policies, technology incentives and the rate of technological change. The most important trends that were distinguished are the following:

- The development of end-to-end multimodal distribution solutions;
- Importance of continuous innovative investments with regards to automation and digitalisation;
- Technical innovation in aircraft manufacturing (electrically-powered aircraft, long-haul narrow body aircraft, etc.);
- Enhanced airport security processes in order to process growing passenger flows;

- Potential risks of cyber-attacks due to further digitalisation and automation of airports;
- Increasing drone activity around airports;

The **environmental factors** highlight ecological and environmental aspects such as weather, climate, and climate change, which may especially affect industries such as tourism, farming, and insurance. The major trends identified are:

- The effect of Flygskam on the European aviation market;
- Unpredictability of natural disasters and the effects of global warming;
- The impact of environmental regulations (CORSIA, ecological taxation, curfews).

The last parameter of the PESTEL analysis concerns the **legal factors**. These factors include health and safety law, discrimination law, consumer law, antitrust law and employment law. They can affect operations, costs and the demand for products. The following two trends were identified:

- Importance of privacy legislation concerning the use of personal data;
- The effect of the Brexit on the employment of foreign workers in the UK.

C.2. Porter's 5 (+1) forces model

Porter's 5 (+1) forces model was applied to analyse the internal factors affecting the European aviation market. By identifying the threat of new entrants, the threat of substitutes, bargaining power of customers, bargaining power of suppliers, competitive rivalry and the influence of the authorities, the impact on the structure of the European aviation industry can be determined and its effect on overall performance minimised.

The **threat of new entrants** implies that the positioning of a company is subject to the extent to which new start-ups can enter the market. If there are high barriers of entry in the industry in question, this is to the advantage of the incumbent airlines and it can be taken advantage of. The following trends with regard to the European aviation market were identified:

- Significant barriers of entry protect the incumbents of new market players (start-up capital, required certificates, slots availability at airports, etc.);
- The closure of regional airports will reduce competitive pressure but could have major economic consequences;
- European airline market is more competitive than in other comparable regions such as North-America, China and Japan.

→ Threat of new entrants in the airline industry is considered to be low.

The **threat of substitutes** highlights products or services allowing consumers to switch from one product or service to another one, giving them the same level of utility or satisfaction. The following substitutes for air travel were found:

- Europe's advanced high-speed rail network gives consumers alternative means of transport when it comes to intra-European and domestic flights;
- Increasing popularity of bus companies (Flixbus) and carpooling affects air travel and European regional airports;
- Revival of local tourism could substitute the need for air travel;
- Re-emergence of tourism in North-Africa might have a negative effect on local tourism in Europe but is beneficial for the aviation industry.

→ High threat of substitutes for the European airline market, especially for domestic and intra-European traffic.

As regards the **bargaining power of customers**, the extent to which customers are able to put the organisation under pressure is analysed. If the company has a large amount of customers, the bargaining power of them will be low. On the other hand, however, the bargaining power will be high in case of having a small and selected group of buyers. The following trends have been identified:

- Evolving buyer power between airlines and passengers, that is gradually moving to the benefit of consumers;
- Developing company policies with greater emphasis on online meetings;
- Fluctuating buyer power between airlines and travel agencies, where the latter's strength is on a downward trend;
- Different levels of buyer power at European airports, where regional airports have the least power;
- Evolving trends in the airport retail stores policy to gain purchasing power.

→ Buyer power in the European aviation market varies from market player to market player.

The force regarding the **bargaining power of suppliers** determines the capability of the organisation's supplier(s) to raise the price of the input. The most important trends that were distinguished are the following:

- Changing supplier power between airlines and aircraft manufacturers, with aircraft manufacturers taking slightly the upper hand;
- Supplier power of airports vis-à-vis airlines, in which regional airports lose out over hub airports.

→ Supplier power evolves over time and depends on the economic situation in which market players find themselves.

Competitive rivalry highlights intensity of the current competition in the industry by identifying the number of competitors, their size and power on the market. As regard the European aviation market, the following trends were found:

- Increasing competitive pressure coming from MEB3 carriers (Etihad Airways, Qatar Airways and Emirates);
- Intense hub competition between airports, where, as far as Europe is concerned, Western Europe in particular faces a very high level of competition;
- Increasing trend of LCC operating from primary hubs;
- Emergence of high volume city pairs;
- Increased consolidation of airlines resulting in a decrease of competition and a more oligopolistic aviation market;

→ Very high level of competitive rivalry, partly due to the entry of LCC, low switching costs and price transparency for consumers.

The last strength concerns the **influence of authorities** where different aspects, such as taxes or the presence of environmental regulations, the role of the authority in relation to the company, the level of protectionism in the country, or the financing role of the State need to be examined. The most important trends that were distinguished are the following:

- Involvement of stakeholders in the decision-making process;
- Power of Member States and European institutions on the regulation of the air transport sector;
- EASA influence on certification processes;

- Power of bilateral agreements;
- The role of regulatory authorities with regards to tax regulation;
- The effect of environmental regulation on airports;
- Local authority's involvement to support new routes and regional airports

→ Authorities' influence on the European aviation market is considerable. Airlines and airports are strongly influenced by their decisions.

FOREWORD

An aviation strategy for Europe

Over the last decade, the aviation sector has strongly grown in terms of passenger traffic (+32.3% since 2014 according to the ACI). To support this growth and to sustainably develop the market, in December 2015, the European Commission launched its Aviation Strategy, aiming to provide the EU with *"a comprehensive strategy for a more competitive EU aviation sector",* focusing on four main objectives:

- To place the EU as leading player in international aviation, on the basis of a level playing field;
- Facilitate growth in the aviation sector and the wider economy;
- Secure high EU standards;
- Support innovation, the spread of digital technologies and investment in the aviation sector.

FIGURE 1. DIAGRAMME OF THE FOUR PILLARS OF THE AVIATION STRATEGY FOR EUROPE

Five years after the presentation of the Aviation Strategy, the European Commission wants to contrast this policy in relation to the socio-economic aspects of the development of the EU air transport market during a period of 2016-2019 – including environmental and social aspects. Have the resulting objectives been achieved? Exceeded? What have been the impacts of the policy led by the European Commission on the competitiveness of the European market? What are the emerging trends?

How did the European aviation market develop since 2016?

The last four years have shown a steady growth in air traffic (passengers and freight) worldwide and particularly in Europe. For 2019, ACI Europe reported a slower passenger growth & declining freight for its airports (weakest performance in five years). European airports welcomed 2.43 billion passengers in 2019. This performance was notably marked by a more pronounced decline for non-EU countries. Major airports (Top 5 European airports: +1.8%) and small regional airports (+0.3%) underperformed the European average. Meanwhile, freight traffic dropped by -1.9% in 2019, the worst performance since 2012[1]. The period also showed consolidation of the airline market with several bankruptcies (Air Berlin, Thomas Cook, etc.). What are the underlying trends in the evolution of the air transport market over the last four years?

The COVID-19 outbreak is having a major impact on transport and connectivity in the EU. Measures to contain the outbreak have resulted in a dramatic reduction in transport activity, especially in passenger transport. Air traffic received a major hit since the start of the pandemic. Although there are still developments and a lot of uncertainty on the extent of effects of COVID in air traffic, various outlooks published by key aviation stakeholders are analysed to come up with a "consensus" outlook of the foreseeable developments up to 2025 - including environment and social aspects. This study does not analyse in detail the impacts of the COVID crisis, nevertheless it takes into account the recent analyses available on the evolution of traffic.

Structure of the report

This report analyses developments since 2016 and trends up to 2025 in the European aviation market (airports and airlines). It is divided into three chapters:

- **Overview of the EU air transport market:** 2016-2019 quantitative analysis of air transport market developments.
- **Trends & Development:** Qualitative analysis of the major trends in the aviation sector at the present time.
- **Strategic overview:** General strategic synthesis through an analysis of the external environment and the internal functioning of the European aviation sector.

In order to facilitate the reading of the report, and to quickly access its main conclusions, we have prepared several numbered boxes that summarize the conclusions of the report. Below is an example of a box. Where applicable, the conclusion is put into perspective from the point of view of the citizen (icon), the consumer (icon) and the worker (icon).

Example of a conclusion box

Conclusion 49 – Electrification of operations as the major technology trend

The most important emerging technology trend is the electrification of airport operations. London Heathrow is the frontrunner among European airports. Future trends include the implementation of the 5G network to replace 4G.

: Further electrification of aviation processes will help improve the air quality around the airport which will be beneficial to local residents.

: Emerging technology trends offer opportunities to meet the changing demands of consumers and improve their airport experience.

: Innovative technology trends will better support employees in the performance of their tasks, electrification provides a greener working environment.

[1] *ACI Europe, 2020.*

1. OVERVIEW OF THE EU AIR TRANSPORT MARKET (2016-2019)

1.1 Generic Economic Analysis

This chapter provides an economic analysis of the EU air transport market. The paragraphs 1.1.1 till 1.1.5 focus on the development of passenger and cargo air traffic between 2016 and 2019. These paragraphs provide insight in the development of air traffic per world region and per EU+ country. Special attention is given to low-cost carriers (LCCs). Subsequently, we discuss the development of airline and airport profitability in the paragraphs 1.1.6 and 1.1.7.

1.1.1. Development of passenger traffic by world region

Conclusion 1

The EU has a mature air transport market, with average growth (+17% between 2016 and 2019) compared to other world regions (+16% in the World between 2016 and 2019). A slowdown in traffic growth is observed for the Middle East and Asia-Pacific, although growth rates strongly vary over different countries in the region.

: EU is mature but still growing air transport market (+17% passengers between 2016 and 2019)

Between 2016 and 2019, the number of air passenger movements at EU+ airports increased by 17% from 1.6 billion to 1.9 billion.[2] In all world regions the number of air passengers increased between 2016 and 2019, while only Africa and non-EU+-Europe countries outperformed the EU in terms of air passenger growth (see Table 1 and Figure 1). In these regions, passenger traffic rose with respectively +25% and +33 %.

In the non-EU-Europe world region, especially the Russian Federation and Turkey contributed to the strong passenger growth, with a respective increase of 46 and 34 million passengers between 2016 and 2019 (+38% and +23%, respectively). In relative terms, Georgia (+86%) and Ukraine (+84%) experienced a strong traffic increase. In these countries the growth is largely driven by LCCs, most notably Wizz Air, benefiting from liberal aviation agreements.

In Africa, passenger numbers between 2016 and 2018 strongly increased in North Africa (Egypt, Tunisia and Morocco), where tourism numbers surge again after an eight-year slump following the Arab Spring. A comprehensive aviation agreement between Morocco and the EU was signed in 2006 while Tunisia initialled it in 2017. Traffic from these countries has increased by 6.6 million (+36%) and 3.8 million (+48%), respectively. In addition, steep growth rates are observed in Tanzania (+48%) and Ethiopia (+37%).

TABLE 1. PASSENGER TRAFFIC PER WORLD REGION (IN MILLIONS)

World region	2016	2017	2018	2019	Percentage change 2016-2019
Africa	148	157	174	185	+25%
Asia and the Pacific Region	1,892	2,044	2,177	2,211	+17%
European Union +	1,624	1,748	1,842	1,895	+17%
Non-EU-Europe	310	357	394	413	+33%
Latin America and the Caribbean	534	557	587	612	+15%
Middle East	294	310	321	330	+12%
North America	1,699	1,760	1,850	1,913	+13%

Source: SEO Analysis based on ACI WATR

Note: For some airports no 2019 passenger data was unavailable. The 2019 passenger traffic at these airports is estimated using OAG Traffic Analyser data.

Passenger traffic in the Americas and the Middle East increased slower compared to the EU+ between 2016 and 2019. The total growth rate over four years in Latin America amounted +15%, while North America and

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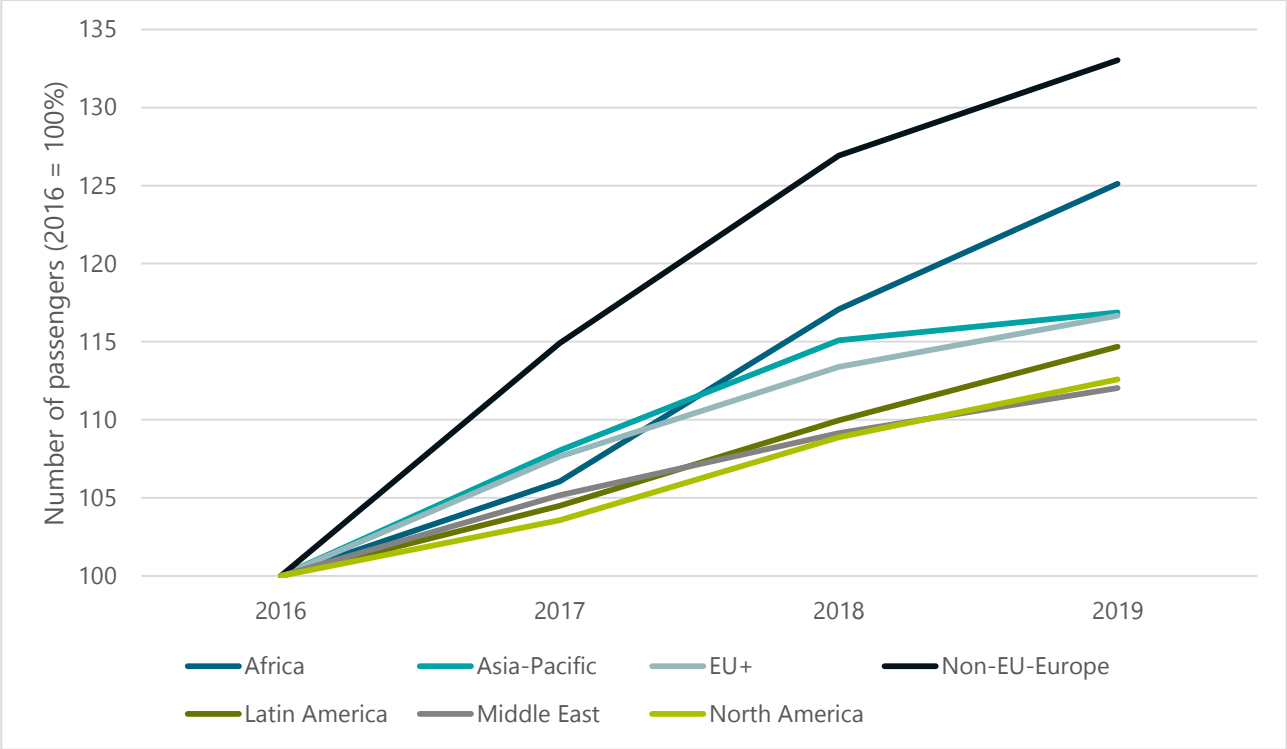
[2] *The reported passenger totals are the sum of airport level totals. Aggregating airport totals results in double counting of domestic and intra-EU+ passengers in terms of passenger movements, as departures and arrivals are counted at both the origin and destination airport. The aggregate passenger numbers in this report differ from figures reported by Eurostat, as Eurostat eliminates this double counting.*

the Middle East saw their passenger traffic increase by respectively +13% and +12%. **The modest growth in the Middle East is particularly surprising, considering the steep traffic growth at the beginning of the decade. Especially the growth of passenger traffic in Qatar (+3%) and the United Arab Emirates (+1%) is low compared to the rest of the world**. The modest growth is mainly caused by the geopolitical unrest in the region, for example leading to the aerial blockade of Qatar. In the UAE, the grounding of the 737MAX has strongly affected the operations of flydubai. In addition, aviation markets in the Gulf have become increasingly saturated, urging airlines to revise their growth strategies.

FIGURE 2. PASSENGER TRAFFIC PER WORLD REGION (2016 = 100)



Source: SEO Analysis based on ACI WATR

1.1.2. Development of passenger traffic by country

Conclusion 2

Air passenger demand has increased in all EU+ countries (+17% between 2016 and 2019), with Central and Eastern Europe showing the strongest growth (e.g. +44% between 2016 and 2019 in Poland). In Scandinavia passenger growth is slowing down, due to a combination of environmental concerns, aviation taxes and airline bankruptcies (e.g. +2% in Sweden over the same period).

: Strong growth observed in Central and Eastern Europe confirms development of the air transport market in these countries.

The number of passengers increased in all EU+ countries between 2016 and 2019 (see Table 2 and Figure 2). The countries with the highest relative growth figures are Estonia (+47%), Luxembourg (+46%), Latvia (+44%), Poland (+44%) and Malta (+42%).

Other countries that show stronger growth than the EU+ average (+17%) are, among others, Hungary, Croatia, Romania, Czech Republic, Lithuania and Portugal. **Interestingly, most of the fastest growing in terms of passenger traffic are countries which joined the European Union relatively recently.**

EU+ countries that show the lowest growth figures are Sweden (+2%), Iceland (+6%), Denmark (+6%), Norway (+8%) and the United Kingdom (+10%).

In Sweden, the passenger traffic decreased in 2019. The introduction of a passenger tax in this country in April 2018 probably is a main cause of this decrease. Moreover, the change in public attitude towards flying has been catalysed by the *flygskam* movement which started in Sweden. In Iceland, the bankruptcy of WOW Air in March 2019 led to a decrease of 2.4 million passengers compared to 2018.

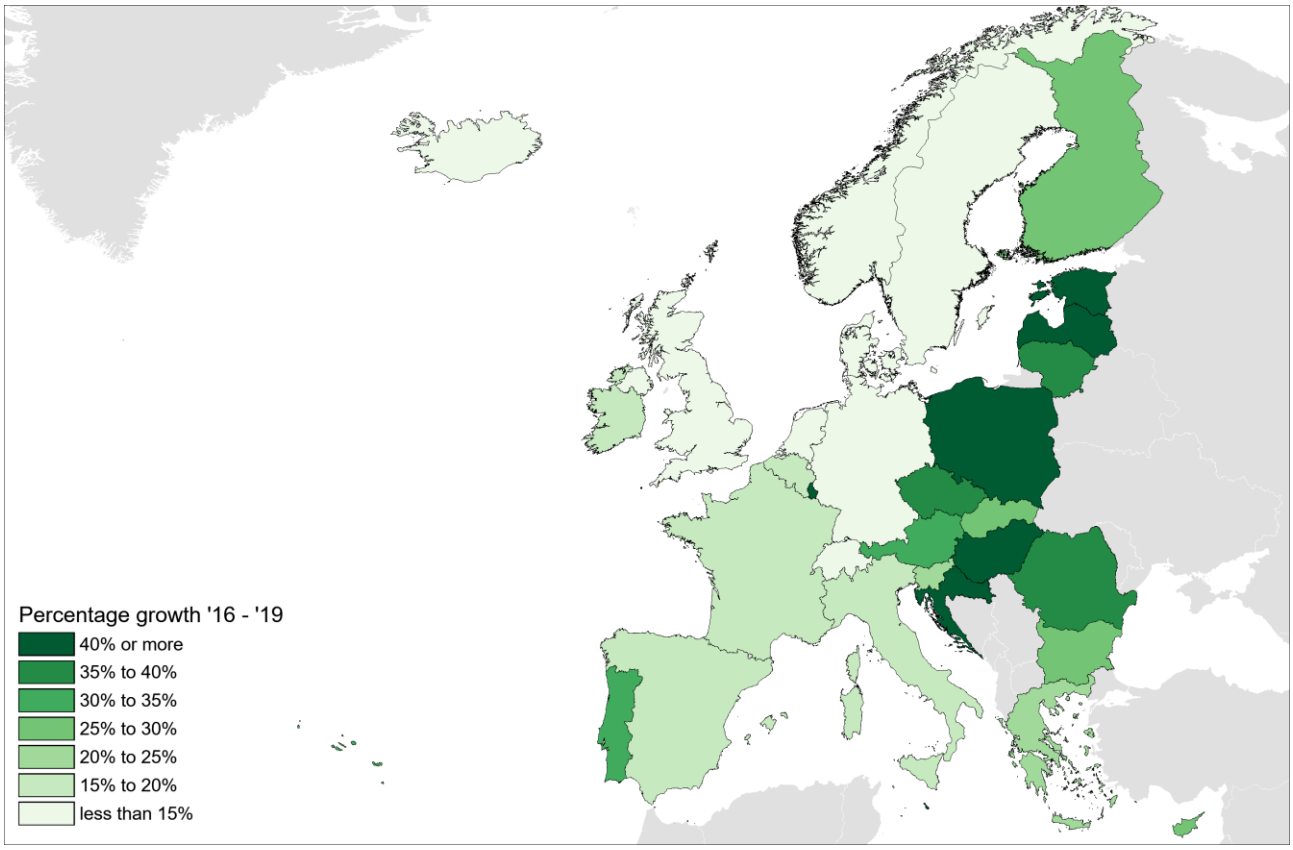
Other countries that show moderate growth figures in terms of passenger traffic are Germany (+11%), Switzerland (+13%), France (+15%) and the Netherlands (+15%). **In general, most countries experiencing low or moderate growth are located in Western and Northern Europe.**

TABLE 2. PASSENGER TRAFFIC BY COUNTRY (IN MILLIONS)

Country	2016	2017	2018	2019	Percentage change 2016-2019
Austria	27.7	29.0	31.7	36.2	+31%
Belgium	29.8	33.1	34.4	35.3	+19%
Bulgaria	9.5	11.4	12.5	12.1	+26%
Croatia	8.0	9.4	10.3	11.2	+40%
Cyprus	9.1	10.3	11.0	11.4	+26%
Czech Republic	13.8	16.2	17.7	18.7	+36%
Denmark	32.1	32.5	33.8	33.9	+6%
Estonia	2.2	2.7	3.0	3.3	+47%
Finland	20.7	22.6	24.9	26.0	+25%
France	165.2	174.7	182.8	190.0	+15%
Germany	224.7	236.4	245.9	250.1	+11%
Greece	53.5	57.9	63.5	65.1	+22%
Hungary	11.4	13.1	14.9	16.2	+41%
Iceland	6.8	8.8	9.8	7.2	+6%
Ireland	31.9	33.6	35.7	37.2	+17%
Italy	159.2	169.6	179.7	186.7	+17%
Latvia	5.4	6.1	7.1	7.8	+44%
Lithuania	4.8	5.2	6.3	6.5	+36%
Luxembourg	3.0	3.6	4.0	4.4	+46%
Malta	5.1	6.0	6.8	7.3	+42%
Netherlands	68.4	74.2	77.2	78.4	+15%
Norway	51.7	54.3	55.6	56.0	+8%
Poland	33.4	39.2	45.0	48.2	+44%
Portugal	45.3	52.7	56.3	60.1	+33%
Romania	16.1	19.9	21.2	22.5	+40%
Slovakia	2.2	2.5	2.9	2.9	+30%
Slovenia	1.4	1.7	1.8	1.7	+23%
Spain	229.9	248.9	263.3	273.7	+19%
Sweden	44.1	46.8	47.0	45.0	+2%
Switzerland	51.8	54.9	57.6	58.6	+13%
United Kingdom	256.1	270.9	277.9	281.3	+10%
EU+	**1624.2**	**1748.3**	**1841.7**	**1895.0**	**+17%**

Source: SEO Analysis based on ACI WATR

FIGURE 3. PASSENGER GROWTH PER COUNTRY BETWEEN 2016 AND 2019



Source: SEO analysis

Table 3 presents the share of domestic, intra-EU+ and extra-EU+ traffic for 2019 per country. The extra-EU+ traffic is subdivided into different world regions.

At the EU+ level, the majority of traffic (52 %) is international intra-EU+, 29% of the passengers travel outside EU+, and 19% of the traffic is domestic. Of the extra-EU+ traffic, 19% travels to other continents, while 10% travels to a non-EU+ European country.

TABLE 3. SHARE OF DOMESTIC, INTRA-EU+ AND EXTRA-EU+ TRAFFIC FOR 2019

Country	Domestic traffic	Intra-EU+ traffic	Extra-EU+ traffic						
			Total extra-EU+ traffic	*Non-EU Europe*	*Africa*	*Latin America*	*Asia/ Pacific*	*Middle East*	*North America*
Austria	2%	78%	20%	*11%*	*1%*	*0%*	*3%*	*3%*	*2%*
Belgium	0%	79%	21%	*6%*	*8%*	*1%*	*1%*	*2%*	*3%*
Bulgaria	3%	81%	16%	*14%*	*0%*	*0%*	*0%*	*2%*	*0%*
Croatia	5%	86%	8%	*6%*	*0%*	*0%*	*0%*	*2%*	*1%*
Cyprus	0%	53%	47%	*42%*	*0%*	*0%*	*0%*	*4%*	*0%*
Czech Republic	0%	79%	21%	*13%*	*1%*	*0%*	*2%*	*4%*	*1%*
Denmark	7%	81%	12%	*5%*	*0%*	*0%*	*2%*	*2%*	*2%*
Estonia	0%	91%	9%	*9%*	*0%*	*0%*	*0%*	*0%*	*0%*
Finland	16%	74%	11%	*4%*	*0%*	*0%*	*3%*	*2%*	*1%*
France	16%	55%	29%	*4%*	*11%*	*2%*	*3%*	*2%*	*5%*
Germany	14%	63%	23%	*11%*	*3%*	*1%*	*3%*	*3%*	*3%*
Greece	17%	70%	12%	*7%*	*1%*	*0%*	*0%*	*2%*	*2%*
Hungary	0%	85%	15%	*11%*	*0%*	*0%*	*1%*	*2%*	*1%*
Iceland	4%	81%	15%	*1%*	*0%*	*0%*	*0%*	*0%*	*14%*
Ireland	0%	88%	12%	*1%*	*0%*	*0%*	*0%*	*2%*	*8%*
Italy	20%	64%	15%	*6%*	*2%*	*1%*	*2%*	*2%*	*3%*
Latvia	0%	81%	18%	*18%*	*0%*	*0%*	*0%*	*0%*	*0%*
Lithuania	0%	79%	21%	*13%*	*0%*	*0%*	*0%*	*8%*	*0%*
Luxembourg	0%	96%	4%	*2%*	*1%*	*0%*	*0%*	*0%*	*0%*
Malta	0%	93%	7%	*5%*	*1%*	*0%*	*0%*	*2%*	*0%*
Netherlands	0%	76%	24%	*6%*	*3%*	*3%*	*4%*	*2%*	*6%*
Norway	43%	53%	4%	*2%*	*0%*	*0%*	*1%*	*1%*	*1%*
Poland	5%	83%	12%	*8%*	*0%*	*0%*	*1%*	*2%*	*1%*
Portugal	11%	79%	10%	*1%*	*3%*	*2%*	*0%*	*1%*	*3%*
Romania	6%	84%	10%	*8%*	*0%*	*0%*	*0%*	*2%*	*0%*
Slovakia	0%	79%	21%	*18%*	*1%*	*0%*	*0%*	*2%*	*0%*
Slovenia	0%	77%	23%	*23%*	*0%*	*0%*	*0%*	*0%*	*0%*
Spain	21%	69%	10%	*2%*	*2%*	*2%*	*1%*	*1%*	*2%*
Sweden	21%	69%	10%	*5%*	*0%*	*0%*	*1%*	*2%*	*1%*
Switzerland	2%	80%	18%	*7%*	*2%*	*0%*	*2%*	*3%*	*3%*
United Kingdom	8%	69%	23%	*4%*	*2%*	*1%*	*4%*	*5%*	*7%*
EU+	**19%**	**52%**	**29%**	***10%***	***4%***	***2%***	***3%***	***4%***	***5%***

Source: SEO Analysis based on ACI WATR and OAG Traffic Analyser

Note 1: Traffic shares are corrected for double counting: per country domestic passengers are divided by 2 to calculate shares (i.e. counted only at one airport). At EU+ level intra-EU+ passengers are divided by 2.

Note 2: At the time of writing, OAG Traffic Analyser does not yet provide complete passenger traffic data for 2019. For that reason the share of domestic, intra-EU and extra-EU traffic in 2019 is estimated based on the data that is available at this moment (i.e. January to October 2019), following the estimation method outlined in Table 1.

The shares of the various regions differ substantially between countries. The largest differences exist with respect to the percentage of domestic traffic: while countries like Italy, Norway, Spain and Sweden have relatively extensive domestic networks, several other countries do not have any domestic traffic. In Cyprus the share of traffic to European countries that do not belong to the European Union (42%) is remarkably high. One of the reasons is that partly as a result of its geographical location Cyprus has a high number of connections with Israel, Turkey and Russia. In Iceland, the percentage of traffic to North-America (14%) is exceptionally high. The reason is that Reykjavík–Keflavík Airport (KEF) is an important hub for passengers travelling from Europe to destinations in the United States and Canada.

Intra-EU+ traffic and extra-EU+ traffic increased in all EU+ countries between 2016 and 2019 (see Table 4). Intra-EU+ traffic especially increased in Estonia (+46%), Luxembourg (+46%) and Croatia (+41%). Sweden (+1%), Denmark (+2%) and Norway (+3%), on the other hand, experienced low relative intra-EU+ traffic growth. Extra-EU+ traffic especially increased in Slovakia (+314%), Poland (+214%) and Lithuania (+144%). In general, most EU+ countries experiencing high extra-EU+ traffic growth are located in Eastern Europe.

Domestic traffic strongly increased in Romania (+82%) and Ireland (+72%). In Romania, domestic traffic increased particularly between 2016 and 2018, with Blue Air, Ryanair and Wizz Air increasing its capacity in the domestic market. In 2019, domestic traffic volumes decreased again as Wizz Air axes its domestic flights. In Ireland, Aer Lingus has seen its passenger numbers increase on the two domestic routes it operates.

TABLE 4. PASSENGER TRAFFIC DEVELOPMENT BY DESTINATION CATEGORY

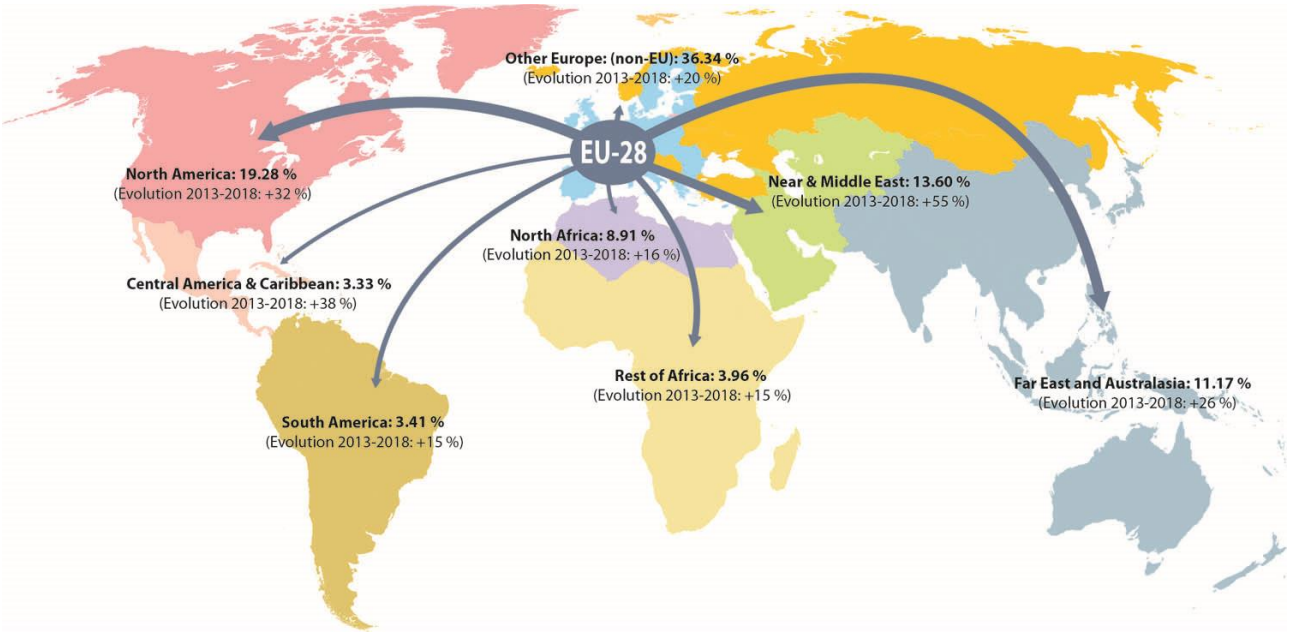
	Growth 2016-2019		
Country	**Domestic**	**Intra-EU+**	**Extra-EU+**
Austria	+10%	+29%	+46%
Belgium		+13%	+43%
Bulgaria	+36%	+29%	+13%
Croatia	+19%	+41%	+60%
Cyprus		+20%	+33%
Czech Republic		+32%	+59%
Denmark	+11%	+2%	+25%
Estonia		+46%	+62%
Finland	+26%	+21%	+52%
France	+11%	+14%	+23%
Germany	+9%	+10%	+18%
Greece	+11%	+24%	+50%
Hungary		+35%	+96%
Iceland	-9%	+9%	+2%
Ireland	+72%	+14%	+36%
Italy	+12%	+16%	+37%
Latvia		+38%	+74%
Lithuania		+22%	+144%
Luxembourg		+46%	+49%
Malta		+39%	+116%
Netherlands		+14%	+16%
Norway	+9%	+3%	+15%
Poland	+18%	+38%	+214%
Portugal	+24%	+32%	+64%
Romania	+82%	+33%	+64%
Slovakia		+10%	+314%
Slovenia		+17%	+33%
Spain	+27%	+12%	+44%
Sweden	0%	+1%	+21%
Switzerland	-12%	+13%	+20%
United Kingdom	-4%	+6%	+15%
EU+	**+12%**	**+14%**	**+28%**

Source: SEO Analysis based on ACI WATR and OAG Traffic Analyser

Note: For some EU+ countries the growth in domestic traffic is not reported as in these countries no (substantial) domestic traffic takes place.

Figure 3 shows the development of passenger traffic from the EU28 to non-EU28 members over a longer time period, between 2013 and 2018. The figure indicates that the majority of extra-EU28 travel (36%) is to other European countries. The largest intercontinental passenger markets are North America (19%), Middle East (14%) and the Far East (11%). Particularly the Middle East has shown substantial growth over the period 2013-2018, with a passenger traffic increase of +55 %. In addition, passenger traffic to Central America and the Caribbean and North America strongly increased, respectively by +38% and +32%. Growth to Africa and Latin America – regions accounting for a small share of traffic – remained relatively limited.

FIGURE 4. DEVELOPMENT OF EXTRA-EU PASSENGER TRAFFIC BETWEEN 2013 AND 2018



Source: Eurostat

1.1.3. Development of passenger traffic by airline type

Conclusion 3

LCCs have contributed strongly to EU passenger traffic growth (+5 percentage points of market share in EU+ between 2016 and 2019). In many Central and Eastern European countries LCCs are responsible for the majority of air passenger traffic, in the absence of large national airlines (up to 82% of passenger traffic in a country like Slovakia in 2019).

: LCCs contributed to a better integration of Central and Eastern Europe countries through improvement of their connectivity.

: The development of low-cost airlines induced a new demand that travelled less (or gave up travelling).

This section assesses to what extent specific airline types have contributed to passenger growth. Firstly, the market penetration of LCCs[3] across EU+ states is addressed. Secondly, the airlines which experienced the strongest passenger growth between 2016 and 2019 are identified.

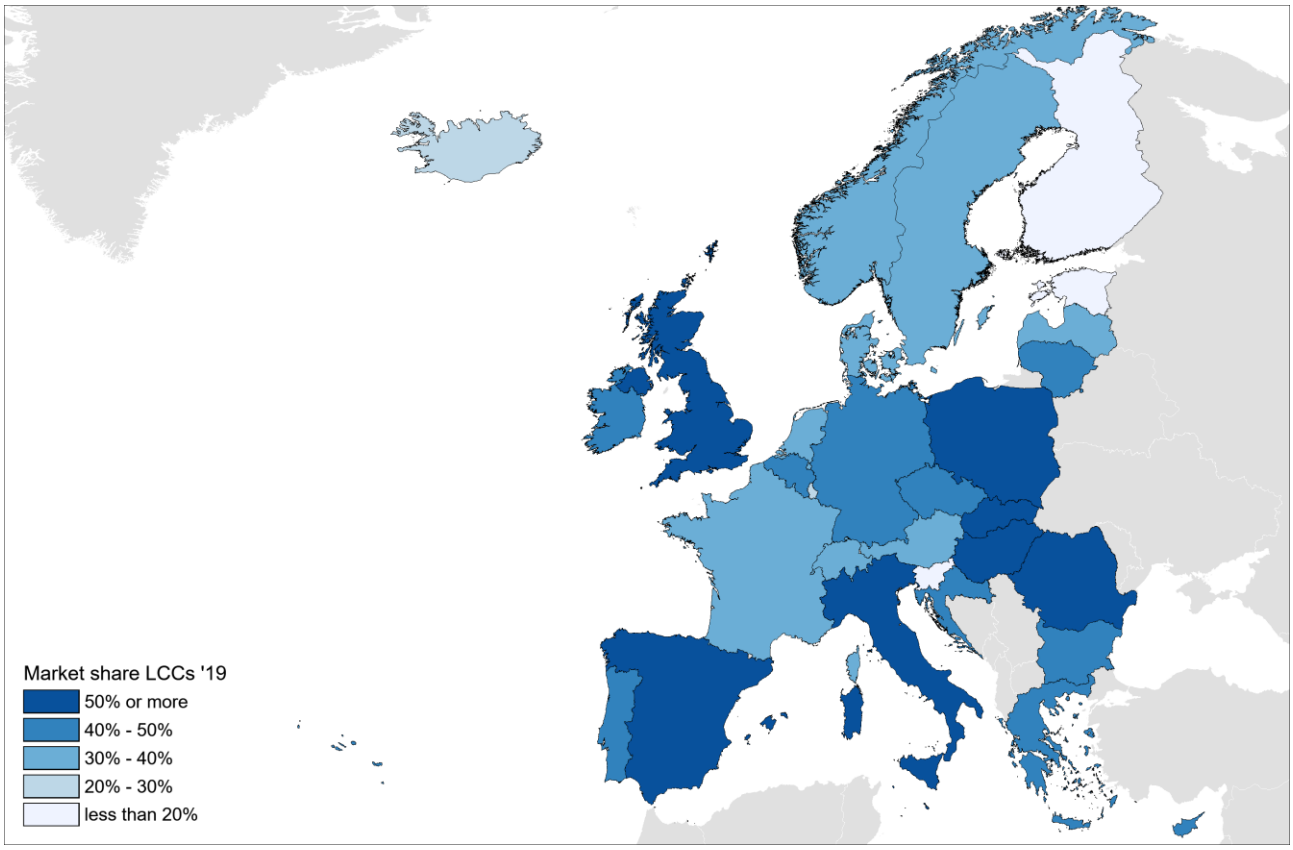
1.1.3.1. LCC traffic

Figure 3 shows strong variation in the share of passenger travelling with LCCs across states in EU+. In seven countries, the majority of passengers in 2019 travels with an LCC: Slovakia (82%), Hungary (58%), Spain (58%), Romania (55%), Poland (54%), Italy (51%) and Malta (51%).

At the other end of the spectrum, countries with a low share of LCC traffic include Finland (15%), Slovenia (17%), Estonia (18%) and Iceland (21%, after the bankruptcy of WOW Air).

[3] *Appendix 1 presents the airlines categorised as LCC*

FIGURE 5. LCC SHARE PER COUNTRY IN 2019



Source: SEO Analysis based on OAG Traffic Analyser

Table 5 shows that the market share of LCCs increased in most of the EU+ states between 2016 and 2019. Particularly in Luxembourg (+14 percentage points), Germany (+12 percentage points) and Austria (+12 percentage points) LCCs managed to increase their market share. In Germany, especially Germanwings/Eurowings,[4] Easyjet and Ryanair grew substantially. Germanwings/Eurowings and Easyjet also managed to increase their market share significantly in Austria. In addition, Wizz Air and Lauda increased their market shares in Austria. **At the EU+ level, the market share of LCCs increased by +5 percentage points.**

The LCC market share did not increase in all states between 2016 and 2019. A decrease is observed in Iceland (-8 percentage points), Belgium (-5 percentage points), Latvia (-3 percentage points), Lithuania (-2 percentage points), Norway (-1 percentage points) and Ireland (-1 percentage points). In Iceland, this is almost entirely attributable to the bankruptcy of WOW Air. The defunct of Thomas Cook Airlines Belgium in 2017 is one of the main causes of the decline of the market share of LCCs in Belgium.[5] Another important cause is the decrease in the number of flights operated by Easyjet from Brussels airport.

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[4] Since 2016 LCC Germanwings is a wet lease operator for its sister company Eurowings. Both airlines operated under the Eurowings brand form then, although Germanwings' IATA code "4U" has been used for after that. For that reason, the naming "Germanwings/Eurowings" has been used in this analysis.

[5] https://www.ch-aviation.com/portal/news/60877-thomas-cook-airlines-belgium-ceases-all-operations

TABLE 5. MARKET SHARE LCCS PER STATE

Country	2016	2017	2018	2019	Percentage point change
Austria	19%	19%	25%	31%	**+12**
Belgium	47%	45%	41%	42%	**-5**
Bulgaria	36%	48%	51%	47%	**+11**
Croatia	33%	36%	36%	41%	**+8**
Cyprus	44%	47%	49%	46%	**+2**
Czech Republic	34%	36%	39%	40%	**+6**
Denmark	33%	33%	35%	35%	**+2**
Estonia	13%	11%	15%	18%	**+5**
Finland	14%	14%	16%	15%	**+1**
France	29%	30%	32%	34%	**+5**
Germany	32%	36%	42%	44%	**+12**
Greece	40%	40%	40%	42%	**+2**
Hungary	53%	55%	57%	58%	**+5**
Iceland	29%	39%	44%	21%	**-8**
Ireland	45%	44%	44%	44%	**-1**
Italy	47%	49%	50%	51%	**+4**
Latvia	34%	32%	33%	31%	**-3**
Lithuania	50%	48%	49%	48%	**-2**
Luxembourg	8%	16%	19%	22%	**+14**
Malta	46%	50%	49%	51%	**+5**
Netherlands	33%	33%	34%	35%	**+2**
Norway	41%	41%	42%	40%	**-1**
Poland	52%	54%	53%	54%	**+2**
Portugal	42%	44%	43%	43%	**+1**
Romania	50%	58%	56%	55%	**+5**
Slovakia	81%	79%	80%	82%	**+1**
Slovenia	12%	15%	16%	17%	**+5**
Spain	53%	56%	57%	58%	**+5**
Sweden	27%	29%	31%	30%	**+3**
Switzerland	28%	29%	30%	31%	**+3**
United Kingdom	47%	49%	49%	50%	**+3**
EU+	40%	42%	44%	45%	**+5**

Source: SEO Analysis based on OAG Traffic Analyser
Note: The calculations for 2019 are based on the first eleven months of 2019

1.1.3.2. Fastest growing airlines

Table 6 shows that the largest LCCs, Ryanair and Easyjet, show the largest absolute growth figures between 2016 and 2019: the airlines grew by 23.2 and 20.5 million passengers respectively. In the top 10 of the airlines with the highest absolute growth figures, only three network carriers show up: Lufthansa (7th), TAP Air Portugal (9th) and KLM (10th). The other top achievers are LCCs, with Jet2.com and Wizz Air showing the highest relative growth figures: 121 % and 54 % respectively. **Lauda, a subsidiary of Ryanair Holdings, shows remarkable growth as well, moving almost 5 million passengers in 2019 after being introduced in March 2018.**

TABLE 6. 10 FASTEST GROWING AIRLINES IN ABSOLUTE TERMS (IN MILLIONS)

Airline	2016	2017	2018	2019	Absolute difference 2016/2019	% difference 2016/2019
Ryanair	111.0	121.9	128.0	134.2	**+23.2**	**+21%**
Easyjet	68.5	74.2	84.6	89.0	**+20.5**	**+30%**
Wizz Air	18.6	21.8	25.2	28.7	**+10.1**	**+54%**
Vueling	20.4	21.4	26.2	28.4	**+8.0**	**+39%**
Jet2.com	6.0	9.1	11.3	13.3	**+7.3**	**+121%**
Eurowings/ Germanwings	17.1	20.5	24.0	23.8	**+6.7**	**+39%**
Lufthansa	33.4	34.7	37.9	38.3	**+4.9**	**+15%**
Lauda	-	-	3.0	4.7	**+4.7**	**-**
TAP Air Portugal	8.4	9.8	11.0	11.7	**+3.4**	**+40%**
KLM	15.3	17.4	18.0	18.3	**+3.0**	**+19%**

Source: SEO Analysis based on OAG Traffic Analyser
Note: In the calculation of the number of passengers per airline we only take into account passengers on departing flights from EU+ airports.

1.1.4. Development of cargo traffic by world region

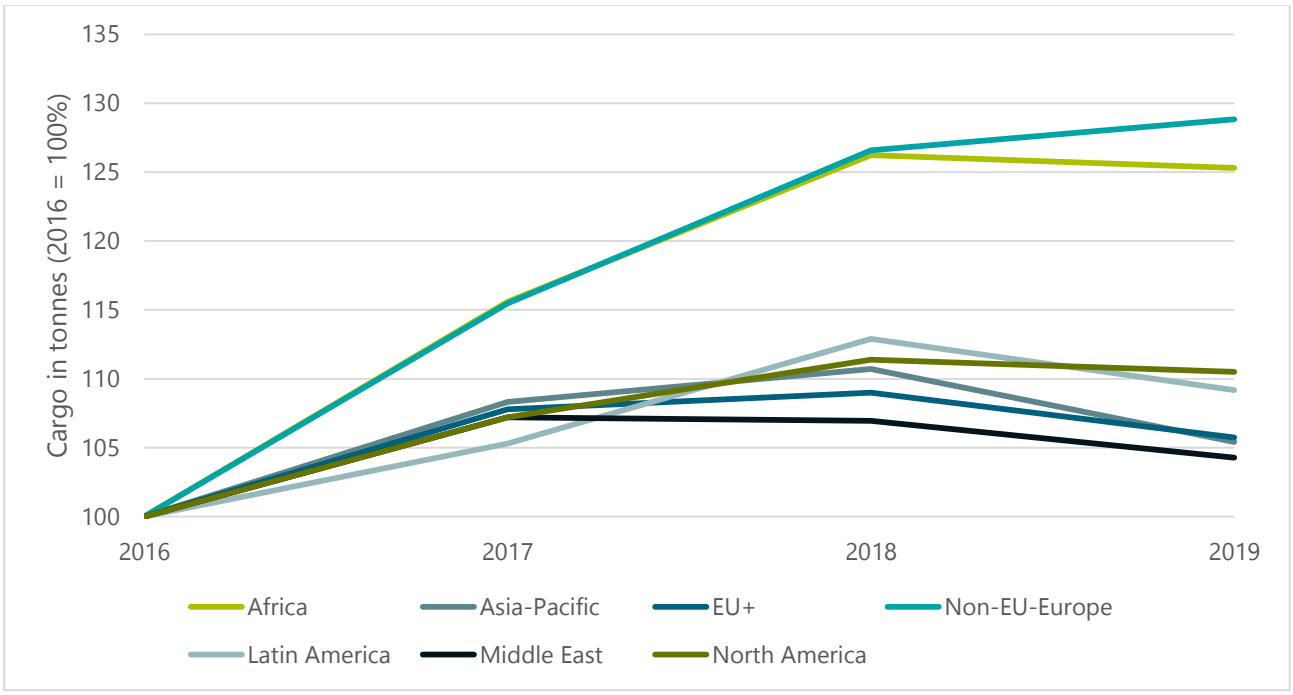
Conclusion 4

Global growth in air cargo is slower than global passenger growth (+6% over the 2016-2019 period). Between 2018 and 2019 air cargo growth has stalled, fuelled by international trade tensions and slower economic growth.

The amount of cargo handled at EU+ airports increased by +6% between 2016 and 2019 (see Figure 4 and Table 7).[6] Cargo traffic growth in the EU+ is relatively modest, only outpacing Asia/Pacific and the Middle East with respective growth rates of +5% and +4% over the last four years.

The modest growth rates are mainly caused by a decrease in cargo traffic in 2019. In all world regions, cargo volumes decreased between 2018 and 2019, caused by the slowing down of worldwide economic growth and the US-China trade dispute.[7] The two world regions with the highest growth rate are Africa and non-EU European countries. Cargo volumes at airports in these regions increased by +25% and +29%, respectively.

FIGURE 6. CARGO TRAFFIC PER WORLD REGION (RELATIVE VALUES)



Source: SEO Analysis based on ACI WATR

[6] *2019 cargo traffic data is missing for a limited number of cargo airports. We estimated the cargo traffic at these airports based on the average regional growth rate. The following formula is applied: tons of cargo in 2018*cargo growth rate of the non-missing airports in the world region of the missing airport in 2019.*

[7] https://airlines.iata.org/news/freight-demand-falls-again-in-november

TABLE 7. CARGO TRAFFIC PER WORLD REGION IN TONNES (1,000 TONNES)

World region	2016	2017	2018	2019	Percentage change 2016-2019
Africa	1,705	1,971	2,152	2,136	**+25%**
Asia and the Pacific	35,824	38,807	39,661	37,763	**+5%**
European Union+	17,206	18,545	18,753	18,195	**+6%**
Non-EU+-Europe	1,738	2,007	2,200	2,239	**+29%**
Latin America	4,666	4,913	5,268	5,094	**+9%**
Middle East	8,070	8,652	8,631	8,414	**+4%**
North America	28,972	31,056	32,268	32,016	**+11%**

Source: SEO Analysis based on ACI WATR

1.1.5. Development of cargo traffic by country

Conclusion 5

Developments in cargo traffic show strong variation across countries of EU+ (min -31% in Sweden and max +40% in Portugal between 2016 and 2019). Cargo transport is concentrated at a limited number of airports. As airport catchment areas for air cargo tend to stretch over large parts of Europe, air cargo demand can easily shift from one country to another.

Table 8 and Figure 5 present the changes in cargo traffic for the EU+ countries between 2016 and 2019. **Although the overall cargo growth is modest, some countries recorded strong growth rates. The countries with the highest relative cargo growth are Portugal (+40%), Croatia (+38%), Latvia (+38%), Norway (+37%), Poland (+34%) and Spain (+33%).** However, especially in the smaller states absolute cargo volumes are often limited. In absolute terms, Belgium, Spain and Germany witnessed the highest growth in cargo volumes.

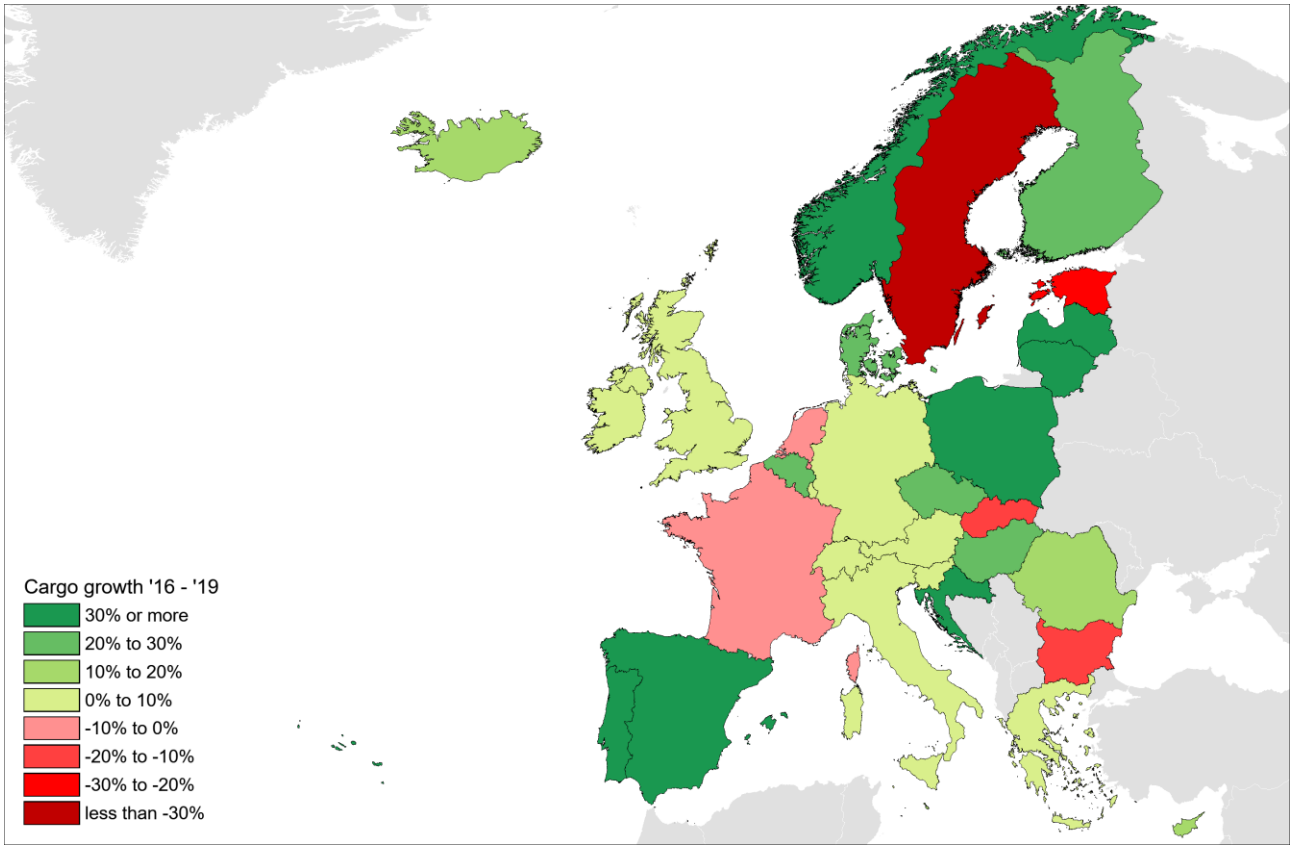
TABLE 8. CARGO TRAFFIC PER STATE (1,000 TONNES)

Country	2016	2017	2018	2019	Percentage change 2016-2019
Austria	227	231	238	229	**+1%**
Belgium	1159	1267	1446	1430	**+23%**
Bulgaria	32	35	31	29	**-10%**
Croatia	8	10	12	11	**+38%**
Cyprus	28	31	33	32	**+14%**
Czech Republic	78	89	89	94	**+20%**
Denmark	200	236	242	245	**+22%**
Estonia	14	11	12	11	**-22%**
Finland	178	181	192	215	**+21%**
France	2357	2427	2330	2256	**-4%**
Germany	4595	4902	4970	4814	**+5%**
Greece	88	90	93	94	**+7%**
Hungary	78	87	101	96	**+23%**
Iceland	50	56	56	55	**+10%**
Ireland	155	170	163	156	**+1%**
Italy	1012	1104	1096	1066	**+5%**
Latvia	20	26	28	27	**+38%**
Lithuania	14	16	18	18	**+31%**
Luxembourg	802	897	895	854	**+6%**
Malta	16	16	18	18	**+17%**
Netherlands	1695	1778	1730	1592	**-6%**
Norway	146	172	181	200	**+37%**
Poland	107	122	135	144	**+34%**
Portugal	150	178	187	210	**+40%**
Romania	40	45	48	47	**+18%**
Slovakia	24	27	25	21	**-13%**
Slovenia	10	12	12	11	**+10%**
Spain	830	950	1043	1100	**+33%**
Sweden	163	176	168	112	**-31%**
Switzerland	455	516	517	480	**+6%**
United Kingdom	2475	2687	2644	2528	**+2%**
EU+	17206	18545	18753	18195	**+6%**

Source: SEO Analysis based on ACI WATR

On the other hand, seven EU+ countries faced a decrease in cargo volumes between 2016 and 2019: Sweden (-31%), Estonia (-22%), Slovakia (-13%), Bulgaria (-10%), the Netherlands (-6%) and France (-4%). In absolute terms, the strongest volume decreases are observed in The Netherlands, France and Sweden. In The Netherlands, the decrease in cargo volumes is related to capacity constraints at Amsterdam Schiphol. As a result of the flight cap of 500,000 movements, which was reached in 2018, not all cargo operations could be accommodated and diverted to other airports in neighbouring countries. The increase at Belgian airports, most notably Brussels Zaventem and Liège, is possibly related to the capacity constraints at Schiphol.

FIGURE 7. CARGO TRAFFIC GROWTH PER COUNTRY BETWEEN 2016 AND 2019



Source: Analysis SEO

Cargo traffic by destination world region

The majority of cargo traffic to or from the EU (75 %) is intercontinental traffic (see Table 9). Within Europe, road transport is often preferred over air transport, due to the lower costs and limited relative time benefits of air transport. Only 3% of EU cargo traffic is domestic transport, concentrated in a limited number of countries. Between 2016 and 2018,[8] the amount of domestic and intra-EU air cargo declined with 14 and 19 %, respectively. Extra-EU air cargo increased by 11 % in the same period.

The development of air cargo traffic by destination region differs across countries. Some countries report growth of intra-EU cargo traffic, including Greece (+19%), Denmark (+19%), Spain (+19%), Portugal (+16%), Belgium (+12%) and the United Kingdom (+9%). Others show a strong decline in intra-EU cargo traffic, including The Netherlands (-42%), France (-15%) and Austria (-11%). In terms of extra-EU traffic, Greece (+75%), Portugal (+68%) and Belgium (+39%) are among the fast growing countries. The Netherlands is the only country with a substantial air cargo operation reporting a decline in extra-EU cargo traffic, by -5%.

[8] *2019 data by destination region was not available for all countries.*

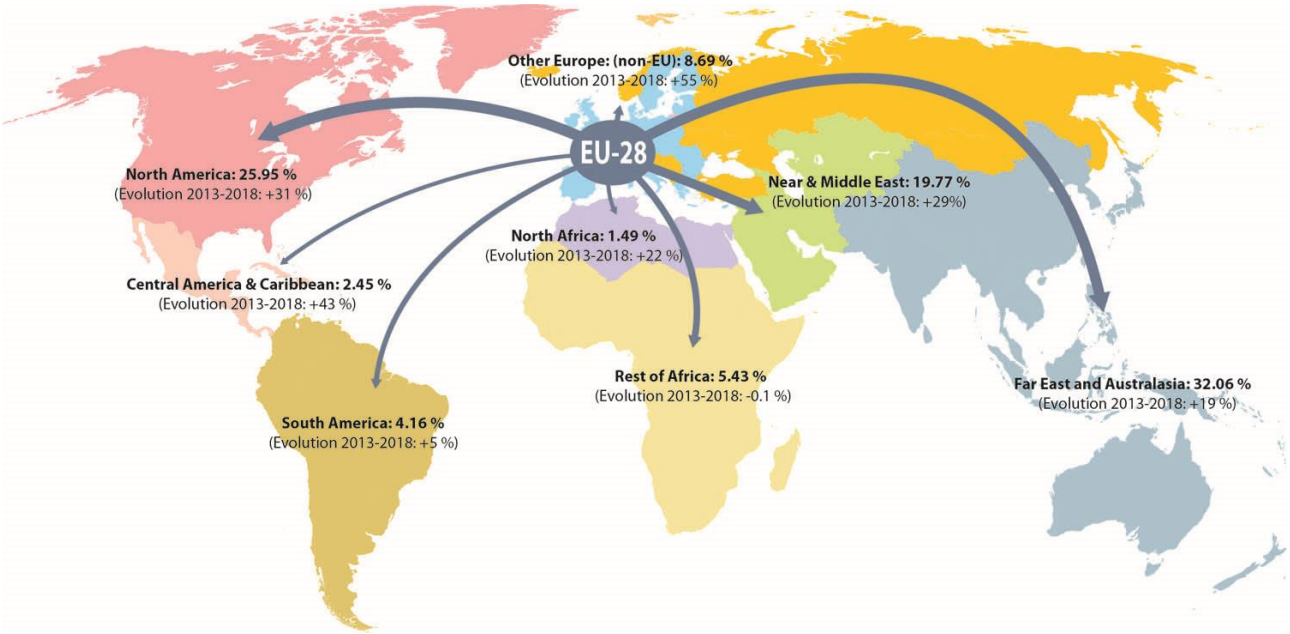
TABLE 9. BREAKDOWN OF CARGO TRAFFIC BY DESTINATION CATEGORY

	Share of total (2019) (2018 for countries indicated with *)			Growth 2016-2019 (countries indicated with * show growth rates between 2016-2018)		
	Domestic	Intra-EU	Extra-EU	Domestic	Intra-EU	Extra-EU
Austria*	0%	24%	76%		-11%	+13%
Belgium*	0%	29%	71%		+12%	+39%
Bulgaria*	0%	58%	42%		+7%	-26%
Croatia	3%	57%	40%		+14%	+146%
Cyprus	0%	64%	36%		+5%	+33%
Czech Republic	1%	43%	56%		+14%	+32%
Denmark	0%	31%	69%		+19%	+24%
Estonia	0%	90%	10%		+17%	-81%
Finland	1%	31%	68%		+1%	+34%
France	8%	21%	71%	-8%	-15%	+1%
Germany	3%	25%	73%	+4%	+7%	+4%
Greece*	7%	50%	43%		+19%	+75%
Hungary	0%	48%	52%		-3%	+65%
Ireland*	3%	49%	48%		-3%	0%
Italy	5%	27%	68%	-5%	+2%	+11%
Latvia	0%	56%	44%		+39%	+52%
Lithuania*	0%	72%	28%		+24%	+15%
Luxembourg	0%	5%	95%		+4%	+12%
Malta	0%	66%	34%		-35%	+24%
Netherlands*	0%	4%	96%		-42%	-5%
Poland*	0%	48%	51%		+8%	+14%
Portugal	8%	31%	61%	+11%	+16%	+68%
Romania	2%	69%	29%		+7%	+66%
Slovakia	0%	96%	4%		-6%	-59%
Slovenia*	0%	81%	19%		+14%	+146%
Spain*	8%	32%	60%	-5%	+19%	+8%
Sweden*	7%	38%	55%	-26%	+7%	+15%
United Kingdom	3%	18%	79%	-4%	+9%	+10%
EU+*	**3%**	**22%**	**75%**	**-4%**	**+4%**	**13%**

Source: Eurostat, elaboration SEO

Figure 7 shows the development of cargo traffic from the EU28 to non-EU28 members between 2013 and 2018. The figure indicates that the majority of extra-EU28 cargo traffic (32%) is to the Far East and Australasia. Other large air cargo markets are North America (26%) and the Middle East (20%). Cargo traffic to extra-EU28 countries has shown substantial growth over the period 2013-2018, with an increase of +55%. In addition, cargo traffic to Central America and the Caribbean and North America strongly increased, respectively by +43% and +31%. Similar to the passenger market, growth to (sub-Saharan) Africa and Latin America – regions accounting for a small share of traffic – remained relatively limited.

FIGURE 8. DEVELOPMENT OF EXTRA-EU CARGO TRAFFIC BETWEEN 2013 AND 2018



Source: Eurostat

1.1.6. Development of airport financials

Conclusion 6

In general large EU+ airports have similar profitability figures as large non-EU airports (EU+ Average EBITDA is +46.6% against 47.6% in non-EU+ in 2018), although the profitability development of the selection of non-EU airports is slightly better. Smaller airports tend to be less profitable.

This section sheds light on the financial performance of EU+ airports compared to their counterparts in other world regions. Table 9 includes the 21 largest EU+ airport operators and the 10 largest non-EU airport operators for which annual reports are publicly available.

In general large EU+ airports have similar profitability figures as large non-EU airports, although the profitability development of the selection of non-EU airports is slightly better. In addition, the results show that the share of employee expenses is over 4 percentage points higher at EU+ airports, while capital expenses are 3 percentage points lower. Finally, EU airports depend to a lesser extent on non-aeronautical revenues (around 13.5 percentage points difference), suggesting that airport charges are relatively high at EU+ airports.

All EU+ airports included in the analysis show healthy profitability figures with double digit earnings before interest, taxes, depreciation and amortisation (EBITDA) and earnings before interest and taxes (EBIT) in 2018. In fact, the lowest EBITDA recorded over the fiscal year 2018 is little under +30% (Swedavia), while the highest EBIDTDA's are over +60% (AENA, ANA, London Heathrow, and Athens). EBIT figures range from little over +10% to over +50%. In addition, there are considerable differences in share of employee expenses (18% to 51%), capital expenses (14% to 40%) and the dependence on non-aeronautical revenues (9% to 72%).

Finally, it should be noted that especially smaller airports often suffer to be profitable, because their size is sometimes insufficient to cover the capital expenses. Such airports, however, normally do not publish their annual reports which does not allow for a detailed analysis.

TABLE 10. MAIN FINANCIAL INDICATORS FOR AIRPORTS

Airport (group)	Country	Currency	EBITDA 2018	EBIT 2018	EBITDA development 2015-2018	Share employee expenses 2018	Share of capital expenses 2018	Share of non-aeronautical revenues 2018
ADP	France	EUR	+43,8%	+27,6%	**+3,2%**	27.4%	22,3%	57,8%
ADR	Italy	EUR	+49,7%	+39,8%	**+14,3%**	26.7%	16,5%	36,2%
AENA	Spain	EUR	+62,0%	+43,9%	**+2,9%**	17.9%	32,3%	32,4%
ANA	Portugal	EUR	+66,3%	+55,3%	**+11,0%**	34.7%	24,7%	26,3%
AMS	Netherlands	EUR	+39,3%	+22,8%	**-8,5%**	18.4%	21,4%	46,1%
AVINOR	Norway	NOK	+35,8%	+17,9%	**-3,3%**	38.1%	21,8%	53,0%
CPH	Denmark	DKK	+56,5%	+35,6%	**+0,9%**	47.2%	32,4%	42,1%
LHR	UK	GBP	+62,0%	+36,6%	**+3,8%**	20.7%	40,0%	41,2%
FRAPORT	Germany	EUR	+31,3%	+20,3%	**-0,3%**	41.2%	13,9%	72,1%
MUC	Germany	EUR	+34,6%	+20,7%	**-2,7%**	41.2%	17,5%	48,4%
LGW	UK	GBP	+54,4%	+33,5%	**+6,1%**	37.7%	31,5%	47,2%
DAA	Ireland	EUR	+32,2%	+18,4%	**+0,7%**	31.7%	17,0%	64,4%
ZRH	Switzerland	CHF	+57,6%	+36,7%	**+6,8%**	46.1%	33,1%	38,8%
MAG	UK	GBP	+42,7%	+25,4%	**+1,9%**	37.5%	23,2%	60,1%
VIE	Austria	EUR	+43,2%	+27,2%	**+0,2%**	51.0%	21,9%	31,2%
SWEDAVIA	Sweden	SEK	+28,8%	+11,0%	**-12,4%**	36.8%	20,0%	9,4%
BRU	Belgium	EUR	+54,8%	+37,0%	**-3,8%**	20.5%	28,3%	
SEA	Italy	EUR	+39,5%	+26,6%	**+7,4%**	36.2%	17,6%	41,7%
DUS	Germany	EUR	+38,5%	+22,5%	**+0,3%**	39.8%	20,7%	
ATH	Greece	EUR	+68,0%	+51,8%	**-2,2%**	19.7%	33,6%	38,2%
FINAVIA	Finland	EUR	+36.6%	+17.1%	**+7.4%**	36.3%	23.5%	45.7%
BUD*	Hungary	HUF	+71.8%	+56.6%	**+6.3%**	N/A	N/A	N/A
PRG*	Prague	CZK	+55.8%	+42.9%	**+57.9%**	N/A	N/A	N/A
Polish	Poland	PLN	+15.3%	+2.7%	**-69.4%**	N/A	N/A	N/A
EU+[9]			**+46.6%**	**29.9%**	**1.6%**	**33.7%**	**24.4%**	**43.8%**
ATL	US	USD	+42,2%	-6,0%	**-2,2%**	17.2%	30,9%	93,5%
LAX	US	USD	+43,6%	18,3%	**+7,1%**	40.2%	26,2%	80,3%
ORD	US	USD	+31,0%	6,6%	**+26,7%**	37.6%	30,8%	68,3%
HKG	Hong Kong	HKD	+63,9%	47,9%	**-3,9%**	26.5%	17,2%	47,8%
AAI	India[10]	INR	+45,6% *	34,4%	**-3,0%**	42.8%	35,5%	40,3%
DFW	US	USD	+43,4%	12,2%	**+8,0%**	27.3%	15,0%	49,8%
TAV	Turkey	TRY	+47,9%	38,7%	**+4,5%**	34.7%	24,5%	51,7%
CGK+	Indonesia[11]	IDR		31,7%	**0,0%**	26.3%	25,8%	36,7%
SIN	Singapore	SGD	+48,2%	30,3%	**-5,7%**	14.5%	20,7%	60,4%
AOT	Thailand	THB	+62,7%	53,6%	**-0,4%**	25.7%	45,5%	45,3%
non-EU			**47.6%**	**26.8%**	**3.1%**	**29.3%**	**27.5%**	**57.4%**

Source: Analysis SEO based on publicly available annual reports; *: source: BvD/Amadeus Financial data

1.1.7. Development of airline profitability

Conclusion 7

Large EU+ airlines are performing better than smaller ones in terms of profitability. Compared to other regions, large EU+ airlines show a similar financial performance. However as a region N-A accounts over 50% of the global profits while Europe accounts less than 25%. Profitability remains high for most EU+ LCCs, despite a drop in recent years.

This section sheds light on the financial performance of EU+ airlines and airline groups compared to their counterparts in other world regions. Table 10 includes the 19 largest EU+ airlines and the 10 largest non-EU airlines for which annual reports are publicly available.

On average, the large non-EU airlines show higher profit margins than their EU+ counterparts. Both the average EBIT and EBITDA are higher for the non-EU airlines. In fact, all individual non-EU airlines show a higher EBIT and EBITDA than the EU+ average, with the exception of the EBIT of Emirates. It should be noted,

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[9] *EU and extra-EU averages not weighted for the airport size.*

[10] *2018 annual report not (yet) available for the Airport Authority of India.*

[11] *the Indonesian Airport Operator does not publish separate depreciation expenses.*

however, that among the selection of EU+ airlines there are smaller airlines, which in general enjoy lower profits. In fact, the average profitability of the five largest EU airlines is similar to the average of the non-EU airlines. In addition, the EU airlines show just a marginal decrease in EBITDA between 2015 and 2018, whereas the non-EU airlines present an almost 6 percentage points drop on average. To conclude, EU+ airlines have especially smaller shares of capital expenses and fuel expenses than the non-EU airlines included in the selection, while the EU+ airlines especially face higher expenses related to airport charges, which is in line with the relatively low dependence of EU+ airports on non-aeronautical revenues. The share of employee expenses is somewhat similar.

Although LCCs witnessed a drop in profitability between 2015 and 2018 and non-LCC airlines enjoyed a marginal increase in profit margin, the former, with the exception of Norwegian, still show above average profit margins. Norwegian, Ryanair and Easyjet published a drop of over 6 percentage point in EBITDA. Still, Ryanair enjoys the highest EBITDA among the EU airlines in 2018, followed by British Airways, Aer Lingus, Wizz Air, Air France-KLM, and Lufthansa. In line with their lean business model, LCCs have lower shares of employee expenses and higher shares of fuel expenses.

TABLE 11. MAIN FINANCIAL INDICATORS FOR AIRLINES

Airline (group)	Country	Currency	EBITDA 2018	EBIT 2018	EBITDA development 2015-2018	Share employee expenses 2018	Share of capital expenses 2018	Share of fuel expenses 2018
Lufthansa Group	Germany	EUR	14.0%	7.8%	**+3.8%**	26.7%	6.7%	18.4%
Air France-KLM	FR/NL	EUR	15.9%	5.0%	**+6.6%**	30.8%	11.5%	19.7%
Ryanair	Ireland	EUR	21.5%	13.2%	**-7.3%**	14.7%	9.6%	36.3%
Easyjet	UK	GBP	11.4%	7.8%	**-6.2%**	14.0%	3.9%	21.8%
IAG	UK	EUR	20.2%	15.1%	**+4.3%**	21.0%	6.0%	25.5%
British Airways	*UK*	*GBP*	*21.0%*	*15.0%*	***+3.2%***	22,9%	7,1%	26,4%
Vueling	*Spain*	*EUR*	*9.4%*	*8.2%*	***+1.6%***	12,1%	1,4%	23,0%
Iberia	*Spain*	*EUR*	*12.3%*	*6.3%*	***+3.0%***	21,3%	6,4%	22,0%
Aer Lingus	*Ireland*	*EUR*	*19.1%*	*15.0%*	***+6.8%***	22,1%	4,8%	22,2%
Norwegian Air S.	Norway	NOK	-5.4%	-9.6%	**-12.0%**	15.1%	3.8%	28.5%
Wizz Air	Hungary	EUR	16.9%	12.9%	**-1.6%**	9.8%	4.6%	33.1%
SAS Group	Sweden	SEK	9.6%	5.6%	**+0.3%**	22.4%	4.2%	18.9%
TAP	Portugal	EUR	1.0%	-1.4%	**+3.3%**	21.3%	2.4%	24.2%
Aegean Airlines	Greece	EUR	9.2%	7.7%	**-1.9%**	11.7%	1.7%	22.1%
Finnair	Finland	EUR	11.0%	5.8%	**+5.4%**	15.8%	5.5%	21.2%
Flybe	UK	GBP	10.3%	4.0%	**+3.7%**	16.0%	6.5%	14.1%
Virgin Atlantic	UK	GBP	0.4%	-1.6%	**-8.7%**	14.1%	2.0%	24.7%
Icelandair	Iceland	USD	5.1%	-3.8%	**-14.8%**	32.9%	8.5%	19.1%
Croatia Airlines	Croatia	EUR	1.5%	-4.4%	**-4.3%**	15.0%	5.6%	17.5%
EU+[12][13]			**10.2%**	**5.2%**	**-1.1%**	**18.8%**	**5.3%**	**23.0%**
American Airlines	US	USD	10.1%	6.0%	**-8.4%**	29.2%	4.4%	19.2%
Delta Airlines	US	USD	17.1%	11.8%	**-6.6%**	27.4%	5.9%	23.0%
Southwest Airl.	US	USD	20.1%	14.6%	**-5.8%**	40.8%	6.4%	24.6%
China Southern	China	RMB	16.1%	6.1%	**-6.5%**	7.9%	9.8%	29.5%
China Eastern	China	RMB	20.2%	7.6%	**-3.1%**	19.7%	13.6%	29.9%
Air China	China	RMB	20.5%	10.2%	**-5.5%**	19.3%	11.5%	30.4%
Turkish Airlines	Turkey	USD	19.4%	11.0%	**+0.4%**	15.5%	9.5%	32.9%
LATAM	Chile	USD	17.6%	7.7%	**+3.4%**	20.5%	11.1%	33.6%
Air Asia Group	Malaysia	MYR	15.2%	10.3%	**-19.8%**	15.7%	5.5%	36.8%
Emirates	UAE	AED	12.6%	2.7%	**-6.6%**	13.3%	10.2%	32.3%
non-EU			**16.9%**	**8.8%**	**-5.8%**	**20.9%**	**8.8%**	**29.2%**

Source: Analysis SEO based on publicly available annual reports

[12] *Averages are unweighted.*

[13] *In the average, IAG is not included to avoid double counting.*

1.2 Development of air connectivity

This chapter presents a connectivity analysis of the EU air transport market. The first paragraph explains the methodology used to measure connectivity. Subsequently, we focus on direct connectivity (paragraph 1.2.3), indirect connectivity (paragraph 1.2.4) and market openings and closures (paragraph 1.2.5). In line with the previous chapter we make a distinction between domestic, intra-EU and extra-EU flights in the analysis.

1.2.1. Measuring connectivity

The SEO NetScan connectivity model is used to measure connectivity. This model measures the connectivity offered from an airport, taking into account all direct and one-stop connections available for each airport-pair. The model uses OAG passenger flight schedule data on direct flights as input.

Indirect connections are created within the model by connecting two direct flights, taking into account minimum and maximum connecting times between two flights. Indirect connections are possible at any given airport between:

i) flights of the same airline;
ii) flights of airlines working together in an alliance or through a codeshare agreement.

Subsequently, the model determines the quality of each connection. The quality ranges from zero to one. A direct, non-stop flight operated by a jet aircraft is given the maximum quality of one. The quality of an indirect connection will always be lower than one, since the travel time is longer due to transfer time and circuity time. The same holds true for a direct multi-stop connection or a direct connection operated by a turboprop: the quality of such connections is lower due to a longer travel time. Connections with a too long travel time relative to the theoretical direct flight time will be assigned a quality of 0. As such, these connections are considered to be unrealistic travel options for the passenger. Appendix C shows how the model determines the quality of individual connections.

In the NetScan model, connectivity is expressed in Connectivity Units (CNU). The CNU generated by an individual flight is equal to its quality. The CNU of an airport can be calculated by summing the CNUs of all individual (direct or indirect) connections that are offered from that airport. Lastly, the CNU of a country can be determined by summing the CNUs of the airports of that country.

1.2.2. Direct connectivity

Conclusion 8

Eastern European countries have shown the strongest direct connectivity growth between 2016 and 2019, largely driven by LCCs (e.g. over +40% for Bulgaria or Slovakia). Environmental concerns, airline bankruptcies and aviation taxes inhibited connectivity growth in some countries.

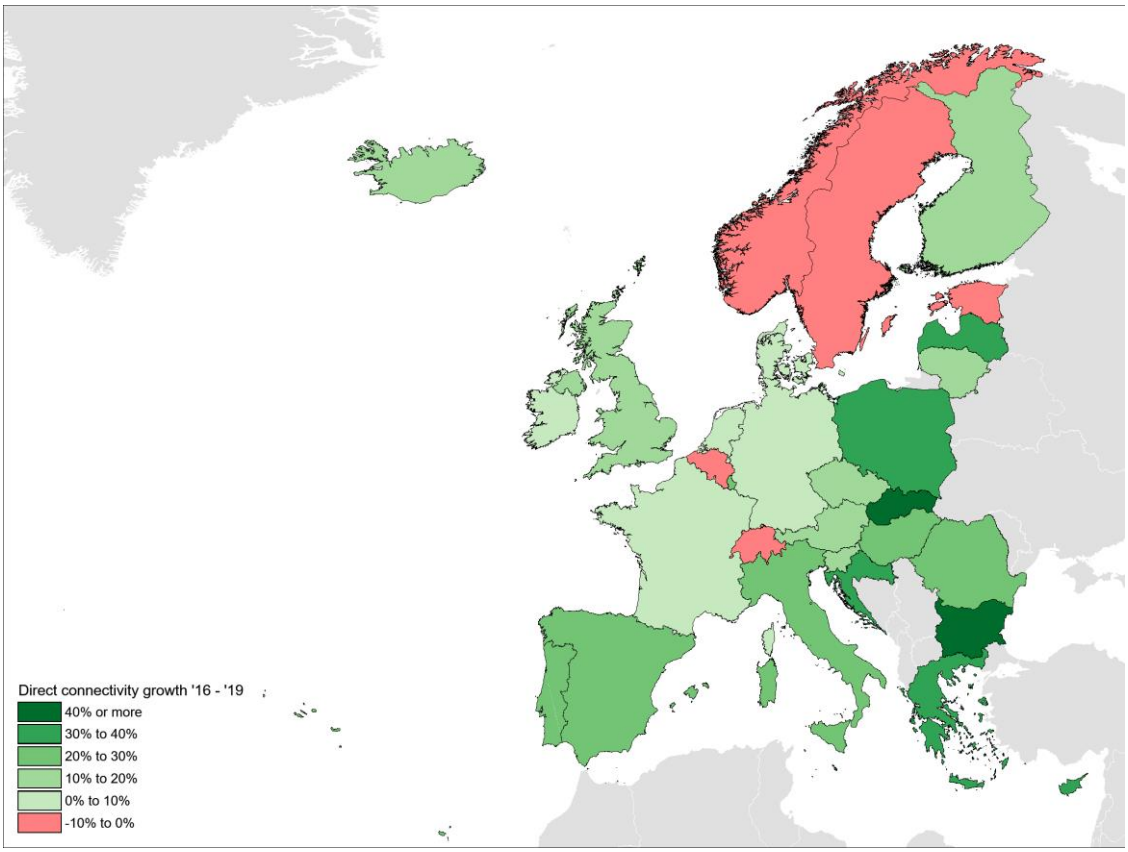
: Better geographical integration of Eastern Europe Member States through direct connectivity.

: Connectivity of Eastern Europe Member States' non-capital cities increased. Consumers can access to direct routes from other places in the country.

Direct connectivity presents the extent to which airports are connected through direct flights. This indicator presents the accessibility of an airport or country through the availability of direct flights.

In this paragraph we discuss the development of direct connectivity in the member states of the European Union (including the UK, Iceland, Norway and Switzerland) from 2016 to 2019.

FIGURE 9. DIRECT CONNECTIVITY GROWTH PER COUNTRY BETWEEN 2016 AND 2019



Source: Analysis SEO

At the EU+ level, direct connectivity increased by 12% between 2016 and 2019. Especially states in Eastern and Southern Europe have experienced strong growth, as shown in Figure 6. Countries experiencing the strongest growth include Slovakia (+97%), Bulgaria (+44%) and Malta (+43%). In absolute terms, the contribution of these countries to EU+ connectivity growth, however, remains relatively limited. Countries with the highest growth in absolute values are Spain, Italy, United Kingdom and Greece.

Four countries experienced a decrease in direct connectivity between 2016 and 2019: Belgium (-3%), Sweden (-4%), Norway (-6%) and Switzerland (0%). In Sweden, the introduction of a passenger tax in April 2018 likely is a reason for the decrease in direct connectivity. Moreover, the public attitude towards flying has changed, fuelled by the *flygskam* movement, possibly leading to an additional reduction in demand. In Norway, the aviation tax introduced in 2016 and revised in 2019, may also have impacted connectivity growth. In Belgium, the -3% connectivity decrease is mainly caused by a reduction of flights due to the bankruptcy of Flybmi in 2019 and to a lesser extent by the bankruptcy of Thomas Cook Belgium in 2017.[14] In Switzerland direct connectivity remained stable between 2016 and 2019. Whereas international connectivity (both intra and extra-EU) increased, the level of domestic connectivity decreased, following the bankruptcies of Darwin and SkyWork airlines, in 2017 and 2018 respectively.

At the EU+ level, all types of direct connectivity increased between 2016 and 2019. The extra-EU+ connectivity increased the sharpest, by +22%. This is mainly caused by strong connectivity growth to Africa (+36%), and to non-EU Europe (+27%). With regards to non-EU Europe, strong connectivity growth is observed to the Russian Federation (+33%), Ukraine (+103%) and Israel (+49%). The main growth markets in Africa are Morocco (+57%), Egypt (+67%) and Tunisia (+58%). The reason for the strong growth is probably a combination of more liberal comprehensive aviation agreements (Morocco, Tunisia , Ukraine and Israel), and the recovery of tourism after the Arab Spring.

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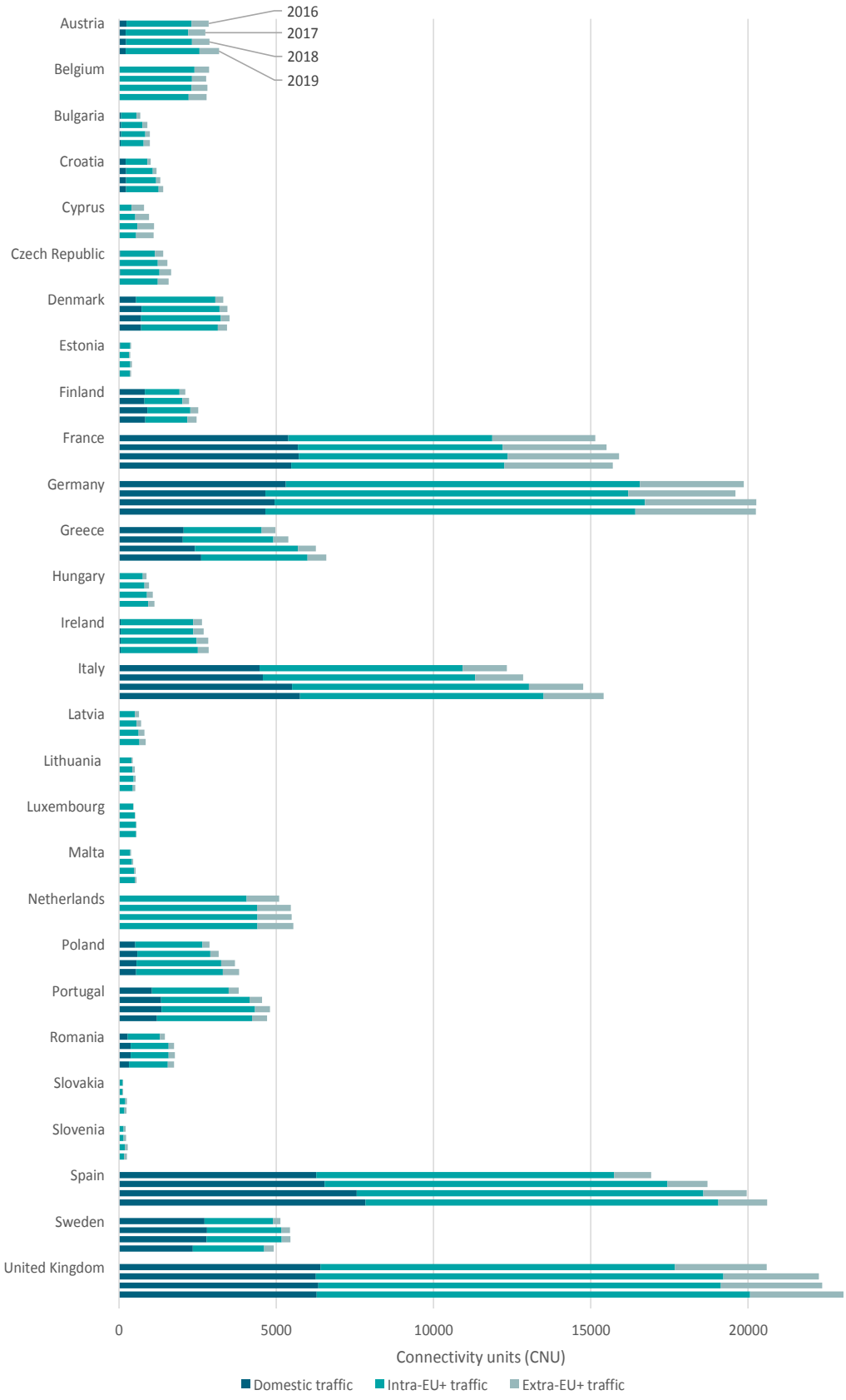
[14] https://www.independent.co.uk/travel/news-and-advice/flybmi-failure-airline-collapse-brexit-competition-passenger-rights-a8783031.html

Intra-EU+ connectivity increased by +14%. Only in Belgium (-8%), Iceland (-6%) and Denmark (-3%) the intra-EU connectivity decreased. Finally, domestic connectivity increased by +5%. Domestic connectivity is only relevant for a limited number of countries, as in most countries domestic traffic is very limited or even non-existent.

FIGURE 10. DIRECT CONNECTIVITY PER TYPE OF FLIGHT IN CONNECTIVITY UNITS (CNU)



Source: Analysis SEO

The majority of direct connectivity from EU+ airports is generated by intra-EU flights: 58% in 2019. The EU+ wide share of domestic and extra-EU connectivity is respectively 28% and 14%. Between 2016 and 2019 the share of domestic connectivity decreased by -2 percentage point, whereas the share of extra-EU connectivity increased by +1.1 percentage point.

1.2.3. Indirect connectivity

Conclusion 9

Eastern European Member States experienced strongest indirect connectivity growth, through improved connections via both EU and non-EU hub airports (+50% or more for countries like Lithuania or Slovakia between 2016 and 2019, against +17% at EU+ level). Large EU hub airports play an important role as gateway to other world regions.

: Better geographical integration of Eastern Europe Member States through indirect connectivity increase.

Indirect connectivity presents the extent to which airports are connected through connections at intermediate hub airports. This is an important measure to consider, as many EU airports rely on indirect connections to access most destinations. For this reason, adequate connections with hub airports are important to improve a country's connectivity.

At EU+-wide level, indirect connectivity increased by +17% between 2016 and 2019 (see Figure 8). There are only a few countries that did not witness double-digit growth. As was the case with direct connectivity, the fastest growing countries are located in Eastern and Southern Europe, whereas the slowest growing countries are situated in Northern and Western Europe.

Figure 9 breaks down the indirect connectivity development between 2016 and 2019 into connectivity provided to destinations within the EU+ (intra-EU+) and outside the EU+.[15] **At the EU+ level, the indirect intra-EU+ connectivity increased by +16%.** Only in Belgium (-3%), Austria (0%), Romania (0%) and Slovenia (0%) the indirect intra-EU connectivity did not increase.

The percentage growth of indirect extra-EU+ connectivity is slightly higher than that of direct intra-EU+ connectivity, namely +17%. The strongest indirect connectivity increase is observed to non-EU European countries (+27%) and Asia-Pacific (+24%). Important growth markets in both regions are Russia (+46%), China (+25%), Japan (+20%) and Thailand (+34%). Although less important in absolute terms, Colombia (+53%), Vietnam (+50%) and Ethiopia (+70%) show strong relative indirect connectivity growth rates between 2016 and 2019 as well.

The majority of indirect connectivity is to destination outside the EU+: Indirect extra-EU+ connectivity compromises more than 75% of total indirect connectivity. The reason for this is that indirect travel options are more attractive for long-haul flights. For short-haul, transfer and detour times comprise a larger part of the total travel time, leading to a lower quality of indirect connections. The share of extra-EU+ connectivity remains stable between 2016 and 2019.

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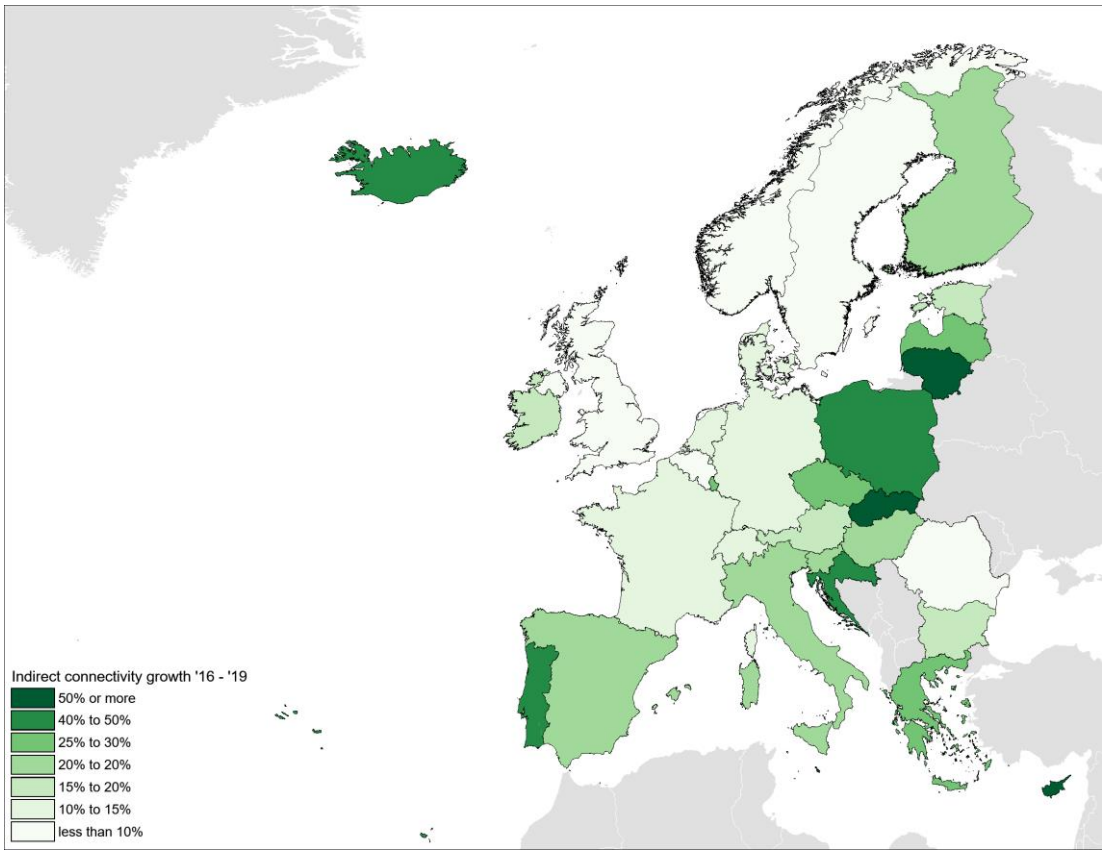
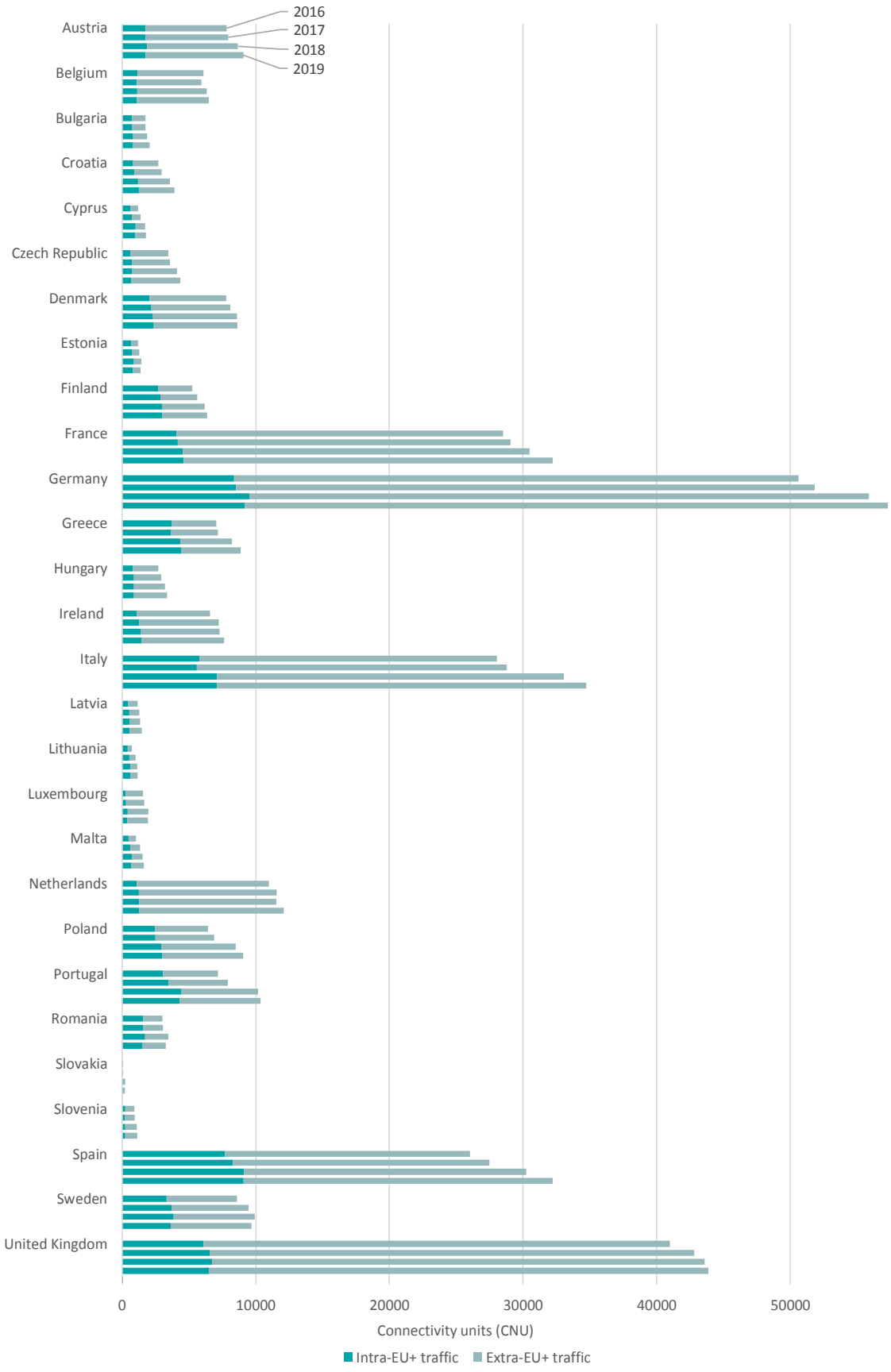
[15] *Indirect domestic connectivity is not displayed in a table, as the amount of indirect domestic connectivity is negligible. This is mainly caused by the low quality of such connections, as detour and transfer times tend to be long relative to the total flight time.*

FIGURE 11. INDIRECT CONNECTIVITY GROWTH PER COUNTRY BETWEEN 2016 AND 2019



Source: Analysis SEO

FIGURE 12. INDIRECT CONNECTIVITY PER TYPE OF FLIGHT (IN CONNECTIVITY UNITS (CNU)



Source: Analysis SEO with NetScan based on OAG schedules analyser

Table 11 and Table 12 zoom in on the top 10 largest and fastest growing 'onward hubs'. The ranking is based on the total indirect connectivity from all EU+ airports facilitated via these hub airports.

Table 11 **shows that the European hub airports of Frankfurt, Amsterdam, Munich and Paris Charles de Gaulle provide most indirect connectivity for EU+ countries. The most important non-EU intermediate hubs are Istanbul (IST) and Moscow Sheremetyevo (SVO)**, ranking 5th and 10th, respectively.

Hubs with a more central geographical location in Europe generally provide more indirect connectivity for EU+ airports, as their geographical location allows them to connect European airports to all world regions. Airports located closer to the European borders focus more on connecting specific markets. London Heathrow for example mainly functions as a gateway to North America, whereas Moscow Sheremetyevo or Istanbul provide mainly indirect connectivity between the EU+ and Asia/Pacific.

TABLE 12. TOP 10 MOST IMPORTANT 'ONWARD HUBS'

Ranking	Hub	CNU from EU+ airports via hub (2019)
1	Frankfurt (FRA)	39,398
2	Amsterdam (AMS)	27,395
3	Munich (MUC)	21,045
4	Paris Charles de Gaulle (CDG)	19,741
5	Istanbul (IST)	13,382
6	London Heathrow (LHR)	12,112
7	Madrid (MAD)	11,576
8	Zurich (ZRH)	9,440
9	Vienna (VIE)	9,048
10	Moscow Sheremetyevo (SVO)	7,897

Source: Analysis SEO with NetScan based on OAG schedules analyser

Table 13 **shows that the three most important hub airports are also the three fastest growing hub airports in absolute terms between 2016 and 2019.** In relative terms, **the role as an onward hub for EU+ airports has strongly increased for Warsaw (84%) and Dallas-Fort Worth (83%).** Interestingly, four of the ten fastest growing intermediate hubs are located in countries, which do not belong to the EU. These are Dallas-Fort Worth (DFW), Istanbul (IST), Moscow Sheremetyevo (SVO), and Zurich Airport (ZRH).

TABLE 13. TOP 10 FASTEST GROWING ONWARD HUBS

Ranking	Hub	CNU provided in 2016	CNU provided in 2019	Absolute growth	Relative growth
1	Munich (MUC)	15,988	21,045	5,057	32%
2	Frankfurt (FRA)	34,367	39,398	5,031	15%
3	Amsterdam (AMS)	23,501	27,395	3,894	17%
4	Moscow Sheremetyevo (SVO)	4,686	7,897	3,211	69%
5	Madrid (MAD)	8,890	11,576	2,686	30%
6	Istanbul (IST)	11,077	13,382	2,305	21%
7	Helsinki (HEL)	5,395	7,450	2,055	38%
8	Dallas Fort Worth (DFW)	2,121	3,888	1,768	83%
9	Zurich (ZRH)	7,681	9,440	1,759	23%
10	Warsaw (WAW)	1,777	3,265	1,488	84%

Source: Analysis SEO with NetScan based on OAG schedules analyser

1.2.4. Route openings and closures

Conclusion 10

In 2017 (+817 routes) and 2018 (+701 routes) European airlines opened substantially more new routes than they closed. LCCs were responsible for the majority of route openings. In 2019, on the other hand, the number of route closures outnumbered the number of route openings (-135 routes).

: From a consumer perspective, new routes opening shows increase of direct connectivity (and/or choice between operators). However, the slowdown in 2019 could mean a consolidation of the market.

In addition to the analysis of direct and indirect connectivity, insight in the development of route openings and closures shows how the offering of connections for EU+ citizens changes over time. This analysis presents the number of route openings and closures between 2016 and 2019. The winter and summer season[16] are considered separately, to prevent that seasonal routes are considered as opened or closed routes. For clarity reasons, this section focuses on the summer season only. Results for the winter season are included in Appendix B. and look similar to those for the summer seasons.

At the EU+-level the number of route openings outnumbered the number of route closures considerably in 2017 and 2018. In summer season, the net increase in the number of routes was +817 and +701, respectively. In 2017 69% of the new routes were opened by LCCs. In 2018 LCCs were responsible for 67% of the route openings. Interestingly, in 2019 the number of routes closures exceeded the number of route openings. The net decrease in the number of routes was -135. Compared to 2017 and 2018 the number of route closures increased substantially, whereas the number of routes openings remained roughly the same.

The fact that several airlines declared bankruptcy or were on the verge of bankruptcy in 2019 is one of the reasons why the number of route closures increased substantially in this year. For example, the default of Germania resulted in the closure of approximately 130 routes.[17] Most of these routes departed or arrived in Germany. For that reason the decline in the number of routes is highest in Germany in 2019 (-108 routes). Other airlines that went bankrupt are Flybmi in 2019 and SkyWork Airlines in August 2018.[18] Flybe and Norwegian Air are examples of airlines that ceased some of their routes in order to prevent their default.[19] The financial problems of the latter airline can explain the substantial decrease in the number of routes in Norway (-21 routes).

Besides Germany and Norway, the number of routes in Greece (-41 routes) and Sweden (-39 routes) is also considerable lower in summer 2019 compared to summer 2018 (see Table 13). Italy (+65 routes), The Netherlands (+22 routes), Malta (+21 routes) and Poland (+20 routes), on the other hand, have in comparison to summer 2018 considerably more routes in summer 2019. This rise in the number of routes is predominantly caused by an above average increase in LCC activity. As a result the share of LCCs in the number of route openings increased by +8 percentage point compared to 2018.

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[16] *The IATA winter season runs from the last Sunday of October and ends on the last Saturday of March; the summer season starts on the last Sunday of April and ends on the last Saturday of October*

[17] *https://www.bbc.com/news/business-47127921*

[18] *https://www.bbc.com/news/uk-47267901* ; *https://www.derbund.ch/wirtschaft/unternehmen-und-konjunktur/skywork-airlines-stellt-betrieb-ein/story/24765644*

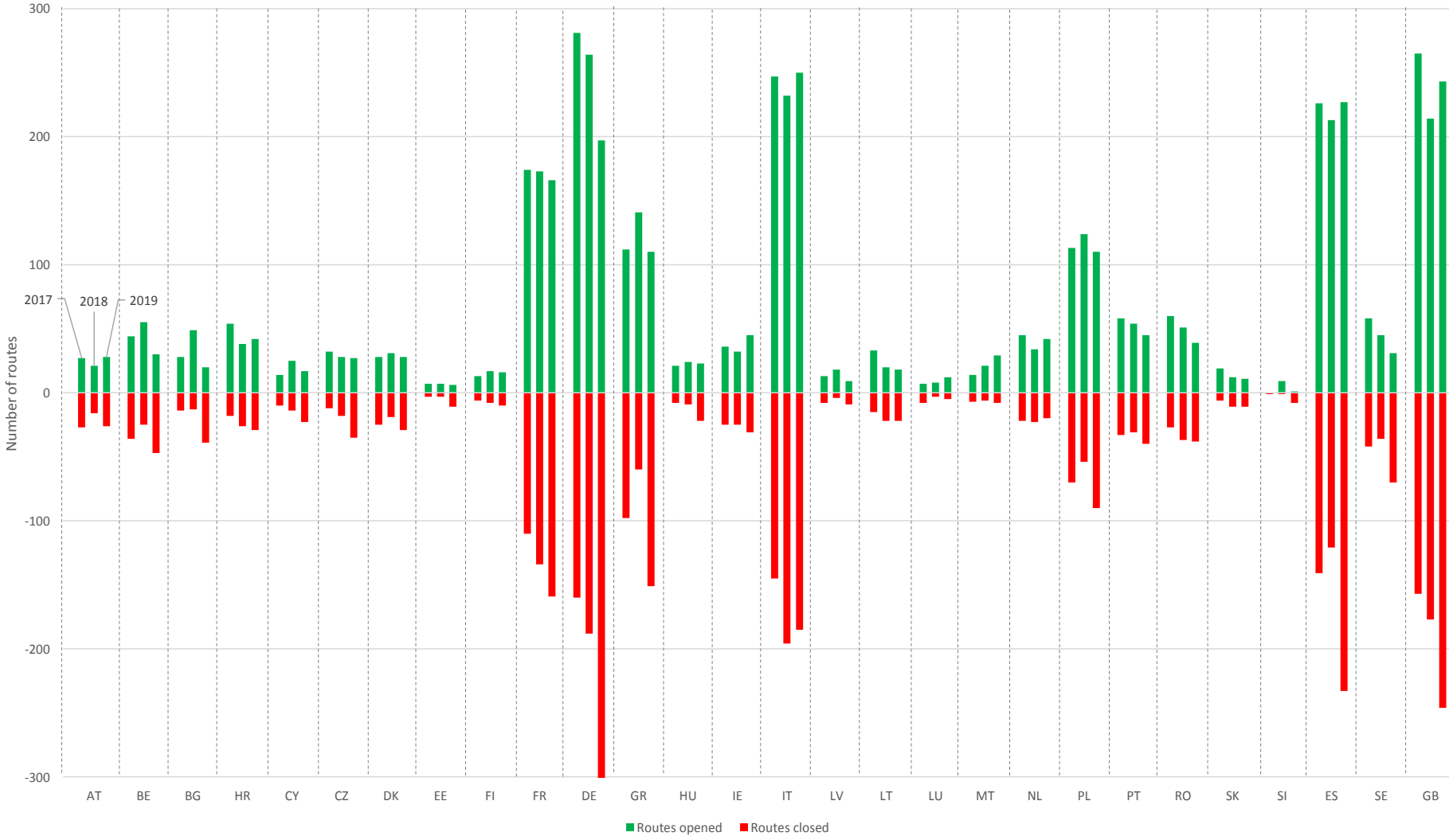
[19] *https://www.theguardian.com/business/2019/apr/03/flybe-cancels-dozens-of-flights-because-of-operational-issues* ; *https://www.reuters.com/article/uk-norwegian-air-routes-idUSKCN1PA2HH*

TABLE 14. NUMBER OF ROUTE OPENINGS AND CLOSURES PER COUNTRY – SUMMER SEASON

	2017			2018			2019		
Country	Openings	Closings	*Difference*	Openings	Closings	*Difference*	Openings	Closings	*Difference*
Austria	27	27	***+0***	21	16	***+5***	28	26	***+2***
Belgium	44	36	***+8***	55	25	***+30***	30	47	***-17***
Bulgaria	28	14	***+14***	49	13	***+36***	20	39	***-19***
Croatia	54	18	***+36***	38	26	***+12***	42	29	***+13***
Cyprus	14	10	***+4***	25	14	***+11***	17	23	***-6***
Czech	32	12	***+20***	28	18	***+10***	27	35	***-8***
Denmark	28	25	***+3***	31	19	***+12***	28	29	***-1***
Estonia	7	3	***+4***	7	3	***+4***	6	11	***-5***
Finland	13	6	***+7***	17	8	***+9***	16	10	***+6***
France	174	110	***+64***	173	134	***+39***	166	159	***+7***
Germany	281	160	***+121***	264	188	***+76***	197	305	***-108***
Greece	112	98	***+14***	141	60	***+81***	110	151	***-41***
Hungary	21	8	***+13***	24	9	***+15***	23	22	***+1***
Iceland	30	4	***+26***	14	15	***-1***	2	18	***-16***
Ireland	36	25	***+11***	32	25	***+7***	45	31	***+14***
Italy	247	145	***+102***	232	196	***+36***	250	185	***+65***
Latvia	13	8	***+5***	18	4	***+14***	9	9	***0***
Lithuania	33	15	***+18***	20	22	***-2***	18	22	***-4***
Luxembourg	7	8	***-1***	8	3	***+5***	12	5	***+7***
Malta	14	7	***+7***	21	6	***+15***	29	8	***+21***
Netherlands	45	22	***+23***	34	23	***+11***	42	20	***+22***
Norway	81	92	***-11***	53	57	***-4***	48	69	***-21***
Poland	113	70	***+43***	124	54	***+70***	110	90	***+20***
Portugal	58	33	***+25***	54	31	***+23***	45	40	***+5***
Romania	60	27	***+33***	51	37	***+14***	39	38	***+1***
Slovakia	19	6	***+13***	12	11	***+1***	11	11	***0***
Slovenia	0	1	***-1***	9	1	***+8***	1	8	***-7***
Spain	226	141	***+85***	213	121	***+92***	227	233	***-6***
Sweden	58	42	***+16***	45	36	***+9***	31	70	***-39***
Switzerland	28	21	***+7***	44	18	***+26***	24	42	***-18***
United Kingdom	265	157	***+108***	214	177	***+37***	243	246	***-3***
EU+	2,168	1,351	***+817***	2,071	1,370	***+701***	1,896	2,031	***-135***

Source: Analysis SEO with NetScan based on OAG schedules analyser

FIGURE 13. NUMBER OF ROUTE OPENINGS AND CLOSURES PER COUNTRY – SUMMER SEASON



Source: Analysis SEO with NetScan based on OAG schedules analyser

1.3. Airline and airport competition

1.3.1. Introduction

This chapter zooms in on airline competition (paragraph 1.3.2) and airport competition (paragraph 1.3.3). We use two indicators for competition: the Herfindahl-Hirschman Index (HHI) and the number of effective competitors. These indicators will be explained in the subsequent paragraphs. In the chapter we focus on differences in competition between the markets for domestic, intra-EU+ and extra-EU+ flights per EU+ country.

1.3.2. Airline competition

Conclusion 11

The level of airline competition varies across EU+ countries. Competition is lower in Central and Eastern Europe, where in many cases one LCC dominates the market. Countries in which large network carriers compete head to head with one or more LCCs include Spain, Portugal and The Netherlands.

: LCCs have been the main providers of new direct routes in Central and Eastern Europe, especially in secondary cities. As a result, consumers often have the choice of only one LCC for routes from these airports to the major regional cities in these countries.

1.3.2.1. Market concentration (HHI)

In this subsection we will examine the changes in airline competition from 2016 to 2019. The Herfindahl-Hirschman Index (HHI) is used to measure airline competition,[20] and is further explained in Appendix B.

The Herfindahl-Hirschman Index (HHI) to measure airline competition

The HHI is a measure for market concentration. Since an increase in market concentration is generally accompanied by a decrease in the degree of competition the HHI can also be used as a measure for competition. One can calculate the HHI of a market by adding up the squared market shares of the firms that operate in that market. The resulting HHI ranges from 0 till 1. A HHI of 0 indicates perfect competition, whereas a HHI of 1 indicates a monopoly. So, an increase in the index indicates a decrease in the degree of competition.

To measure airline competition using the HHI indicator, we use airline market shares per origin-destination market. In the calculation of the HHI we take into account airline alliances. When an alliance is active on a market we calculate the HHI on the basis of the market share of the alliance (instead of the market shares of the individual member of that alliance). The HHI on a specific origin-destination market is calculated by summing the squared market shares in terms of passengers for every airline that operates on that market. This is best explained using an example:

Consider, as an illustration, the market Brussels (BRU)-Hong Kong (HKG), with three active airlines and 10,000 passengers per year. The market shares are distributed as follows:

Airline	Route	Passengers	Market share
Cathay Pacific	BRU-HKG (direct)	6000	60%
Lufthansa	BRU-FRA-HKG (1 stop)	2500	25%
Aeroflot	BRU-SVO-HKG (1 stop)	1500	15%

Note: Figures for illustrational purposes

The HHI on this market is now defined by the sum of the squared market share per airline, i.e.:

$$HHI_{BRU-HKG} = 0.6^2 + 0.25^2 + 0.15^2 = 0.36 + 0.0625 + 0.0225 = 0.445$$

Consequetily, the HHI of a country is obtained by determining the average HHI on the markets departing from that country, weighting each market by the total number of passengers on that market.

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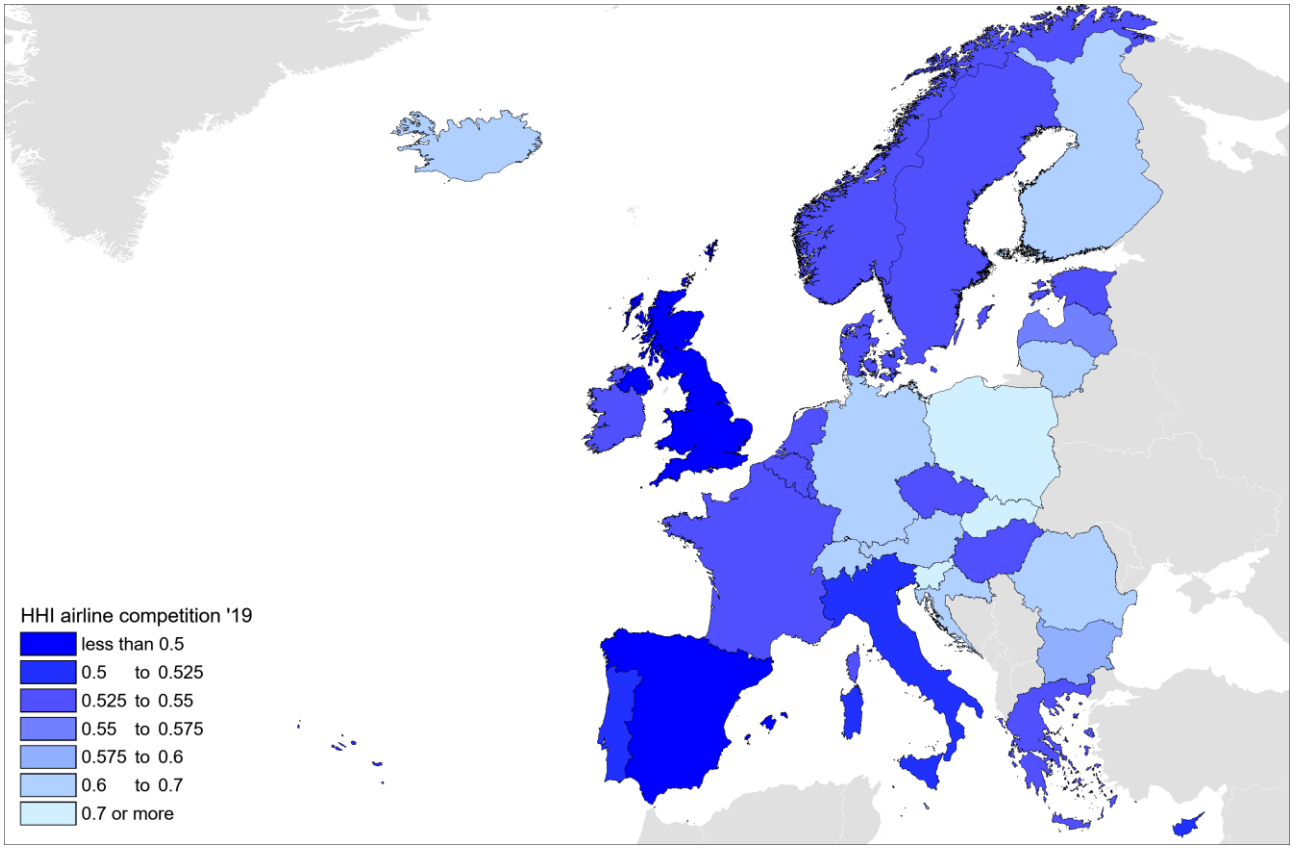
[20] *Airline competition is measured at city-pair level, where a city may be served by multiple airports. Appendix E provides the list of multi-airport cities used in this report.*

Figure 13. presents the level of airline competition per country in 2019 (tables with detailed figures for all years and EU+ countries are included in Appendix C). **Slovakia, Slovenia and Poland have the highest level of market concentration, and thus the lowest level of competition in the EU+.** Slovakia and Slovenia do not have a very dominant home carrier, but the various airlines apparently do not compete on the same routes. Poland, on the other hand, has a strong home carrier (LOT) at Warsaw airport, as well as ample LCC presence. However, the extent to which these carriers compete on the same origin-destination pairs is rather limited. **Spain, The United Kingdom and Portugal have the highest level of competition among the EU+ countries.** A large number of routes from these countries are served by multiple carriers. In Spain, the fact that the countries hub hosts two hub operations (by Iberia and Air Europa) contributes to the high level of competition. Recently however, Iberia's parent company IAG agreed to acquire Air Europa.[21] This might lead to a reduction of competition in Spain in the near future.

FIGURE 14. AIRLINE COMPETITION (HHI) PER COUNTRY IN 2019



Source: Analysis SEO

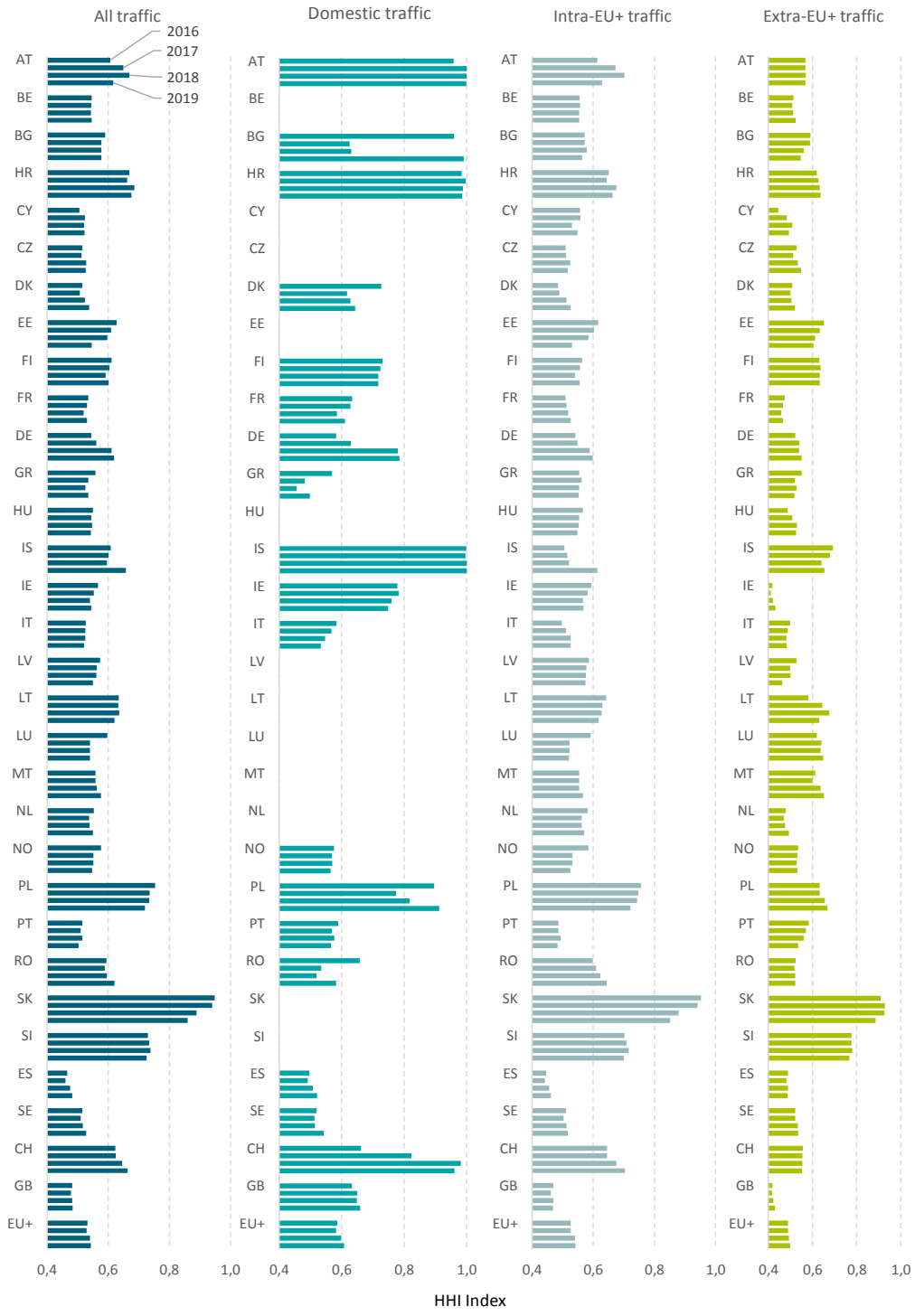
The level of airline competition remained relatively stable at EU+ level over the last four years. At country level, **steep increases in HHI are observed in Germany (+14%), Iceland (+8%) and Switzerland (+6%) between 2016 and 2019 (see also Table 32 in Appendix C). In other words, the degree of competition decreased in these countries.** An important reason for the decrease in the degree of competition in Germany is the bankruptcies of Air Berlin (including Niki) in 2017 and Germania in 2019. The default of WOW Air in 2019 likely is one of the reasons for the decline in the degree of competition in Iceland. Lastly, the defaults of Darwin Airline and SkyWork Airlines in Switzerland played a role in the decrease in competition in that country.

[21] https://www.euronews.com/2019/11/04/iberia-owner-iag-buys-rival-air-europa-for-1-billion-to-boost-madrid-hub

Figure 14. breaks down the airline competition level per state into domestic,[22] intra-EU+ and extra-EU+ traffic. **At the EU+ level, there appears to be more competition on extra-EU+ markets than on domestic and intra-EU+ markets. This is largely attributable to the fact that on long-haul routes more passengers makes use of one of the many indirect routings.**

For Germany and Switzerland, this breakdown shows that the decreases in airline competition in particular materialise in the domestic market. In these respective countries, the market concentration on the domestic market increases by +35% and +45%. In Iceland, the market concentration on the intra-EU+ market increases substantially, by +21%, following the bankruptcy of WOW Air.

FIGURE 15. AIRLINE COMPETITION (HHI) PER COUNTRY BY TRAFFIC TYPE



[22] *The HHI of the market for domestic traffic is shown only for member states with at least 150,000 domestic passengers per year.*

Source: Analysis SEO based on OAG schedules analyser

1.3.2.2. Number of competitors per route

An alternative indicator of airline competition is to determine the average number of competitors that are active on a route,[23] providing a comprehensible indicator for route level competition. Appendix B outlines how the average number of competitors per route is determined.

Number of competitors per route

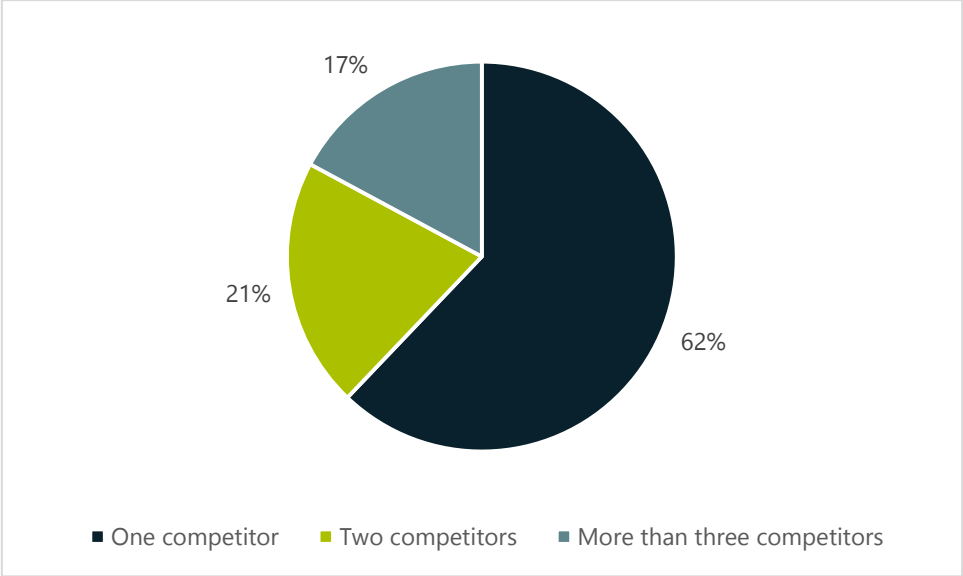
Whereas the HHI focuses on market concentration per origin-destination market, the number of competitors per route focuses on the number of active airlines per flight segment.

The number of competitors per route is determined using monthly flight OAG schedule data. An airline is considered to be active on a route if it operates at least once a week on that route. At country level, the average number of competitors per route is then calculated over all routes from that country, weighting for the total number of passengers per month on that flight segment.

There are on average 3 effective airline competitors per route departing from an EU+ airport (see Figure 17). Figure 13 shows, on the other hand, that 62 percent of the routes that depart from an EU+ airport are served by only one airline. The number of passengers on these routes is, however, limited. As a result these routes do not have a decisive influence on the EU+-wide average of the number of effective airline competitors. **At the EU+ level the average number of effective airline competitors remained stable over the past four years.** For most EU+ countries, all changes in the average number of effective airline competitors are between -0.3 and 0.3. Luxembourg (+0.6 competitors), Estonia (+0.5 competitors) and Bulgaria (+0.4 competitors) are the exceptions. An important reason for the increase in the number of effective airline competitors in Luxembourg is the expansion of easyJet and Ryanair in this country.

Figure 17. provides insight into differences in competition between the EU+ countries in 2019. Airline competition based on the number of airline competitors shows a similar pattern as the market concentration (HHI) analysis. In 2019, the competition between airlines is the most fierce in the United Kingdom (4.5 competitors), Cyprus (3.4 competitors), Spain (3.3 competitors) and Portugal (3.2 competitors). In Slovakia (1,3 competitors), Slovenia (1,7 competitors) and Poland (1,7 competitors), on the other hand, the competition between airlines is relatively limited.

FIGURE 16 SHARE OF EU+ ROUTES WITH ONE,TWO OR MORE THAN THREE COMPETITORS



Source: Analysis SEO based on OAG schedules analyser

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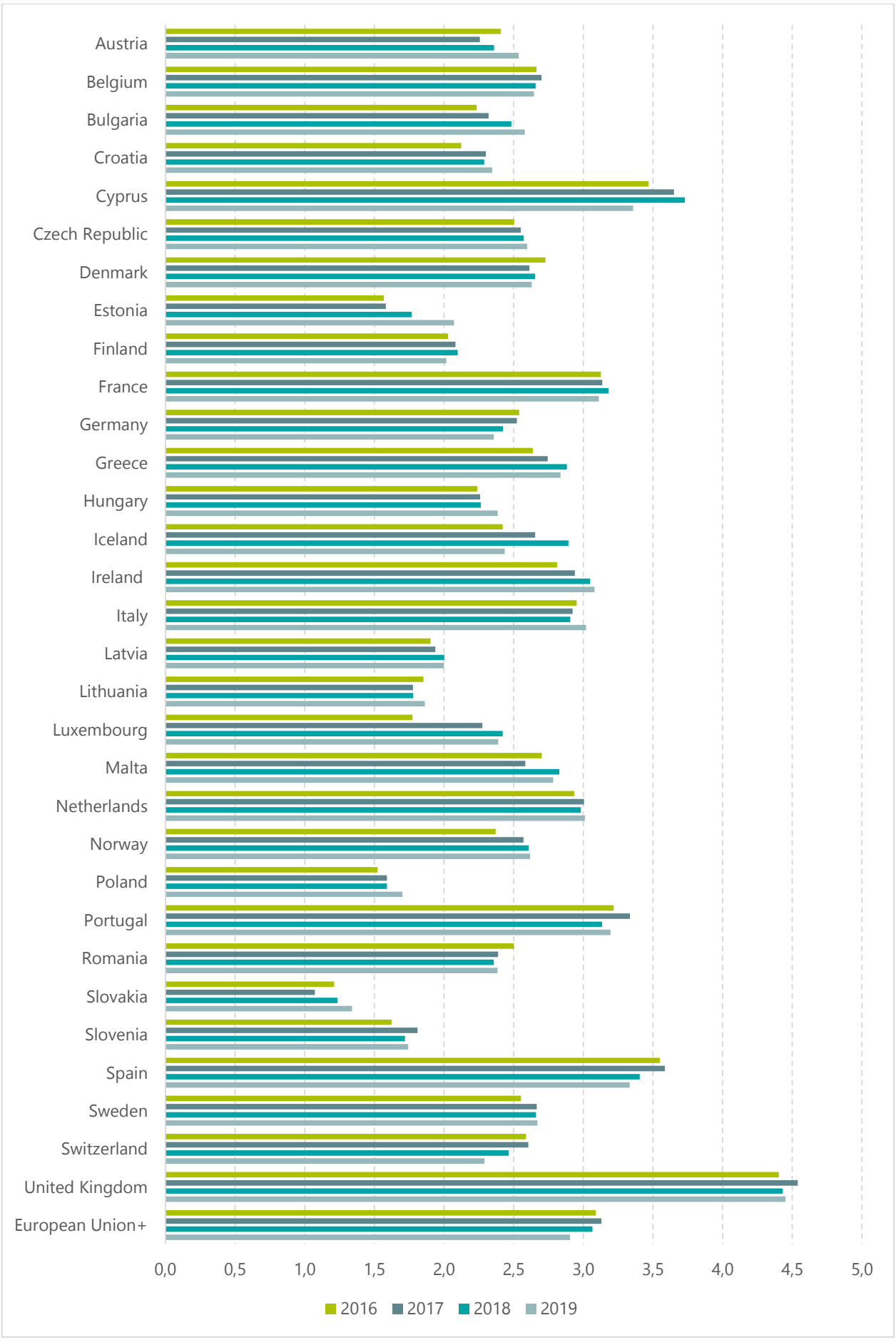
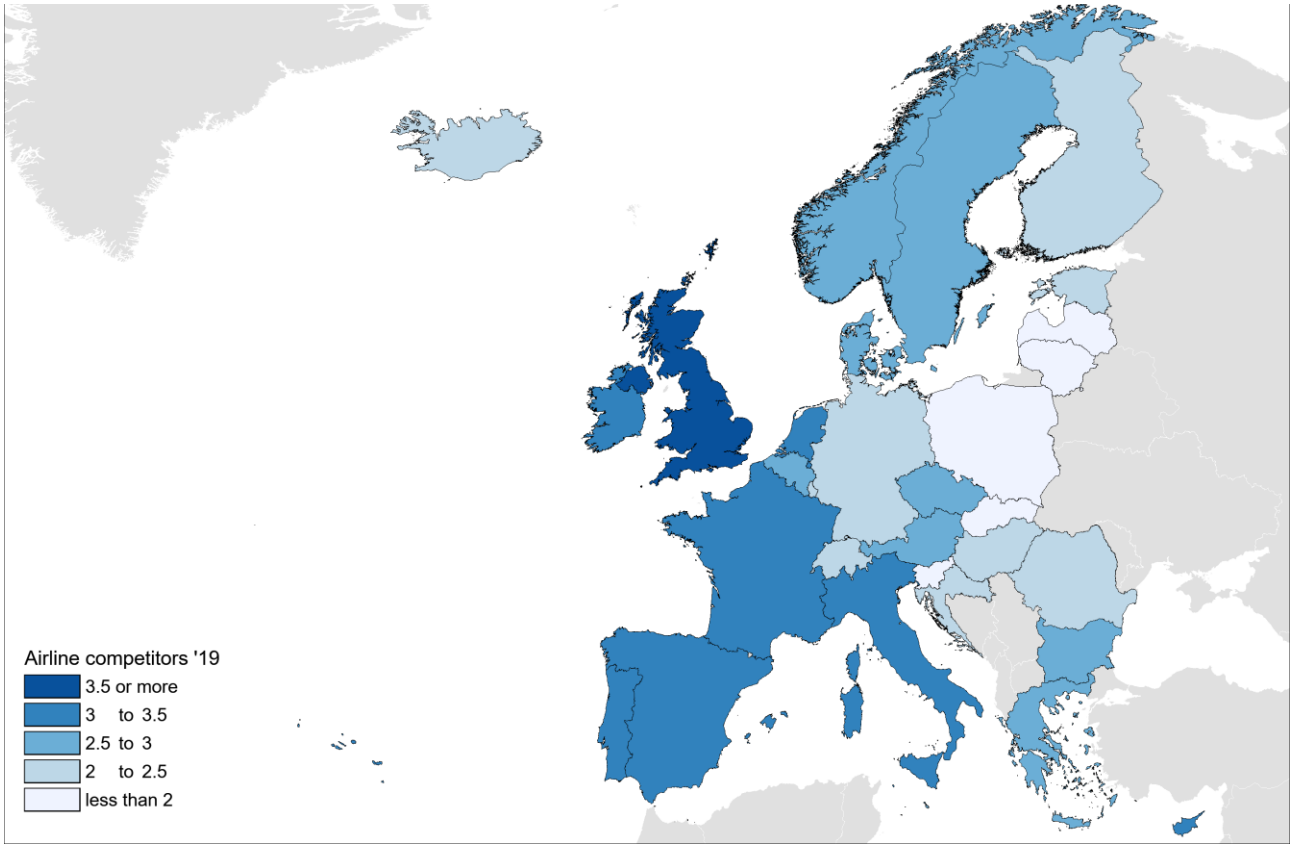
[23] *A route is defined as a city-pair, where multiple airports can serve one city. A list of multi-airport cities is provided in Appendix E.*

FIGURE 17 EFFECTIVE NUMBER OF AIRLINE COMPETITORS PER ROUTE PER COUNTRY



Source: Analysis SEO based on OAG schedules analyser

FIGURE 18. NUMBER OF EFFECTIVE AIRLINE COMPETITORS PER COUNTRY IN 2019



Source: Analysis SEO

1.3.3. Airport competition

Conclusion 12

Airport competition strongly varies across EU+ countries. Especially in Eastern European countries airport competition is limited, as there is generally one airport serving the majority of traffic. Mainly in Western Europe airports face more competition from other airports, either in the same country of across the border.

: To some extent, airport coverage in Central and Eastern European countries can be improved to ensure easy access to mobility for their citizens.

: Consumers in Western European Member States can often choose between several airports to make a trip.

This paragraph presents the development of airport competition between 2016 and 2019. While airports compete in different ways (see box below), the analyses in this paragraph focus on airport competition in the origin-destination markets, from a consumer perspective. As such, the results indicate the choice availability of different departure airports for passengers travelling to/from a certain city or region.

It should be noted that passengers primarily choose for an airline to reach their destination, even though they might have preferences for a specific airport. Airports compete to attract airlines to use their infrastructure and services to serve a certain geographical market. Airlines (mainly) decide on the routes they serve, which drives the ultimate choice for the consumer.

The results from the assessment from a consumer perspective also provides insight in the extent to which a city or region is served by different airports, which is an indication for the choice of airports that airlines have to serve a certain geographical market.

How airports compete

Airports compete in different ways: (i) Competition within the origin-destination market; (ii) competition in the transfer market; (iii) competition for airline operations. This box explains the three forms of competition. The analyses in this chapter focus purely on the first type of competition.

Competition within the origin-destination market

Airports serving the same catchment area compete for OD-passengers travelling to or from the same catchment area. The Brussels region is, for example, served by both Brussels Zaventem and Brussels South-Charleroi. A passenger travelling from Brussels to Barcelona has the choice to depart from either airport.

Competition in the transfer market

Hub airports all over the world compete for transfer passengers. For example, a passenger travelling from Brussels to Los Angeles has a choice to travel via Amsterdam Schiphol, Frankfurt, London Heathrow, New York JFK, and a vast number of other competing hubs. These transfer markets tend to be very competitive, as passengers usually do not have a strong preference for a specific hub airport: the choice for a certain alternative is mainly based on travel time and ticket price.

Competition for airline operations

Besides airport competition for passengers, airports are also in competition to attract airlines. Some smaller (regional) airports have experienced steep traffic growth through base openings by LCCs. These airlines are often attracted through competitive airport charges or ample capacity during peak hours. However, LCCs are relatively flexible in opening and closing new bases, and have done so in various cases over the last years. Airports do not only compete for LCC operations, also for (relatively footloose) cargo flights operators are able to choose between various airports. The same holds for non-European carriers, which generally look for only a limited number of entry points within Europe.

Airport competition also exists for the hub operation of European network carriers. The Lufthansa Group, for example, operates various larger and smaller hubs in Europe at Frankfurt, Munich, Vienna, Zurich, and

Brussels. Also other airline groups operate multiple hubs, including Air France-KLM (at Paris Charles de Gaulle and Schiphol Airport), SAS (at Copenhagen, Stockholm Arlanda and Oslo), and IAG (at London Heathrow, Madrid, and Dublin). As network development is generally coordinated at airline group level, hub airports do compete on where growth is concentrated. This choice is mainly driven by (local) demand and the availability of slot and terminal capacity, but also on the quality of services at airports.

In line with the analysis of airline competition, both the HHI and the number of competing airports are used as indicator to assess airport competition. Appendix B outlines how the indicators are computed.

Airport competition indicators

The first step in the assessment of airport competition is to determine which airports are competitors. Airports are considered to be competitors if they serve the same catchment area. Based on discussion with the European Commission, an airport is considered to compete with another airport if it is located within 2 hours driving time. The Google Maps distance matrix API is used to calculate the travel time between all EU airports, in order to determine all competing airports.

Once the competitors for each airport are defined, for each route the market share per competing airport is determined. This is best explained by an example:

The competing airports from Brussels Airport are Brussels South-Charleroi, Eindhoven, Liège, Lille, Maastricht, Ostend and Rotterdam-The Hague. Suppose the destination Malaga (AGP) in Spain is served from Brussels Airport and three of the competing airports, with the following traffic figures:

Airline	Total passengers (all airlines)	Airport market share
Brussels Airport (BRU)	6000	40%
Brussels South (CRL)	2500	17%
Eindhoven (EIN)	5000	33%
Rotterdam-The Hague (RTM)	1500	10%

Note: Figures for illustrational purposes

Then the level of airport competition in terms of HHI is determined by:

$$HHI_{BRU-AGP} = 0.4^2 + 0.17^2 + 0.33^2 + 0.10^2 = 0.2 + 0.029 + 0.109 + 0.01 = 0.348$$

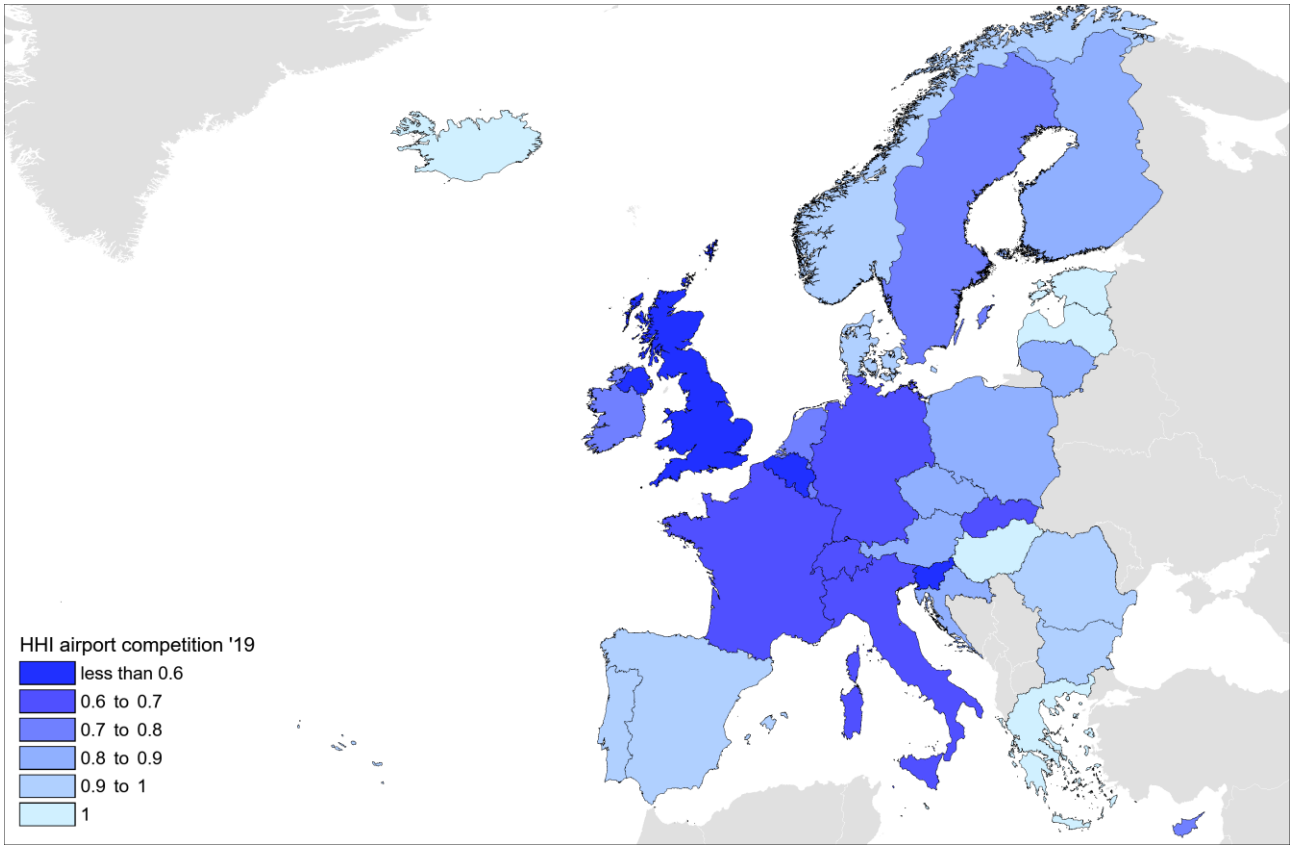
The average HHI per country is determined by calculating the average route level HHI, weighted for the number of passengers per route. The HHI on the country level (that is reported in Figure 20) provides insight into the degree of competition that airports in this country encounter. A low HHI indicates that the airports in the country have to compete with other airports in the neighbourhood (both in the country itself and in other countries) that offer flights to the same destination. A high HHI, on the other hand, indicates that the airports do not have to compete with other airports.

In line with the assessment on airline competition, we also determine the number of competing airports. Similarly to the airline analysis, an airport is said to compete if it serves the same route with at least one weekly flight. In the example above, the number of number of competing airports would be 4. The average number of competitors is computed by taking the average number of airport competitors per route from the respective country, weighing for the total number of passenger per route.

1.3.3.1. Market concentration (HHI)

Figure 18. **shows that there is strong variation in airport competition across European countries. Especially countries in Eastern Europe have limited competition between airports in the origin-destination market.** Estonia, Latvia, Malta, Iceland, Hungary, Greece, Romania and Bulgaria all have an HHI of (almost) 1, which implies that there are no (or hardly) competing airports. In the case of Malta, Iceland and Greece, this is largely related to their geography: many airports are located at islands. For the other countries, the low level of airport competition may be caused by a relatively small market size, for which the co-existence of multiple airports is unviable. Moreover, traffic is often concentrated in specific parts of the country, served by a single airport. Also other geographical factors and/or infrastructure quality can increase surface access times, and therefore limit airport competition.

FIGURE 19. HHI PER COUNTRY IN 2019 – AIRPORT COMPETITION

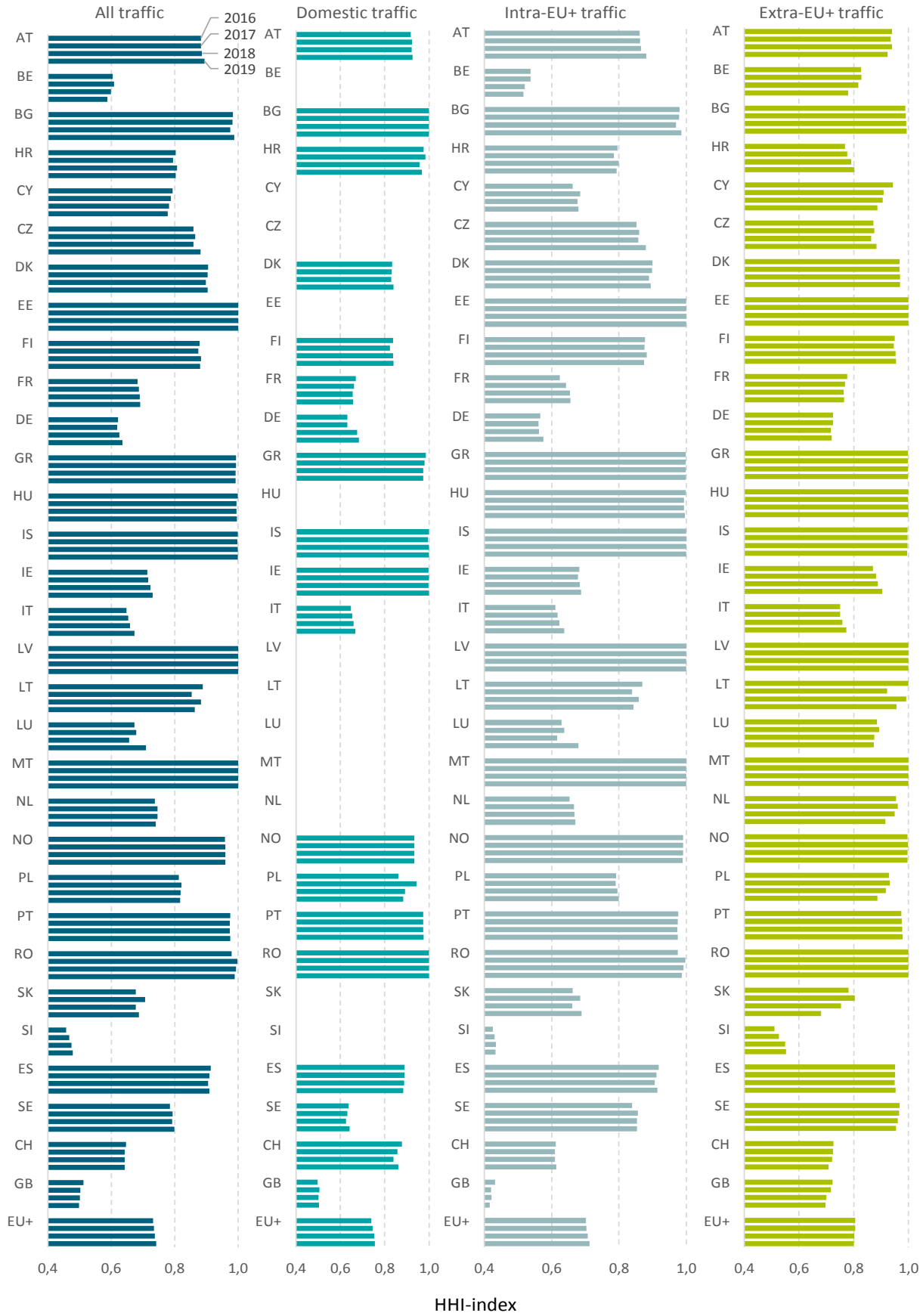


Source: Analysis SEO

Figure 19. shows the development of airport competition between 2016 and 2019, and breaks down airport competition over domestic, intra-EU+ and extra-EU+ traffic. **Between 2016 and 2019 the level of airport competition remained relatively stable. At country level, there are some specific developments. For example, the HHI of the market for domestic flights increased by 8 % in Germany.** This decrease of competition is mainly related to the bankruptcy of Air Berlin (including Niki) in 2017.

Airport competition is highest for intra-EU+ traffic, followed by domestic traffic. For extra-EU+ traffic airport competition is relatively limited. In general, intercontinental air traffic is mainly located at larger airports, whereas secondary airports focus more strongly on intra-EU+ traffic.

FIGURE 20. HHI PER COUNTRY – AIRPORT COMPETITION



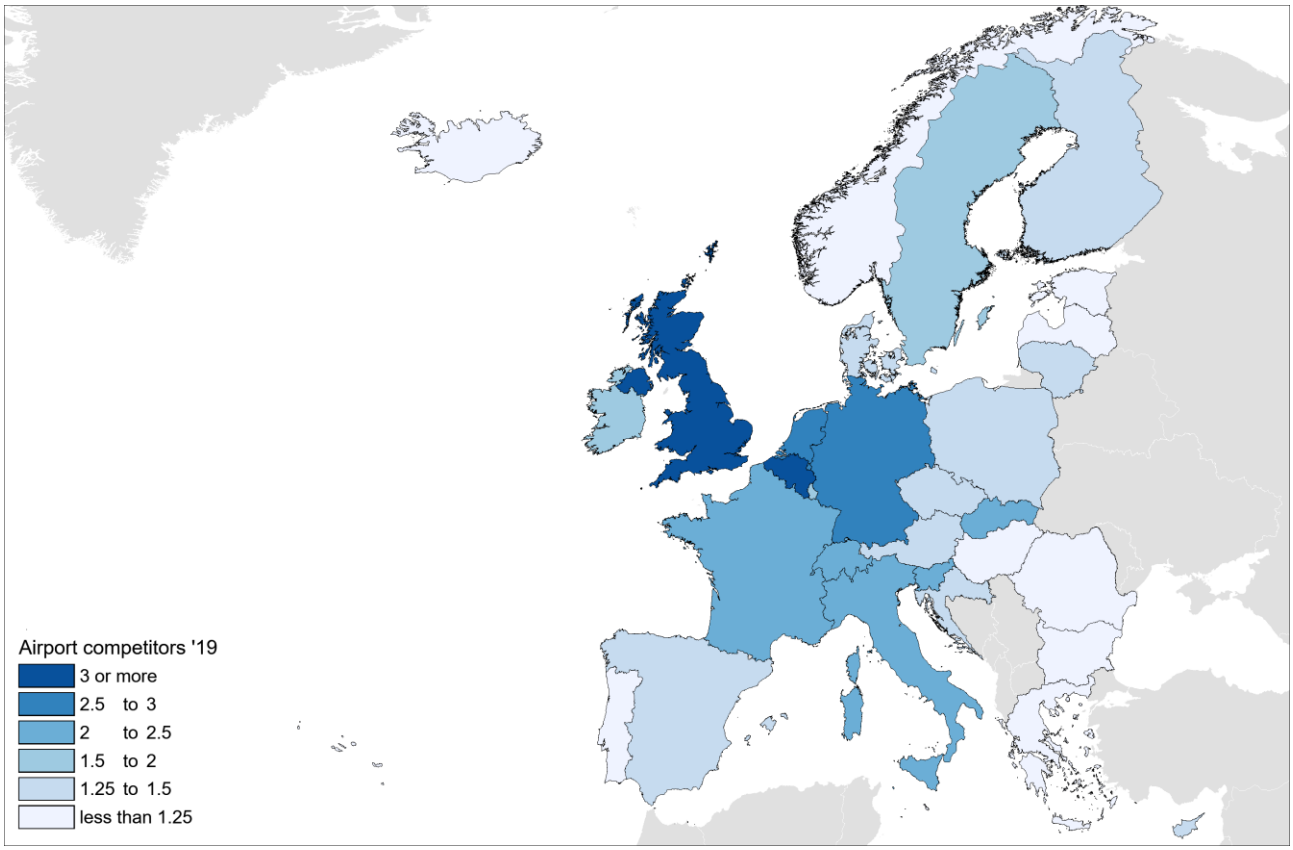
Source: Analysis SEO based on OAG schedules analyser

1.3.3.2. Number of competing airports

Passengers departing from the EU+ can on average choose between two different departure airports for travelling to their desired destination. As also shown in the market concentration analysis, airport competition strongly varies between countries (see Figure 20. and Figure 21.). There are numerous countries where the average number of airport competitors is close to or equal to one (i.e. no or hardly competition). These are, among others, Portugal, Greece, Hungary, Iceland and Estonia. **On the other side of the spectrum there are countries with an average number of airport competitors well above 2, including the United Kingdom (3.6 competitors), Belgium (3.2 competitors), the Netherlands (2.9 competitors) and Germany (2.6 competitors).**

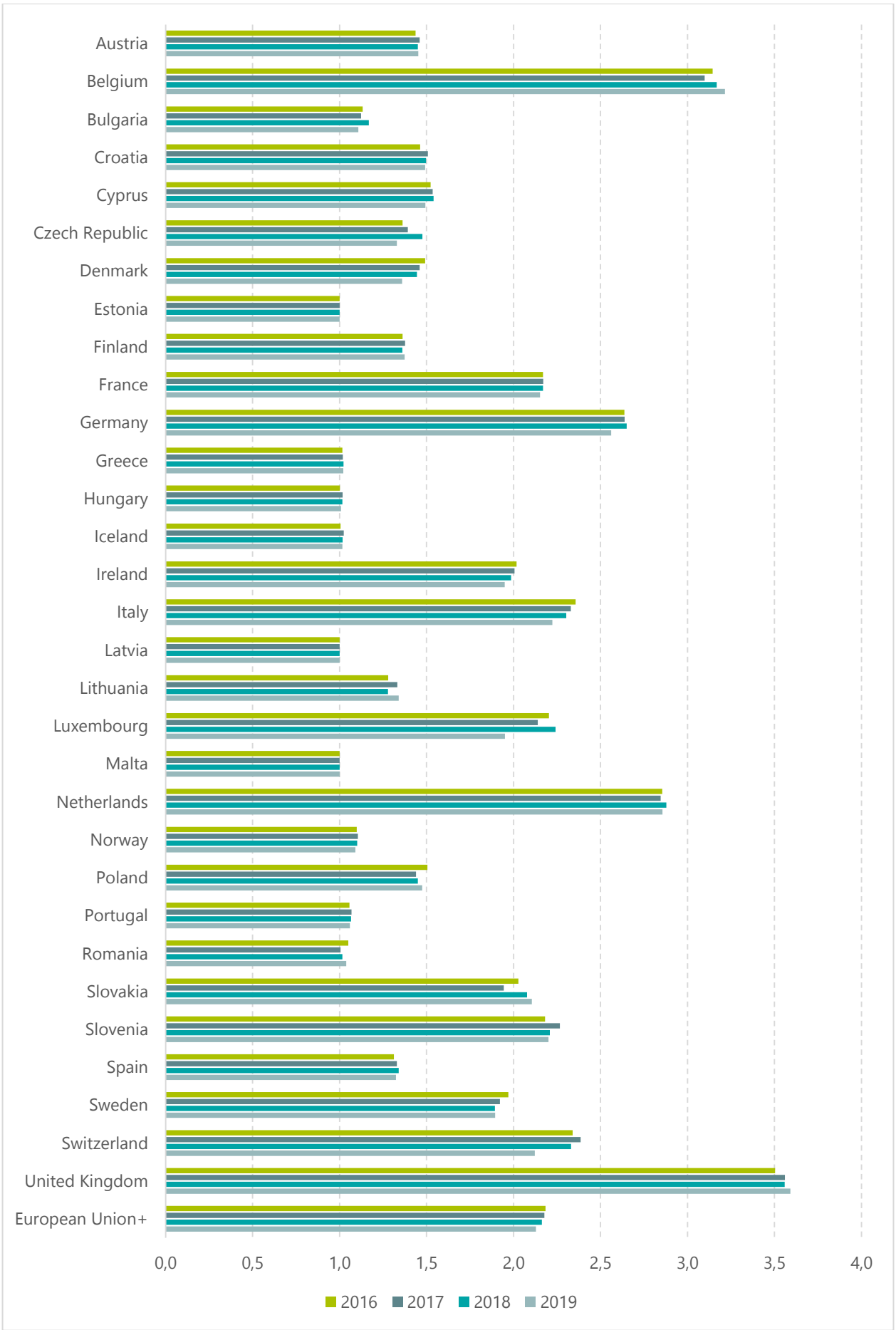
The number of competing airports is relatively stable over time. This is not very surprising, as the opening or closure of airports is generally a long-term process. Small changes occur in various countries, driven by changes in the route networks of competing airports.

FIGURE 21. NUMBER OF EFFECTIVE AIRPORT COMPETITORS PER COUNTRY IN 2019



Source: Analysis SEO

FIGURE 22. AVAILABLE COMPETING AIRPORTS PER DESTINATION PER COUNTRY



Source: Analysis SEO based on OAG schedules analyser

2. TRENDS & DEVELOPMENTS

2.1. Key Trends

2.1.1. Aviation Policy

2.1.1.1.1. Environmental policy

Conclusion 13

An adverse shift in public attitude towards air travel could eventually put into question aviation's "social license".

Market-based measures, sustainable aviation fuels, ATM modernisation and more fuel efficient aircraft can make a significant contribution to help decarbonise EU aviation in line with the 2050 climate objectives whilst maintaining its competitiveness.

Carbon trading schemes are generally considered more cost-effective than taxes, especially where revenues can be used to support the deployment of CO_2 mitigation measures.


: Decarbonisation is also beneficial for the people living in the vicinity of the airport in terms of air quality.

Conclusion 14

Because international aviation rules consider intra-EU flights not as domestic but international flights, introduction of an **EU aviation fuel tax** is currently not an option, except where negotiated amongst EU member states on a bilateral basis, or as part of a comprehensive air services agreement between the EU and third country.

While **fuel taxes for domestic aviation** do exist in some non-EU countries (including India, Japan, Mexico, Thailand and the U.S.), the applicable rates are relatively modest.

The use of **emissions trading** is growing in other parts of the world (including China, Japan, Mexico, Thailand and the US) but the EU ETS is currently the only scheme to include aviation activities.

EU Member States have been early supporters and adopters of **CORSIA** rules, together with G7 countries, whereas several other major economies (including Brazil, China, India) have so far declined.

Offsetting of flight emissions is emerging as a trend amongst airlines, complementing to some extent the international scope of CORSIA.

More ambitious and wide-spread policy incentives is expected to accelerate and scale up **SAF** uptake in Europe.


: The emergence of offsetting flight emissions may have a positive effect on the attitude of citizens towards aviation.


: The cost of taxes, emissions trading, offsetting and SAF incentives are likely to be passed on to the final consumer.

Conclusion 15

While operational and modal changes make essential contributions towards reducing aviation's climate impact, an accelerated introduction of innovative new aircraft designs combined with a sharp rise in SAF use appears to be indispensable for achieving mid- and long-term aviation climate goals.


: Innovative aircraft design ensures quieter and greener aircraft, increasing the acceptance of local residents.


: Exploring new areas of technology and development leads to additional job opportunities in the aeronautical sector.

2.1.1.1.2. Introduction & Wider policy context

The **European Green Deal** (EGD), adopted by the European Commission in December 2019, aims for an EU-wide transition towards a resource-efficient, green, sustainable and competitive low-carbon economy, putting green growth at the heart of EU policy. In the words of EC President von der Leyen, the EGD will help Europe to "*become the world's first climate-neutral continent by 2050*".[24] Concretely, the EGD looks to enshrine the 2050 climate-neutrality target into a European Climate Law while increasing the emissions reduction target for 2030 from 40% to between 50% and 55%, compared with 1990 levels.[25] In doing so, it will ensure that regions and sectors most affected by the transition receive the financial and technical support they require through the EGD's Just Transition Mechanism (JTM).[26]

Sustainable Mobility features amongst the seven key policy areas of the EGD. With civil aviation's share of total EU transport greenhouse gas (GHG) emissions estimated at 13.9% (2017), the EGD highlights the need for a 90% reduction in overall transport emissions by 2050. [27]

With regards to **carbon pricing** measures with specific relevance for aviation, the EGD mentions the need to end fossil fuel subsidies and to reduce free allowance allocations to aircraft operators under the EU ETS. The European Commission further expects Single European Sky (SES) reform to help *"cut up to 10% of air transport emissions*" (…) *"at zero cost to consumers and companies*". [28]

At the same time, the EU will focus on building an "Economy that Works for People" that is future-ready and delivers stability, jobs, growth and investment. Specifically, EU economic policy should support wider societal and environmental goals, including the UN Sustainable Development Goals (SDGs).[29] How best to marry these policy objectives and apply them to the EU aviation sector in an international context is one of the key questions that this section of the report seeks to address.

The EU is also actively working with other countries and regions to achieve the goals of the **Paris Agreement**[30]. The EU's current nationally determined contribution (NDC) under the Paris Agreement is to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990, under its wider *2030 climate and energy framework*.

Overview of Aviation Sector in Europe

Sustainability and decarbonisation objectives embodied in the EGD contrasted starkly with the air traffic growth in Europe until 2019. According to the European Aviation Environmental Report[31], the number of flights in the EU increased by 8% between 2014 and 2017 and is forecast to grow by 42% from 2017 to 2040 – however all this needs to be reviewed and reassessed in light of the recent COVID-19 pandemic.

Aviation GHG emissions in the EU have more than doubled since 1990 and were 29% higher in 2017 than in 2000, making aviation the second most important source of transport GHG emissions after road traffic. Emissions from the sector have increased each year between 2013 and 2017, at an annual average rate of 3 %. In 2017, GHG emissions from aviation represented 3.9 % of EU GHG emissions.[32]

Technological improvements, fleet renewal and increased operational efficiency have been able to only partially counterbalance the impact of traffic growth. And while improvements in aviation's environmental efficiency (expressed in average fuel burn per passenger kilometre flown) were expected to continue [33] ,

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[24] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[25] Mission Letter from U. von der Leyen to EVP-designate F.Timmermans, 10 September 2019
[26] https://ec.europa.eu/info/files/just-transition-mechanism-making-sure-no-one-left-behind_en
[27] https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6726
[28] Ibid.
[29] Mission Letter from U. von der Leyen to EVP-designate V.Dombrovskis, 10 September 2019
[30] https://ec.europa.eu/clima/policies/international/negotiations/paris_en
[31] European Aviation Environmental Report 2019 (EASA 2019)
[32] https://www.eea.europa.eu/themes/transport/term/increasing-oil-consumption-and-ghg
[33] Improvements of a further 12% by 2040 are mentioned by EASA

predictions were that CO_2 emissions from EU aviation would increase by at least 21% over the next two decades.[34]

2.1.1.1.3. Market-based measures to decarbonise aviation

License to grow

As emissions from non-transport sources decline, emissions from aviation became increasingly significant during the past years. European aviation today represents about 20% of global aviation's CO_2 emissions.[35] EU citizens, in particular younger generations, are becoming increasingly sensitive to the climate impact of aviation.

A negative shift in public attitude towards air travel could eventually put into question aviation's social license to continue to grow its activities. The European aviation sector, to win public acceptance, will have to proactively engage with stakeholders' climate concerns and integrate sustainable climate solutions into its business strategies.

Market-based measures (MBMs) have the potential to further the decarbonisation of air travel by incentivising the uptake of new equipment and technologies (including sustainable aviation fuels (SAF)) and improved infrastructure and operations. These measures may affect the competitiveness of EU aviation players in the global market in different ways.

Ongoing efforts towards decarbonisation of EU aviation may require a fundamental paradigm shift in response to growing societal pressures to further increase climate ambitions. This dynamic may however create opportunities to promote a step-change in the way EU governments perceive the role and development of the EU aviation sector in years to come. A comparative analysis of the extent to which EU and non-EU aircraft operators are exposed to the effects of the various types of MBMs will provide valuable insights in this respect.

Methodology

The main objective in this section of the report is to undertake a comparative analysis of the extent to which EU and non-EU airlines are subject to regulatory measures aimed at the decarbonisation of the aviation sector.

Specific questions this report seeks to address include:

- What are the general trends in the adoption of regulatory measures aimed at the decarbonisation of aviation in different world regions?
- Which region(s) have experienced the strongest uptake of CO2-related MBMs for aviation?
- To what extent can 'smart regulations' be used to incentivise the decarbonisation of aviation in the EU?
- Is there any evidence to suggest that MBMs aimed at decarbonisation of the aviation sector have had (or will have) adverse effects on the competitiveness of EU airlines?
- In response to increased climate ambitions, what more can be done to responsibly accelerate decarbonisation of the EU aviation sector?

To catalogue existing MBMs the analysis relies on available information from a wide range of sources, including databases, reports and research papers from leading public and private organisations and institutions, as well as news articles.

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[34] *European Aviation Environmental Report 2019 (EASA 2019)*

[35] *idem*

Adopting a focused, factual approach that prioritizes advanced MBMs, the emphasis in our analysis will be on taxation, emissions trading, carbon offsets and regulatory incentive schemes. Other types of levies and duties (e.g. NO_x and noise charges, VAT) which, admittedly, may produce side-benefits in terms of CO_2 mitigation, have been de-emphasized in our analysis.

Further, a comprehensive collection of information about relevant SAF-incentive schemes across world regions was found not to be readily available. The information in this report, therefore, has been compiled from the bottom up using literature and online research.

Brazil, China, India, Indonesia, Japan, Mexico, Thailand, UAE and the United States have been selected in this report as countries representing "world regions" for the purposes of carrying out the comparative analysis between the EU and non-EU aviation markets.

Analysis of the effects of selected MBMs is predominantly of a descriptive nature, illustrated and explained through several informative case studies, based on information from available literature.

A general description of the categories of MBMs considered in the report is as follows:

- **Taxation**

  In the context of aviation policy, a clear distinction exists between charges levied in relation to specific services provided (e.g. by airports or air navigation service providers) and taxes levied to generate revenues for national treasuries. To the extent that taxes are reflected in air fares, this may dampen air travel demand in certain markets and generate some associated CO_2 reductions. However, international agreements, including the Chicago Convention on International Civil Aviation, do not allow for taxation of fuel that is on board of aircraft when they land in a jurisdiction, while other policies adopted under the UN's International Civil Aviation Organization (ICAO) also urge States to refrain from taxing international aviation.[36]

- **Emission trading**

  Emissions trading systems (ETSs) have advanced both in established markets and in emerging economies, as a cost-effective way to address GHG emissions that cannot otherwise be avoided or reduced. In 2018/2019, analysis carried out for the WorldBank[37] identified 28 ETSs in regional, national and subnational jurisdictions covering an estimated 15% of global emissions (GHGs).

- **Carbon offsetting**

  In a further effort to address the effects of growing air transport emissions, carbon offsetting programmes have been adopted throughout the aviation sector with a growing number of airlines offering their passengers the opportunity to offset CO_2 emissions from their flight. Internationally, ICAO has been establishing the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) since 2016. The monitoring, reporting and verification of CO_2 emissions is in place since 2019 while the offsetting part of the scheme will be implemented in 3 phases, starting with the early participation of countries on a voluntary basis from 2021[38]. It aims to compensate for any annual increase in total CO_2 emissions from international civil aviation above 2020 levels. As of June 2020, 85 countries, representing 76.8 % of international aviation activity, intended to voluntarily participate in the GMBM scheme from its outset.[39]

- **Sustainable aviation fuels incentives**

  Sustainable aviation fuels (SAF) have the potential to make an important contribution to mitigating the current and expected future environmental impacts of aviation. Policy measures to incentivise SAF

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[36] https://www.politico.eu/wp-content/uploads/2019/06/Aviation-taxes.pdf

[37] *"State and Trends of Carbon Pricing 2019" State and Trends of Carbon Pricing (June), World Bank, Washington, DC.*

[38] *Pilot Phase (2021-2023), First Phase (2024-2026), Second Phase (2027-2035). The pilot and first phases are voluntary while the second phase must be regarded as a compulsory one for those Member States with an individual share of international activities in the year 2018 above 0.5% of RTK or whose cumulative share is 90% of global RTK.*

[39] https://www.icao.int/environmental-protection/CORSIA/Pages/state-pairs.aspx

production and uptake can come in various forms, including zero rating, reduced compliance obligations, mandates, credits, targets and direct funding. In 2018, the global aviation body IATA (International Air Transport Association) set out a target for one billion passengers to fly on aircraft using a mix of clean energy and fossil fuels by 2025.[40]

[40] https://www.iata.org/en/pressroom/pr/2018-02-26-01/

2.1.1.2. Analysis of aviation market-based measures in Europe and selected regions

2.1.1.2.1. European Union

Taxation

Aircraft fuel, other than that used in private pleasure-flying, is exempt from excise duty in the EU.[41] However, EU Member States can tax aviation fuel for domestic flights and, through bilateral agreements, also fuel used for intra-EU flights. In such cases, Member States may apply a level of taxation below the minimum level set out in the Energy Tax Directive.

The EU tax exemption of aircraft fuel is rooted in the provisions of the 1944 ICAO Chicago Convention, Article 24. Mutual fuel tax exemptions also exist in numerous bilateral air service agreements between the EU and third countries. [42]

Because international aviation rules consider intra-EU flights not as domestic but international flights, introduction of an EU aviation fuel tax is currently not an option, except where negotiated amongst EU member states on a bilateral basis, or as part of a comprehensive air services agreement between the EU and a third country. While fuel taxes for domestic aviation do exist in some of the non-EU countries considered in this report (including India, Japan, Mexico, Thailand, and the U.S.), the applicable rates are relatively low (€ 0.01/L – € 0.15/L) when compared to the minimum excise duty rate for kerosene under the EU Energy Tax Directive which is € 0.33/L.

Considering taxes other than fuel excise duties, most European countries levy either standard or reduced VAT rates on domestic flights [43] while several amongst them (Austria, France, Germany, Italy, Norway, Sweden, and the United Kingdom) apply different types of ticket- and passenger taxes.

Overall, in 2018, the United Kingdom levied the highest taxes on aviation in the Europe, at an average of €40.04 per passenger. Italy (€22.82), and Norway (€19.98) levied the second and third highest taxes, followed by Germany (€18.12) and France (€15.41).[44]

It should be noted that in many cases specific categories of passengers (e.g. transit passengers, connecting passengers, passengers on PSO routes, children under the age of two) are exempted from departure taxes. In other cases, differentiated tax levels are applied according to passenger categories, travel class or flight distance.

Finally it should be also mentioned that the European Green Deal acknowledges the crucial role of taxation in the transition towards a greener and more sustainable European growth and the need to better align our taxation

Towards an EU Aviation Tax?

In 2019, the finance ministers of Belgium, Bulgaria, Denmark, Germany, France, Italy, Luxemburg, the Netherlands, and Sweden appealed to the European Commission for the introduction of an EU-wide aviation pricing mechanism to address the sector's growing emissions.

The UK and France have imposed aviation taxes since the 1990s while Germany and Austria introduced a ticket tax in 2011. Norway followed in 2017, and Sweden in early 2018. Italy also imposes an embarkation tax, as well as a passenger service fee. The Netherlands is said to be planning its own aviation (departure) tax in 2020 "unless an EU agreement is reached before then."

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[41] *Energy Tax Directive 2003/96/EC (Article 14(1)(b)).*

[42] *For example the EU/US Air Transport Agreement (2007/339/EC) states: "There shall also be exempt, on the basis of reciprocity, from the taxes, levies, duties, fees and charges […] with the exception of charges based on the cost of the service provided:[…] fuel, lubricants and consumable technical supplies introduced into or supplied in the territory of a Party for use in an aircraft of an airline of the other Party engaged in international air transportation."*

[43] International air travel is VAT-exempt

[44] *https://taxfoundation.org/aviation-taxes-europe-2019/*

systems with EU climate objectives. The Energy Taxation Directive 2003/96 lays down the EU rules for the taxation of energy products used as motor fuel or heating fuel and of electricity, and since its adoption in 2003, there has not been any revision. The European Green Deal Communication announces two initiatives in the field of taxation:

Pending

- Revising the Energy Taxation Directive (ETD), with the aim to reflect more accurately the climate impact of the various sources of energy and to encourage consumers and businesses to change their behaviour;
- Creating a Carbon Border Adjustment Mechanism (CBA).

DG TAXUD has already launched the work on the preparation of the impact assessment of the ETD to inform the Commission's decision before proposing an amendment to the Directive by June 2021. The Commission has also begun its assessment of the CBA and will propose a design for such a measure. An external study will be conducted in the course of 2020 to gather data and assess the different options.[45]

Emissions trading

Aviation was integrated into the European Union Emissions Trading Scheme (EU ETS) by Directive 2008/101/EC. As of 1 January 2012, all aircraft operators who operate flights that arrive at or depart from an airport in the European Economic Area (EEA) [46] became subject to the scheme. This includes both EU and non-EU aircraft operators.[47] According to Annex I of the EU ETS Directive, over 5,000 aircraft operators were covered by the scheme in 2019, from about 170 different jurisdictions.[48]

In order to promote momentum in ICAO and to facilitate the operationalisation of CORSIA, the 2017 aviation EU ETS review extended the restriction to intra-EEA scope until 31 December 2023.[49] EU ETS legislation[50] further mandates the European Commission to assess key CORSIA elements and developments and consider ways to implement these instruments in EU law, taking into account the Union's economy-wide GHG emission reduction commitment for 2030.

According to EASA, between 2013 and 2020, an estimated net saving of 193.4 Mt CO_2 (twice Belgium's annual emissions) will be achieved by aviation via the EU ETS through funding of emissions reduction in other sectors.[51]

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[45] *https://ec.europa.eu/taxation_customs/european-green-deal-taxation-customs_en*

[46] *EU Member States plus Iceland, Liechtenstein and Norway*

[47] *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance)*

[48] *See Commission Regulation (EU) 2019/226 of 6 February 2019*

[49] *Regulation (EU) 2017/2392 of the European Parliament and of the Council of 13 December 2017 amending Directive 2003/87/EC to continue current limitations of scope for aviation activities and to prepare to implement a global market-based measure from 2021*

[50] *See art. 1 (7) of Regulation (EU) 2017/2392*

[51] *EASA, European Aviation Environmental Report 2019*

Carbon offsetting (Incl. CORSIA)

All 44 Members of the European Civil Aviation Conference (ECAC), including those of the EU/EEA, have announced their participation in the first phase of CORSIA from 2021. CORSIA participation may create offset obligations for European operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

Recently, several airlines (including Air France, British Airways and JetBlue) announced their intention to offset their own domestic flight emissions [52] [53] [54] - or in the case of Easyjet, the full emissions from all its flights. [55] Several airlines and booking sites offer the option of offsetting to their customers.

CORSIA and SAF

ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) foresees in the possibility for aeroplane operators to claim emissions reductions – and hence lower their offset obligations - from the use of CORSIA-eligible fuels. To facilitate this mechanism, ICAO in 2019 published supporting documentation outlining Sustainability Criteria for CORSIA Eligible Fuels as well as a Methodology for Calculating Actual Life Cycle Emissions Values.

As highlighted in the report, operators based in countries participating in CORSIA will be able to benefit from this incentive mechanism.

SAF incentives

Policy measures to incentivise the production and uptake of SAF for the European aviation sector exist in various forms, including zero rating under the EU ETS, reduced compliance obligations under CORSIA, tradeable credits (e.g. in the UK), mandates and targets under the EU Renewable Energy Directive. As set out in the European Green Deal, the European Commission is assessing legislative options to boost the production and uptake of SAF.[56] The introduction of a range of possible SAF incentive measures is under consideration, including a blending mandate, revision of the REDII multiplier (see below) as well as auctioning and funding mechanisms.

Renewable energy directive (REDII)

In June 2018, the EU Commission, Parliament and Council reached agreement on the recast of the Renewable Energy Directive (REDII), which introduced a 14% renewable energy target ("minimum share") for the transportation sector and a 3.5% advanced biofuels [57] sub-target by 2030. The Directive[58] specifies national renewable energy targets for 2020 for individual EU Member States, ranging from a low of 10% in Malta to a high of 49% in Sweden. The Directive further stipulates that "*For the purposes of demonstrating compliance with the minimum shares*" (…) "*the share of fuels supplied in the aviation and maritime sectors shall be considered to be 1.2 times their energy content*". [59]

Individual EU/EEA Member States have adopted a variety of policy instruments to meet the targets in the Directive, for example:

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[52] https://corporate.airfrance.com/en/press-release/air-france-proactively-offset-100-co2-emissions-its-domestic-flights-january-1st-2020

[53] https://mediacentre.britishairways.com/pressrelease/details/86/2019-319/11662

[54] http://blog.jetblue.com/offset-jan-2020/

[55] http://corporate.Easyjet.com/~/media/Files/E/Easyjet/pdf/investors/results-centre/2019/fy19-release.pdf

[56] *https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12303-ReFuelEU-Aviation-Sustainable-Aviation-Fuels*

[57] *Defined in Annex IX, Part A of the Renewable Energy Directive*

[58] *Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources*

[59] *"with the exception of fuels produced from food and feed crops"*

A recent energy agreement signed by the Danish government focuses on widespread electrification for road transport, with biofuels to be used mainly for heavy-duty vehicles and aviation.[60]

In Sweden, the government has a target for a 70% reduction in GHG emissions in the transportation sector by 2030 compared to 2010 – however, this excludes aviation.[61]

The Italian government supports the introduction of advanced biofuels with mandates and the issuance of tradeable certificates (CICs). However, aviation biofuels cannot currently opt into the mandate and are not eligible to receive CICs.

The Netherlands updated its renewable fuel mandate in 2011 to grow from 4.25% to 10% in 2020. It also increased its advanced biofuels mandate from 0.6% in 2018 to 1% by 2020. [62] Aviation biofuels are not subject to the mandate, but bio-kerosene producers can opt in.

The United Kingdom's 2008 Renewable Transportation Fuel Obligation (RTFO) includes a biofuel mandate of 6% in 2018. Renewable aviation fuels used in the UK are eligible to opt into the programme. The RFTO also includes a market-based credit trading system using Renewable Transport Fuel Certificates (RTFCs). Aviation fuels are one of the fuel types qualifying for RTFCs.

In 2018, Norway's Ministry of Climate and Environment announced it will require aviation fuel to contain at least 0.5 % advanced biofuel starting in 2020.[63]

In addition, as part of the EU's Horizon 2020 Work Programme, specific project funding has been put towards facilitating the introduction of SAF into major EU airports.[64]

Under the EU ETS [65] biomass use has a unique designation of an emissions factor of zero, meaning that operators with 100% biomass combustion have no CO_2 emissions to report and are not held to surrender emissions allowances. The definition of 'biomass' includes 'biofuels', i.e. "liquid or gaseous fuel for transport produced from biomass". In this sense, the EU ETS constitutes a support scheme within the meaning of the EU Renewable Energy Directive.[66]

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[60] *"New Danish energy agreement secured: 50 % of Denmark's energy needs to be met by renewable energy in 2030," State of Green, accessed November 8, 2018, https://stateofgreen.com/en/partners/ state-of-green/news/new-danish-energy-agreement-a-green-focus-towards-2030/.*

[61] *Government Offices of Sweden, "The Swedish Government's climate initiatives – three years into the electoral period" (2017), https://www.government.se/articles/2017/10/the-swedish-governmentsclimate-initiatives--three-years-into-the-electoral-period/*

[62] *Note that the energy content of biofuels from wastes, residues, non-food cellulosic material and ligno-cellulosic material, the so-called second-generation biofuels, may be counted double to achieve the mandatory target.*

[63] *http://biomassmagazine.com/articles/15657/norway-to-implement-biofuel-mandate-for-aviation-fuel-in-2020*

[64] *See Horizon 2020 Work Programme 2018-2020 "Secure, clean and efficient energy", LC-SC3-SA-1-2020: Smart Airports*

[65] *Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814*

[66] *Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources*

2.1.1.2.2. Brazil

Taxation

Brazil does not have a fuel- or carbon tax in place to address CO_2 emissions from energy use. In the off-road sector, which includes commercial aviation, fossil fuels are untaxed[67]. However, as in Mexico, passenger tax levels for international flights are relatively high in Brazil: up to € 35 per passenger.

Emissions trading

Brazil does not have an ETS in place to address GHG emissions from the aviation sector.

Carbon offsetting (Incl. CORSIA)

Brazil has thus far declined to voluntarily sign up to the ICAO CORSIA mechanism. In line with CORSIA rules, it is expected to join CORSIA no later than the start of the 2nd phase, from 2027.

SAF incentives

In 2018, Brazil´s National Council for Energy Policy (CNPE) approved a 10 % carbon intensity reduction target for its transport fuels matrix by 2028. The target, to be met by fuel distributors, forms part of the country's National Biofuels Policy (RenovaBio). The Policy, which is modelled after California's Low Carbon Fuel Standard, assigns carbon intensity ratings to individual producers and creates decarbonization credits (CBIO) which can freely traded on financial markets. [68] While predominantly focused on the domestic bioethanol market in Brazil, efforts are underway to also bring SAF under RenovaBio's scope. [69]

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[67] *https://www.oecd.org/tax/tax-policy/taxing-energy-use-brazil.pdf*

[68] *https://bioenergyinternational.com/policy/renovabios-carbon-intensity-reduction-target-transport-fuels-approved*

[69] *See e.g. https://www.icao.int/Meetings/altfuels17/Documents/6_Pedro_Scorza_GOL_V1.pdf*

2.1.1.2.3. China

Taxation

Tax rates in China differ across energy products and users.[70] Generally, diesel and fuel oil are taxed across the various sectors of the economy. On the other hand, coal, coke and natural gas are not taxed - and the same holds true for biofuels and aviation kerosene. Note however that aviation fuel is subject to excise duty in Hong Kong, at about € 0.70 per litre.[71]

Emissions trading

Building on the successful implementation of nine pilot ETSs at the regional level [72], China announced the launch of its national ETS in December 2017. China's national ETS is expected to be introduced gradually in three phases. Starting with the power sector, other sectors would be added gradually at later stages, including chemical industry, iron and steel, building materials, petrochemical industry, paper making, non-ferrous metals and civil aviation. Despite the effects of the 2020 COVID-19 virus outbreak in China, companies are expected to submit their 2019 emissions data, suggesting authorities are on track to launch the national scheme by the end of the year.[73] China has not announced any decision to include aviation in its scheme.

Carbon offsetting (Incl. CORSIA)

China has thus far declined to confirm its previously signalled intent to voluntarily sign up to the ICAO CORSIA mechanism. In line with CORSIA rules, it is expected to join CORSIA no later than the start of the 2nd phase, from 2027.

SAF incentives

In 2012, the China Petroleum and Chemical Corporation (Sinopec) partnered with Airbus to develop and promote a renewable aviation biofuel. Five years later, in 2017, Sinopec worked with Boeing and Hainan Airlines to complete a passenger flight powered by sustainable aviation biofuel from used cooking oil (UCO). It was considered a key environmental milestone for China's commercial aviation industry. [74] [75]

While biofuels are said to be part of "*China's long-run strategic plan to protect the environment, conserve resources, and reduce dependence on imported energy*", ethanol appears to be the only biofuel receiving significant attention. Currently, there are no off-take agreements in China to supply commercial flights with biojet fuel on a regular ongoing basis.[76] No evidence was found pointing to any incentive schemes specifically promoting the use of SAF.

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[70] http://www.oecd.org/tax/tax-policy/taxing-energy-use-china.pdf

[71] *European Commission Report: Taxes in the Field of Aviation and their impact (2019)*

https://www.politico.eu/wp-content/uploads/2019/06/Aviation-taxes.pdf

[72] *Beijing, Tianjin, Shanghai, Hubei, Chongqing, Guangdong, Shenzhen, Fujian and Sichuan*

[73] https://carbon-pulse.com/94123/

[74] https://www.aerospace-technology.com/uncategorised/newsairbus-sinopec-develop-aviation-biofuel-china/

[75] https://www.aerospace-technology.com/news/newsboeing-sinopec-complete-passenger-flight-sustainable-aviation-bio-fuel-4537760/

[76] https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Biofuels%20Annual_Beijing_China%20-%20Peoples%20Republic%20of_8-9-2019.pdf

2.1.1.2.4. India

Taxation

In the off-road sector, diesel fuel in India is taxed at the highest rate (about €5/Gj), whereas aviation fuels are taxed at significantly lower rates than gasoline and diesel (around €0.50/Gj). [77]

Regarding other types of air travel taxes, no airport taxes are levied on passengers upon embarkation at airports in India, although Passenger Service Fees and Development Fees are levied at selected airports. [78] [79]

Emission trading

India recently launched a regional pilot ETS aimed specifically at tackling particulate air pollution. [80] It does not have an ETS in place to address GHG emissions from the aviation sector.

Carbon offsetting (Incl. CORSIA)

India has thus far declined to voluntarily sign up to the ICAO CORSIA mechanism. In line with CORSIA rules, it is expected to join CORSIA no later than the start of the 2nd phase, from 2027.

SAF incentives

Bioethanol enjoys a concessional excise duty of 16% and biodiesel is exempted from excise duty in India. [81] In order to further promote biofuels in the country, the Indian government in 2018 approved a National Policy on Biofuels extending financial and fiscal incentives to various categories of biofuels at central and state government levels. [82]

In 2019, US-based company Gevo and Praj Industries from India signed a Memorandum of Understanding (MoU) to start commercializing renewable alcohol-to-jet fuel (ATJ). [83] Presumably, this type of renewable jet fuel would benefit from the newly adopted government incentives.

2.1.1.2.5. Indonesia

Taxation

Fuels used in off-road transport (including kerosene) are not subject to excise or carbon taxes in Indonesia. As of 2015, however, all airlines departing from Indonesia are required to include departure taxes in the ticket price [84]. Rates for international departures range from € 4.75 to € 14.50 per passenger and may differ between airports, or even terminals.

Emissions trading

Indonesia does not currently have an ETS in place to address GHG emissions from the aviation sector. However, in October 2019 the Indonesian government announced plans to launch a carbon market under the

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[77] http://www.oecd.org/tax/tax-policy/taxing-energy-use-india.pdf
[78] https://www.iatatravelcentre.com/IN-India-customs-currency-airport-tax-regulations-details.htm
[79] http://www.airindia.in/explanation-of-taxes-fees-charges.htm
[80] https://www.livemint.com/science/news/india-launches-emissions-trading-programme-to-reduce-air-pollution-1559799447842.html
[81] https://mnre.gov.in/file-manager/UserFiles/biofuel_policy.pdf
[82] https://bioenergyinternational.com/policy/indian-cabinet-approves-2018-national-policy-on-biofuels
[83] https://bioenergyinternational.com/biofuels-oils/gevo-to-work-with-praj-industries-to-commercialize-renewable-isobutanol-biojet-fuel-and-isooctane-in-india
[84] https://www.biaya.net/2017/04/tarif-airport-tax.html

newly created Environment Fund Agency, under supervision of the finance ministry. The pilot scheme is said to start in 2020.[85] It is unclear at this point whether emissions from aviation will be included.

Carbon offsetting (Incl. CORSIA)

Indonesia was amongst the first wave of countries in 2016 announcing its willingness to participate in the first phase of CORSIA from 2021.[86] CORSIA participation may create offset obligations for Indonesian operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

SAF incentives

In 2016, Indonesia announced a biojet fuel mandate of 2% by 2018, rising to 5% by 2025. These mandates were however not successfully implemented. There are currently no biojet-specific policies to encourage supply chain commercialisation. [87]

Indonesia is in the fortunate position that it has availability of palm (kernel) oil as domestic feedstock for the relatively mature HEFA pathway.

2.1.1.2.6. Japan

Taxation

Japan introduced a nation-wide carbon tax in 2012. Aviation fuel is subject to excise duty on domestic flights, at a rate of about € 0.14 per litre [88], while various types of passenger and sales taxes are also being levied (e.g. a Japan consumption tax, VAT and a departure tax). Effective January 7, 2019, a departure tax is charged to each passenger leaving the country by aircraft or ferry, regardless of nationality. The government has indicated it will use the income from the departure tax to boost tourism infrastructure in Japan.

Emissions trading

Although Japan's Voluntary Emissions Trading Scheme (JVETS) has been in existence since 2005, Japan's government has been very cautious in considering a transition towards a regulated ETS, evaluating potential burdens on Japanese industry and employment. [89] In June 2018, a deliberative council, with participation of both industry groups and academic experts, was set up to consider how carbon pricing can encourage Japan to make the transition to a decarbonized society and to achieve economic growth. Discussions are still ongoing.

Carbon offsetting (Incl. CORSIA)

Japan was amongst the first wave of countries in 2016 announcing its willingness to participate in the first phase of CORSIA from 2021. [90] CORSIA participation may create offset obligations for Japanese operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

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[85] https://www.bloomberg.com/news/articles/2019-12-11/indonesia-aims-to-start-pilot-carbon-market-as-soon-as-next-year
[86] https://www.icao.int/Meetings/a39/Documents/WP/wp_211_rev1_en.pdf
[87] https://www.irena.org/DocumentDownloads/Publications/IRENA_Biofuels_for_Aviation_2017.pdf
[88] https://www.env.go.jp/en/policy/tax/20170130_greening.pdf
[89] https://www.whitecase.com/publications/insight/japan-greenhouse-gas-emissions-trading-schemes
[90] http://www.mlit.go.jp/common/001146859.pdf

SAF incentives

Through its 2014 Basic Energy Plan, the Japanese government committed to the diversification of energy sources in the transportation sector. It has adopted a 500 million litre biofuel production mandate until, at least, 2022.

Japanese biotechnology company Euglena, partnering with aviation group ANA Holdings, is to start mass production of biojet fuel and biodiesel out of algae and waste oil, with the aim of being the first company to fuel green commercial flights out of Japan.[91] ANA will support Euglena to develop the airport infrastructure to supply aircraft.[92] [93]

The Japanese government uses a range of policies to incentivise the uptake of and transition to low-carbon energy sources, including tax breaks, financial assistance and other fiscal measures.[94] The aim was to introduce biojet fuel for commercial flights in 2020, the year that the Summer Olympic Games and Paralympic Games were supposed to be held in Tokyo. Originally scheduled to take place between 24 July and 9 August 2020, and 25 August to 6 September 2020 respectively, the Games were rescheduled for 23 July to 8 August 2021 and 24 August until 5 September 2021 respectively, as a result of the COVID-19 pandemic. [95]

2.1.1.2.7. Mexico

Taxation

In 2014, the Mexican government introduced a nation-wide carbon tax. According to estimates by the Ministry of Environment, the carbon tax has been responsible for an abatement of approximately 1.8 million tonnes of CO_2 per year. Jet fuel used domestically is taxed at a rate of 11.41 US¢/litre (€ 0.10/litre) [96] while jet fuel used internationally is zero-rated.

Non-fuel related aviation taxes in Mexico are considered relatively high; these include Airport Departure Taxes (€ 16.25 for domestic flights and € 37.53 for international flights), a tourism tax (€ 23.45) and various levels of VAT for domestic and international flights. [97]

Emissions trading

Mexico does not currently have an ETS in place to address GHG emissions from the aviation sector. However, a Mexican ETS pilot was launched in 2020. It is the first national ETS in Latin America and is expected to prepare the way for an 'operational' phase due to commence in 2023. It is unclear whether aviation would be covered.

Carbon offsetting (Incl. CORSIA)

Mexico was amongst the first wave of countries in 2016 announcing its willingness to participate in the first phase of CORSIA from 2021. [98] CORSIA participation may create offset obligations for Mexican operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

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[91] http://www.biofuelsdigest.com/bdigest/2018/11/04/euglena-begins-producing-algae-and-waste-oil-biojet-fuel/
[92] https://asia.nikkei.com/Business/Companies/Jet-biofuel-mass-production-to-begin-in-Japan
[93] https://english.kyodonews.net/news/2019/12/8c9c73393685-japanese-firms-start-growing-euglena-abroad-for-biofuel.html
[94] https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Biofuels%20Annual_Tokyo_Japan_8-15-2017.pdf
[95] *https://www.olympic.org/news/ioc-ipc-tokyo-2020-organising-committee-and-tokyo-metropolitan-government-announce-new-dates-for-the-olympic-and-paralympic-games-tokyo-2020*
[96] https://www.edf.org/sites/default/files/mexico_case_study.pdf
[97] *European Commission Report: Taxes in the Field of Aviation and their impact (2019)*
[98] https://www.icao.int/environmental-protection/Documents/GMBM_Support/HAC_EU_RMI_MX_ICAO_Assembly_letter.pdf

SAF incentives

Mexico has a long history of supporting the development of a national market for biofuels, particularly bioethanol and biodiesel, partly driven by local air pollution concerns. As early as 2008, the government passed a national biofuel law, the Bioenergy Promotion and Development Act.

In 2016, biojet consortium *Cluster Bioturbosina* began its research and development programme aimed at establishing an alternative aviation fuel supply chain in Mexico. It is supported by the Ministry of Energy and the National Council of Science and Technology. [99]

2.1.1.2.8. Thailand

Taxation

Aviation taxes in Thailand do exist but are generally considered to be low. In 2017, the government increased excise tax on jet fuel for domestic flights from 0.2 to 4 baht (€ 0.10) per litre. Fuel for international flights is exempt from the tax.[100]

A minimal fee of € 0.76 is applied to international departures and arrivals, while VAT is levied on domestic flights only.[101]

Emissions trading

Thailand does not have an ETS in place to address GHG emissions from the aviation sector. However, under the '*National Reform Plan*' the Thai government is expected to develop a market-based instrument, such as a cap-and-trade program, to incentivize emissions reduction in the private sector. A specific instrument will have to be outlined in the country's Climate Change Act, which is expected to enter into force in 2020.

Carbon offsetting (Incl. CORSIA)

Thailand was amongst the first wave of countries in 2016 announcing its willingness to participate in the first phase of CORSIA from 2021. [102] CORSIA participation may create offset obligations for Thai operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

SAF incentives

In 2015, the Thai government endorsed an updated Alternative Energy Development Plan (AEDP) targeting an increase in biodiesel consumption from 1.23 bn litres in 2015 to 5.1 bn litres by 2036. As the mandate relies on domestic palm oil as feedstock, targets are adjusted annually depending on weather conditions and production yields.

Besides a stated intention by aviation authorities to "*cooperate with other authorities in the region to advance research and testing on alternative fuels in the aviation sector*" [103], no evidence was found pointing towards SAF incentives in Thailand's aviation sector.

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[99] https://www.unitingaviation.com/strategic-objective/environment/profile-cluster-bioturbosina-collaborative-effort-altfuels/
[100] *Thailand raises jet fuel excise tax for domestic flights (https://af.reuters.com/article/idAFL4N1FH1WE)*
[101] *European Commission Report: Taxes in the Field of Aviation and their impact (2019)*
[102] https://www.icao.int/environmental- protection/Documents/GMBM_Support/Thailand_Statement_A39.pdf
[103] https://www.icao.int/environmental-protection/Lists/ActionPlan/Attachments/14/Thailand%20Action%20Plan%202018.pdf

2.1.1.2.9. UAE

Taxation

There are currently no fuel- or carbon-related aviation taxes being levied in the UAE.

On the other hand, the UAE has various types of passenger-based levies in place including a Passenger Facilities Fee and a Departure Fee (€ 8.80 per international passenger). To the extent that these taxes are used for airport infrastructure investment, they should perhaps not be categorised as a tax.

Emissions trading

The UAE does not currently have an ETS in place to address GHG emissions from the aviation sector. However, recognising the significant growth in passenger and cargo air traffic in the country, the UAE Securities and Commodities Authority (SCA) in 2018 announced "*an initiative for launching the region's first-of-its-kind form of trading in emissions that specifically targets carbon dioxide*". [104] More recent information regarding this initiative has not been found.

Carbon offsetting (Incl. CORSIA)

The UAE was amongst the first wave of countries in 2016 announcing its willingness to participate in the first phase of CORSIA from 2021. [105] CORSIA participation may create offset obligations for UAE operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

SAF incentives

The UAE has been an active player in the research and development of renewable jet fuels. In 2014, the UAE`s Masdar Institute of Science and Technology, together with Etihad Airways, Boeing, Total and Takreer, launched *BIOjet Abu Dhabi: Flight Path to Sustainability* to support the creation of a national aviation biofuel industry.

More recently, in 2019, national airline Etihad Airways first flew from Abu Dhabi to Amsterdam using Salicornia-derived SAF sourced from Masdar City`s Seawater Energy and Agriculture System (SEAS) farm. In 2020, Etihad Airways committed to a minimum target of zero net carbon emissions by 2050, to be achieved through a combination of low-carbon measures, including local SAF. [106]

2.1.1.2.10. United States

Taxation

A Commercial Fuel Tax (CFT) applies to aviation fuels when used for commercial aviation purposes, at a rate of USD 0.044 per gallon (€ 0.01 per litre) [107] In addition, a modest U.S. Transportation Tax is also applied to all domestic flights. Although legislative proposals have been made, the U.S. does not currently have a domestic carbon tax in place. [108]

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[104] https://www.albawaba.com/business/pr/sca-proposes-carbon-emissions-trading-1080812
[105] https://www.icao.int/Meetings/ENVSymposium/Presentations/Eng%20Majed%20Session%209.pdf
[106] https://biofuels-news.com/news/etihad-targets-net-zero-carbon-emissions-by-2050-following-commitment-to-biofuels/
[107] https://taxmap.irs.gov/taxmap/pubs/p510008.htm#TXMP440314d6
[108] https://www.piie.com/blogs/realtime-economic-issues-watch/carbon-tax-united-states

Emissions trading

In the absence of an emissions trading (cap and trade) mechanism at the Federal level, several U.S. States have instituted their own schemes.

The Regional Greenhouse Gas Initiative (RGGI) began operations in 2009 as the first mandatory CO_2 cap-and-trade program in the U.S. It brings together nine states [109] that are committed to reducing CO_2 emissions from the power sector.

The California cap-and-trade system coexists with other regulations, and covers approximately 85% of California's greenhouse gas emissions, although like the RGGI, it currently excludes aviation fuel.[110]

Carbon offsetting (Incl. CORSIA)

The United States was amongst the first wave of countries in 2016 announcing its willingness to participate in the first phase of CORSIA from 2021.[111] CORSIA participation may create offset obligations for U.S. operators on international routes, along with a possibility to claim a reduction in offset obligations based on the use of eligible SAF under CORSIA.

SAF incentives

In the U.S., various SAF incentive schemes exist, both at the Federal and State level, the most prominent ones being the U.S. Renewable Fuel Standard (RFS2) and California's Low Carbon Fuel Standard (LCFS):

- **U.S. Renewable Fuel Standard (RFS2)**

The U.S. Renewable Fuel Standard (RFS2) is a federal program that mandates the incorporation of renewable fuels into the national transportation fuel supply based on renewable volume obligations (RVO) issued annually by the U.S. Environmental Protection Agency (EPA). A Renewable Identification Number (RIN) is assigned to every batch of renewable fuel and can subsequently either be used (retired) to meet compliance requirements or traded to other parties.[112] Although primarily designed to replace surface transportation fuels, jet fuel also qualifies for incentives under the program.

- **State of California Low Carbon Fuel Standard (LCFS)**

The Low Carbon Fuel Standard (LCFS) was adopted in California in 2009 to contribute to state GHG emission reduction goals under the Global Warming Solutions Act of 2006. Using a system of tradeable credits aimed at carbon intensity reduction in the transportation sector, it provides for an additional incentive on top of RFS2. Alternative aviation fuels (SAF) were included as from 2019.[113]

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[109] *Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont*

[110] *https://theicct.org/blogs/staff/radar-aviation-california's-climate-policy*

[111] *https://obamawhitehouse.archives.gov/the-press-office/2016/06/29/leaders-statement-north-american-climate-clean-energy-and-environment*

[112] *https://www.eia.gov/todayinenergy/detail.php?id=41975*

[113] *https://ww2.arb.ca.gov/news/carb-amends-low-carbon-fuel-standard-wider-impact*

2.1.1.3. Complementary measures to reduce aviation's climate impact

New aircraft designs

Gradual changes in aircraft design, such as the use of lightweight composite structures, the addition of wingtip devices (winglets, sharklets), air flow technologies (riblets) and other design practices, continue to improve aircraft fuel efficiencies.

More fundamental changes in aircraft design are also being studied, the latest example being Airbus' MAVERIC blended wing prototype, which is said to reduce emissions by 20%.[114] Similar prototype research (X-48C) was undertaken by Boeing in 2013.

Even more ambitious programmes aimed at the development of zero-emissions aircraft designs, are looking to "*reduce, and possibly eliminate, the use of fossil fuels in aviation within the next 30 to 40 years*".[115] In 2018, Norway announced its intention to have all short-haul flights—those that last less than 1.5 hours—using electric planes by 2040.[116]

Operational measures

Opportunities to increase efficiency and reduce fuel consumption and emissions exist across all phases of flight, including taxi, climb, cruise and descent. Good engine and airframe maintenance practices will minimise costs and unnecessary fuel consumption, as will the installation of lighter equipment and fittings and the elimination of non-essential on-board items. In addition, there are many potential opportunities for improving efficiency through enhanced flight planning and execution. A comprehensive compendium of operational opportunities to reduce fuel burn and emissions can be found in ICAO Doc 10013. [117]

SES implementation

The Single European Sky (SES) initiative was launched by the European Commission in 2004 to reform the architecture of European Air Traffic Management. Its key objectives are to restructure European airspace as a function of air traffic flows, to create additional capacity and to increase the overall efficiency of the air traffic management system. The European Commission expects SES reform to help *"cut up to 10% of air transport emissions*" (…) *"at zero cost to consumers and companies*". Chapter 4 of the European Aviation Environmental Report 2019 gives a detailed overview of the different ATM and operational initiatives in place.

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[114] https://www.popularmechanics.com/flight/a30916392/maveric-airbus-concept/
[115] https://www.assemblymag.com/articles/93676-electric-power-will-transform-aviation
[116] https://www.electrive.com/2018/01/18/norway-short-haul-flights-run-electric-2040/
[117] *ICAO Doc 10013 "Operational Opportunities to Reduce Fuel Burn and Emissions"*

Other measures

Shifting air passengers to other modes of transport (primarily rail) has long been a topic of interest amongst policymakers and academia. However, in the absence of viable, competitive rail alternatives, modal shift of this nature has been slow to materialise. A notable exception is KLM's recent decision to replace one of its five daily flights from Amsterdam to Brussels with trains operated by the French-Belgian high-speed rail company Thalys. [118]

Modal shift of a different nature could be pursued by way of shifting certain types of air cargo onto unmanned cargo drones. Flying at lower speeds and altitudes these drones have the potential to lower the cost of cargo transportation while simultaneously producing fewer emissions and less noise than conventional alternatives.

Lessons from other sectors

The "*slow steaming*" practice used in the shipping sector is known to reduce fuel use, costs as well as NO_x emissions. Studies found that ships on European routes lowered their NO_x emissions by 12%. As it turns out, lowering speed can also work for aviation. Several airlines have reported cost, fuel and emissions savings by simply adding a few minutes to their flights.[119] [120]

Finally, assessing well-known flying patterns practiced in military aviation (and obviously birds) Airbus research found that flying commercial aircraft in formation can effectively reduce fuel and emissions in the range of 5-10% per trip while maintaining flight safety. [121]

Summary

Market-based measures can make a significant contribution to accelerate and complement the adoption of innovative technological and operational measures to help decarbonise EU aviation in line with the 2050 climate objectives.

Many countries apply specific taxes to aviation, including departure taxes, air passenger duties, passenger facility charges, and embarkation fees. At the same time, most countries exempt aviation fuels from excise duty and exempt tickets from VAT - or apply a zero VAT rate in case of international aviation.

Because international aviation rules consider intra-EU flights not as domestic but international flights, introduction of an EU aviation fuel tax is currently not an option, except where negotiated amongst EU member states on a bilateral basis, or as part of a comprehensive air services agreement between the EU and a third country. While fuel taxes for domestic aviation do exist in some of the non-EU countries considered in this report (including India, Japan, Mexico, Thailand, and the U.S.), the applicable rates are relatively low (€ 0.01/L – € 0.15/L) when compared to the minimum excise duty rate for kerosene under the EU Energy Tax Directive which is € 0.33/L.

As a measure to decarbonise aviation, carbon trading schemes are generally considered more cost-effective than taxes, especially where revenues can be used to support the deployment of other GHG mitigation measures. In 2018/2019, analysis carried out for the World Bank [122] identified 28 ETSs in regional, national and subnational jurisdictions.

While the EU has been instrumental in the gradual rise of carbon trading schemes around the world, the effective linking of regional schemes has not yet materialised and indeed, with the notable exception of the

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[118] https://www.railwaygazette.com/high-speed/klm-replaces-plane-with-high-speed-train/54577.article

[119] http://www.nbcnews.com/id/24410809/ns/business-us_business/t/airlines-slow-down-flights-save-fuel/#.WvWd0NMvx68

[120] https://alum.mit.edu/slice/why-hasnt-commercial-air-travel-gotten-any-faster-1960s

[121] https://www.engineering.com/DesignerEdge/DesignerEdgeArticles/ArticleID/19779/Airbus-Looks-to-Reduce-Emissions-and-Maybe-More-by-Flying-Craft-in-Formation.aspx

[122] *"State and Trends of Carbon Pricing 2019" State and Trends of Carbon Pricing (June), World Bank, Washington, DC.*

EU ETS – and possibly China at a later stage - none of the other ETSs in existence or under development (including Japan, Mexico, Thailand, UAE or indeed the US) include aviation activities. The additional CO2 emission costs arising from the EU-ETS could negatively impact European airlines using hubs located in the EU (and also the airport hubs themselves), especially as the CO2 prices are expected to be around 10 times higher in the EU-ETS than in CORSIA, and as EU-ETS free allocation is to be reduced, while under CORSIA airlines will only be required to offset the increase in emissions (not the total emissions).

Similarly, European states have been early supporters and adopters of CORSIA rules, whereas several others have yet to do so. Although CORSIA is designed to avoid competitive distortion between aircraft operators on individual routes, the initial absence of other states (such as Brazil, China and India) from the scheme could initially undermine its overall effectiveness and credibility. As of June 2020, 85 countries, representing 76.8% of international aviation activity, intended to voluntarily participate in the GMBM scheme from its outset. While other major countries in terms of international aviation shall join no later than 2027.

At the same time many airlines, both inside the EU as well as other regions, offer their passengers the choice to offset the carbon emissions from their flights on a voluntary basis. In 2019, several airlines (including Air France, British Airways and JetBlue) announced their intention to offset their own domestic flight emissions - or in the case of EasyJet, the full emissions from all its flights.

Currently, only limited volumes of SAF are being produced and consumed – global production is estimated at 15 million litres in 2018, less than 0.1% of total aviation fuel consumption.[123] The main barriers to significantly scaling up the uptake of SAF are not necessarily of a technical nature, as various technologies are ready for or close to commercial deployment. Rather, the obstacles lie with the economic, policy and market-related aspects, as SAF tends to be significantly more expensive than regular jet fuel, logistics chains often require modification, and effective, wide-spread policy incentives are still lacking.

[123] *https://www.iea.org/commentaries/are-aviation-biofuels-ready-for-take-off*

2.1.1.4. Aviation agreements

Conclusion 16
Signature of comprehensive agreements export EU standards to neighbourhood countries. In this way, competition rules are fairer, with similar safety and security requirements.

: Comprehensive agreements promote fair competition allowing consumers to benefit from lower prices, better connectivity and higher frequencies on routes.

Conclusion 17
Comprehensive agreements favoured diversification of airlines and routes between EU and third countries, and therefore, affordability of air travel.

: More affordable access to air transport for the different communities living in Europe.

: The comprehensive agreement implies access to new markets and an increased level of competition, thereby reducing prices and increasing frequencies.

: Comprehensive agreements provide access to new markets and creates job opportunities in participating countries of the agreement.

2.1.1.4.1. The aviation strategy for Europe

Aviation is a **strong driver of economic growth**, jobs, trade and mobility and play a crucial role in the overall performance of the EU economy. In that perspective, the 2015 Aviation Strategy for Europe acknowledge that international EU aviation must be able to grow in a sustainable manner and sets its first priority as:

"Tapping into growth markets, by improving services, market access and investment opportunities with third countries, whilst guaranteeing a level playing field"

To allow EU airlines to tap into the growth markets, the EU wish to tackle the **numerous legal restrictions** in relation to investments and market access that **hinders the sustainable and dynamic growth of international transport**. To do so, the EU set an **ambitious external aviation policy** through the negotiation of **comprehensive aviation agreements** and bilateral aviation safety agreements (BASA).

Given there **isn't any international legal framework regarding unfair commercial practices**, these comprehensive aviation agreements can ensure an open and fair competition.

The Aviation Strategy stresses the need to pursue the relaxation of airline ownership and control rules based on effective reciprocity through agreements.

Timeline:
1944: Chicago Convention – worldwide legal framework for international aviation, granting **exclusive sovereignty of the airspace** above its own territory as well as facilitating the inauguration of **bilateral Air Service Agreement (ASA)** that defines the condition of air transport services between two countries. These agreements are historically focused on national airlines and limits the number of carriers, seat capacity and routes fares.
1997: The EU single aviation market has become fully liberalised in a way that carriers have now unlimited access to all routes including "cabotage". This liberalisation resulted in more competition, more affordable air travel, more routes, more passengers travellingand the emergence of low-cost carriers (LCC).
2002: The **"open skies" judgements of the Court of Justice of the EU** (CJEU) found that a bilateral Air Services Agreement (ASA) between a Member State (MS) and a third country is **in breach of EU law** if it doesn't grant equal market access for routes to destinations outside the EU to any EU carrier in the MS territory regardless of their nationality.
As a reaction, the EU negotiated new **"horizontal air service agreements"** with a number of third countries removing the previously existing nationality clauses of existing ASA, allowing any EU airline to benefit from an ASA between a Member State and a third country.
2006: The **European Common Aviation Area (ECAA)** agreement is signed between the EU, Norway, Iceland and Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Kosovo. Enforced since 2017, this agreement creates a **European common aviation market** with the same **high standards in terms of freedom of establishment, equal conditions of competition, safety, security, ATM, social and environment**.

Table 14 and Figure 21 provides an overview of the different "Freedom of the Air" that can be allocated to carriers in air service agreements.

Freedom	Description
1st and 2nd	The 1st and 2nd allow a carrier to overfly or make a technical or fuel stop.
3rd and 4th	The 3rd and 4th freedoms provide carriers to operate a classic scheduled flight between two countries.
5th	In some cases, additional freedoms are granted: the 5th freedom allows an airline to extend its route from its home to two countries (often used when aircraft range was limited in the past).
6th	The 6th freedom is a combination of the third and fourth freedoms, allowing a carrier to fly between two foreign countries, with an intermediate stop in the home country.
7th, 8th and 9th	The 7th freedom illustrates a carrier's right to go directly between two foreign countries, and the 8th and 9th freedom describe the right to operate domestically in a foreign country (referred as "cabotage").

TABLE 15. DESCRIPTION OF THE FREEDOM OF THE AIR

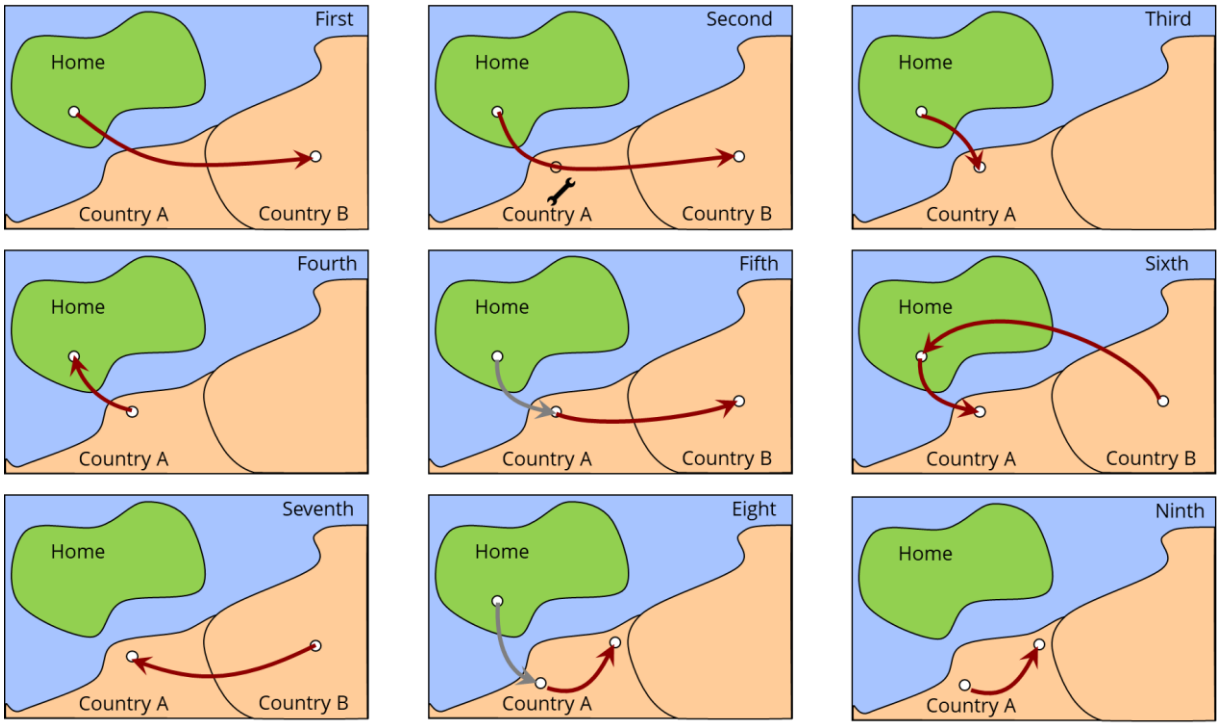


FIGURE 23. FREEDOM OF THE AIR

Initiated in 1979 by the US and Netherlands, an "open sky" agreement is an agreement allowing an aircraft to fly between two countries without any restrictions. This type of agreement allows at minima the firsts sixth freedoms and permits more commercial freedom than traditionally more restrictive ASAs.[124]

[124] *OECD, International Transport Forum, Air Service Agreement Liberalisation and Airline Alliances, P16, 2014*

2.1.1.4.2. Aviation agreements

Context

In parallel with the ECAA (see timeline), the EU is strengthening its relationship with its major international partners by negotiating **comprehensive air transport agreements**, delivering a clear added value compared to ASAs. These agreements do not limit themselves to the "open skies" model as the EU seeks the establishment of a process of liberalisation of ownership of airlines and a process of **regulatory convergence** in matters of **safety and security, competition, environment, passengers protection, labour**, etc. - which could not be obtained at national levels.

The US signed with the EU in 2007 a comprehensive agreement allowing for the 5th first freedoms for passenger and up to 7th for cargo with the EU. This agreement brings together the two biggest aviation market and links 800 million people. In 2011 it was amended to include Norway and Iceland, and amended in August 2019, to allow the wet lease agreement (short-term leasing of an aircraft).

EU and Canada signed a comprehensive agreement in 2009 and will establish progressively a true open aviation area. This agreement includes a gradual phasing-in of traffic rights, mutual investment opportunities, as well as cooperation on a number of issues including safety, security, social matters, consumer protection, environment, air traffic management, competition law and state aid. In its final phase, this agreement would cover the 9th freedoms and allow full foreign ownership of airlines between the two sides.

The EU has air transport agreements with:

- **Neighbourhood:**
  - Switzerland,
  - Western Balkan countries,
  - Morocco,
  - Georgia,
  - Moldova,
  - Jordan,
  - Israel,
  - Ukraine (pending signature),
  - Tunisia (pending signature),
  - Armenia (pending signature).
- **Other key partners:**
  - United States,
  - Canada,
  - Qatar (pending signature).

Negotiations with ASEAN, Oman and Azerbaijan are on-going and those with Turkey are suspended by the Council.

In March 2019, Qatar and EU completed negotiations of a comprehensive agreement and the signature is pending. Oman and the EU started to negotiate at the start of 2019. In 2019, the United Arab Emirates informed the EU side that they were not interested in negotiating a comprehensive air transport agreement with the EU. In November 2018, the EU and the Association of Southeast Asian Nations (ASEAN) almost finalised a comprehensive agreement.

On top of the ECAA with the Western Balkan countries the EU has negotiated neighbourhood agreements with several other countries: Georgia (signed in 2010), Israel (2013), Jordan (2010), Moldova (2012) and Morocco (2006).

Ukraine and the EU in 2013 finalised negotiations and initialled a Common Aviation Area agreement. The signature of this agreement has, however, been delayed by the UK-Spain disagreement over Gibraltar.

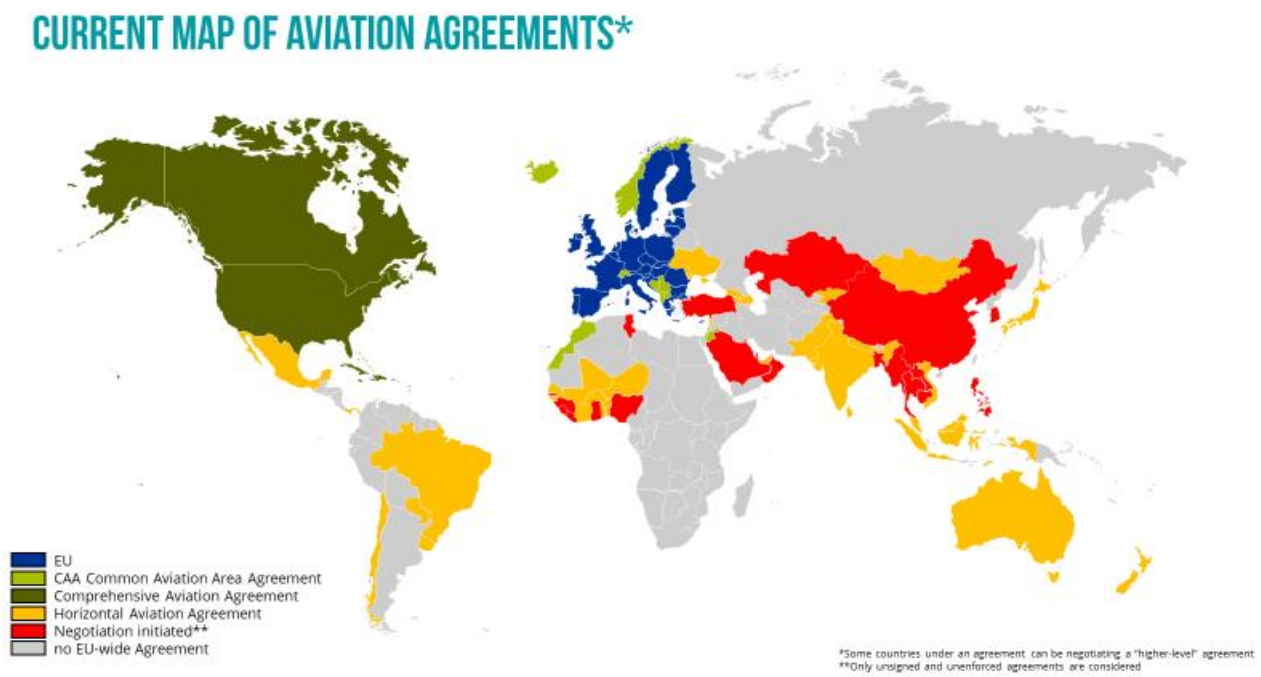


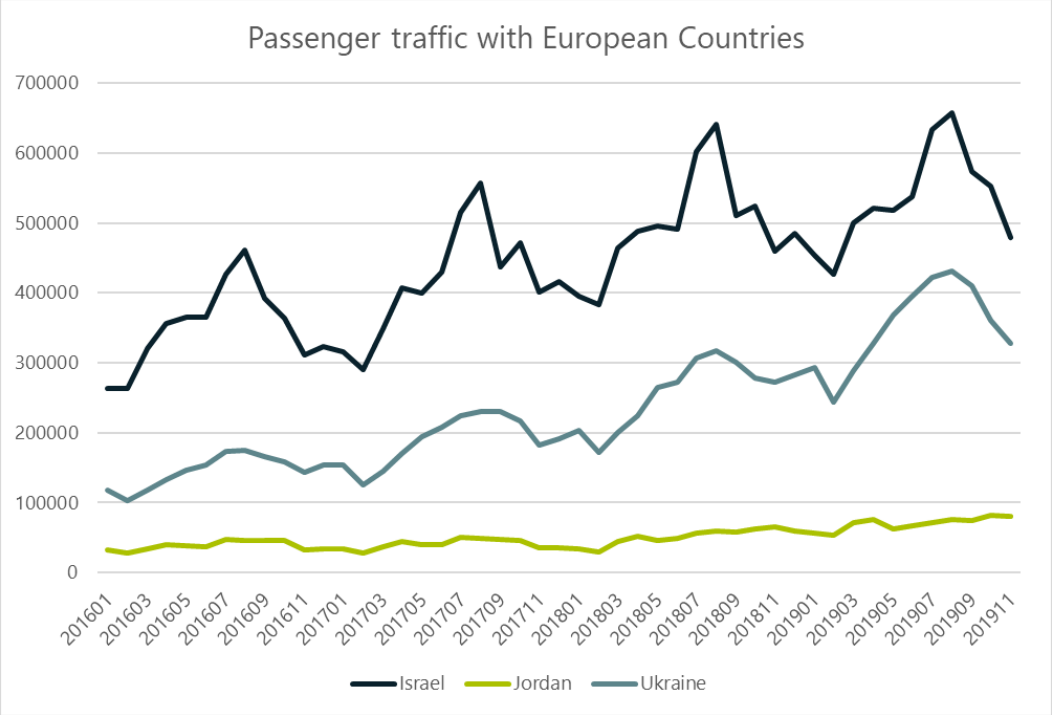
FIGURE 24: MAP OF CURRENT AVIATION AGREEMENTS

FIGURE 25: MAP OF COMPREHENSIVE AGREEMENTS

Does a liberal agreement increase traffic?

Amongst the most recent agreements signed by the EU are the agreements with Israel (2013) and Jordan (2010). These agreements are rather old and the medium-term impact is analysed here.

FIGURE 26. MONTHLY PASSENGER TRAFFIC BETWEEN EU AND ISRAEL, JORDAN OR UKRAINE 2016-2019 (SOURCE: ACI)



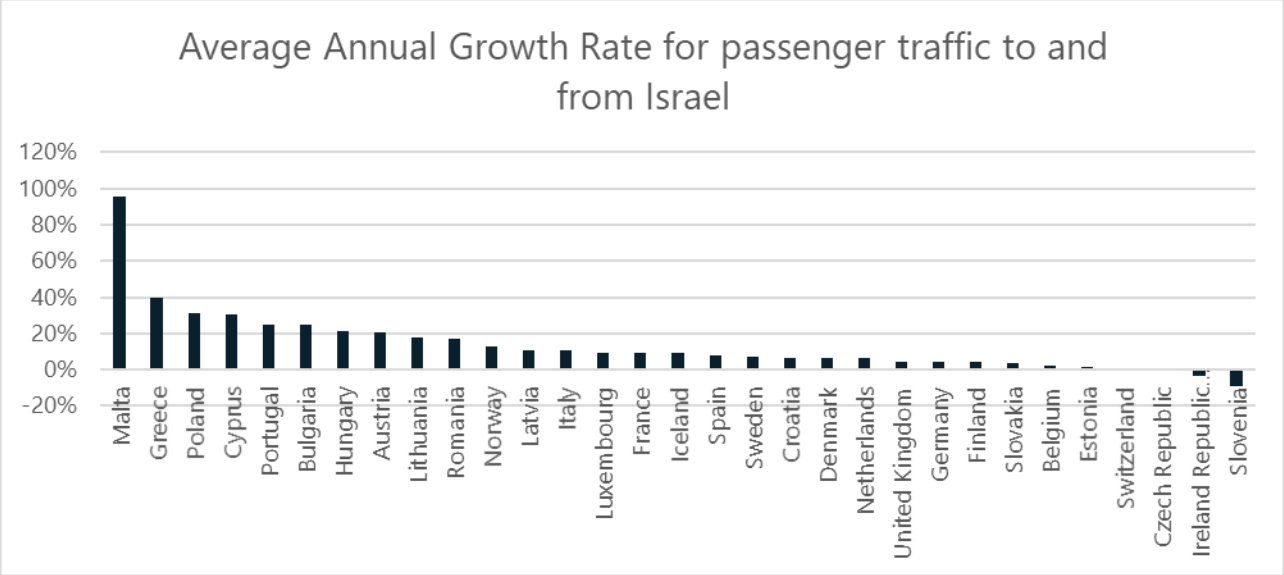
For these three countries and over the last four years, the growth of the traffic has been significant.

The traffic between Israel and EU+ countries increased in average by 12% per year. However, although the growth was strong between in 2017 and in 2018, it has significantly dropped off in 2019 to reach -1%. On the opposite, the traffic between Jordan and EU+ countries is growing faster since 2018 and went from 5% in 2017 to 27% in 2018.

Focus on Israel

Over the last five years, the top 5 destination serving Israel have not changed and are Germany, United Kingdom, France, Italy and Spain. However, for these countries the average annual growth rate was moderate (between 4 and 11%) compared to other countries. The growth is particularly significant for some of the countries from the south of Europe (Malta, Cyprus, Greece, Portugal) and for eastern countries (Poland, Bulgaria, Hungary) where the average growth is of more than 20% per year. The traffic growth between Malta and Israel is particularly important with an annual average of 95%.

FIGURE 27. AVERAGE ANNUAL GROWTH RATE OF TRAFFIC BETWEEN ISRAEL AND EU+ COUNTRIES 2016-2019 (SOURCE: ACI)



Focus on Ukraine

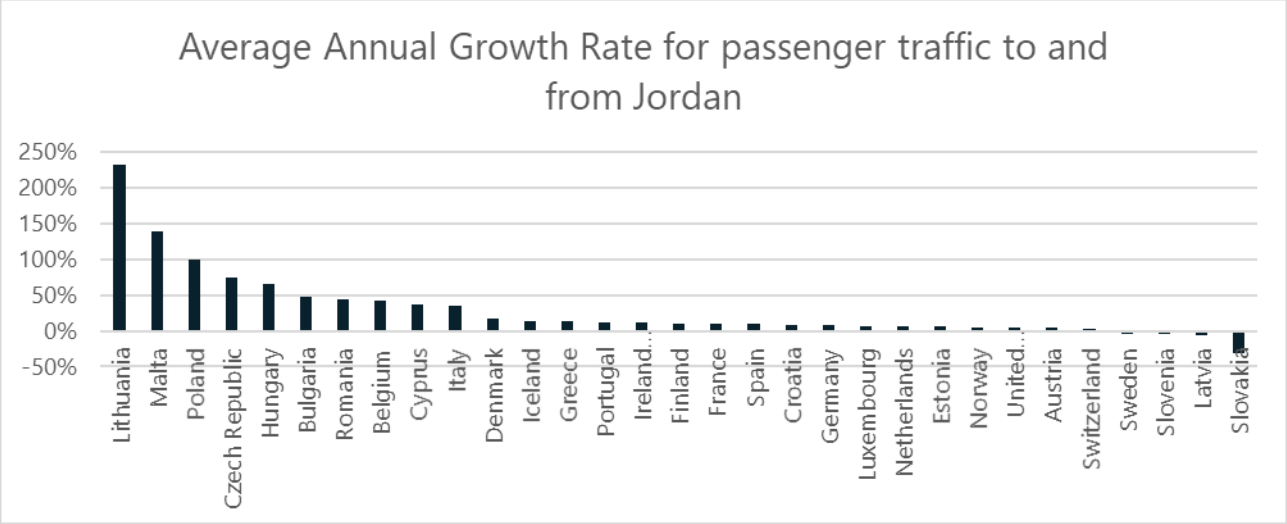
Germany, United Kingdom, Spain, Italy and Poland were the first five European destination to and from Ukraine. The growth for these five countries has been relatively high with an annual average growth rate of at least 23%. The traffic between Poland and Ukraine has particularly increased, it has been multiplied by five between 2016 and 2019, with an annual average growth rate of 78%. Slovakia also witnessed a major growth with 137% of annual average growth rate.

FIGURE 28. AVERAGE ANNUAL GROWTH RATE OF TRAFFIC BETWEEN UKRAINE AND EU+ COUNTRIES 2016-2019 (SOURCE: ACI)

Focus on Jordan

As for Israel, the top five destination to and from Jordan are Germany, United Kingdom, France, Italy and Spain, although the flow of passenger is much lower than for Israel. The annual average growth rate for these countries is moderate (less than 10%), except for Italy where it reaches 35% per year on average. Lithuania, Malta and Poland have the strongest growths to and from Jordan, with a respective average annual growth rate of 233%, 140% and 100%.

FIGURE 29. AVERAGE ANNUAL GROWTH RATE OF TRAFFIC BETWEEN JORDAN AND EU+ COUNTRIES 2016-2019 (SOURCE: ACI)



Conclusion

It is rather difficult to establish a direct causal link between the signing of a EU level air transport agreement and traffic growth. From one country to another the situations can be different. In particular, we can see that Ukraine has experienced stronger growth than the other two countries. What is the reason for this?

Liberal agreements are first and foremost tools. Favourable socio-economic conditions for the development of air traffic do not necessarily depend on this type of tool. On the other hand, it can encourage diversified and above all free market development.

However, these agreements are a key prerequisites for LCCs to open new routes. Few LCCs can live with a system of bilateral agreements:

- Depending on the country and the provisions of the bilateral agreement, a LCC may find itself at a disadvantage. For example, the bilateral agreement between France and Algeria tended to favour national airlines (Aigle Azur, Air Algérie, Air France, ASL Airlines France, Tassili Airlines). Airlines such as Easyjet (United-Kingdom) or Ryanair (Ireland) may therefore find it difficult to open a route between these two countries[125].
- These companies are also able to open and close routes very quickly according to their profitability. The system of bilateral agreements, depending on the specific provisions of each agreement, may limit this freedom to open and close routes. LCCs may therefore be reluctant to position themselves in a market regulated by a bilateral agreement.

On the other hand, two important effects are induced by the comprehensive agreements:

- **Diversification of airlines:** Any airline of EU and the third country can position itself on the market. These agreements have therefore encouraged the arrival of new airlines, particularly low-cost airlines (for the reasons mentioned above). Ryanair, Transavia and Wizz Air have been able to open routes between the European Union and Israel, Jordan and Ukraine. For instance, in Jordan, Ryanair operates twelve routes from Amman and five routes from Aqaba. Beyond that, these agreements may possibly contribute in part to the emergence of private operators in third countries that sign with the European Union.
- **Diversification of routes:** Many bilateral agreements, tend to favour air links between capital cities. Secondary cities can be excluded from the agreement. Liberal agreements give the opportunity to

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[125] *Until Aigle Azur's bankruptcy, Transavia and Vueling were the only LCCs to offer routes between Algeria and France. After the bankruptcy of Aigle Azur, Volotea was granted to serve routes between the two countries.*

develop routes between secondary cities of each country. This phenomenon was particularly noticeable with Poland's access to EU market. Ukraine may in due course be going through the same development. Israel and Jordan are smaller countries, however, their secondary airports (Eilat, Aqaba) developed their traffic from/to EU.

- **Affordability of travel:** The various analyses have shown that LCCs have been the main providers of air traffic growth with the introduction of comprehensive agreements, provided that the distance between the European Union and the third country is compatible with the type of aircraft operated by these companies. In Central and Eastern Europe, the diversification of routes and airlines (particularly low-cost) has made it possible to simplify journeys (more direct flights), intensify competition and lower ticket prices. This reduction in fares has been particularly useful for the VFR segment, especially for the various Diasporas living in Europe; thus facilitating the mobility of families and workers within the EU, but also from/to third countries that are signatories to a comprehensive agreement (e.g. Balkans, Israel, Morocco, etc.).

2.1.1.4.3. Airline alliances

Airline alliances are cooperative arrangements between airlines, ranging from interline agreements to highly integrated forms of cooperation such as metal-neutral revenue sharing joint ventures. An important benefit enabled by an alliance is access to traffic that in the absence of the alliance would not be possible, due to limitations established by bilateral ASAs or national laws.

By code sharing, two airlines can provide customers **many more itinerary combinations** than either airline on its own could provide.

> Code sharing is a business arrangement where 2 or more airlines publish and market the same flight. Typically, the flight is operated by one airline, while seats are sold for the flight by the other(s) airline(s) using their own designator and flight number.

Tactical alliances aim to address specific gaps in individual carrier networks, and Strategic alliances seek to **optimise global networks**.There are three main global strategic airline alliances: The Star Alliance, SkyTeam and Oneworld with respectively, 26, 19 and 13 members. Value Alliance, U-FLY Alliance and Vanilla Alliance forms more local alliances, with respectively 6, 5 and 5 members.

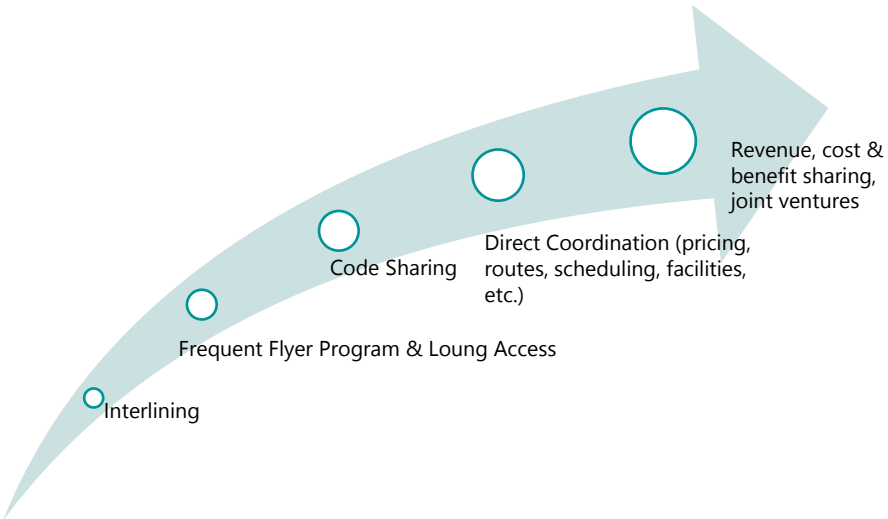

FIGURE 30. COMMON TYPES OF AIRLINE ALLIANCES

Alliances can range from low level cooperation to a metal-neutral joint venture, involving a full coordination of revenue, cost and profit sharing, jointly determine prices, capacity and frequency of flights, and cooperate in marketing and sales. The latter form of cooperation is **closely watched by antitrust agencies** around the world.

A metal neutral joint venture is structured so that partners in the venture are indifferent as to which operates the 'metal' (aircraft) when they jointly market services.

The empirical literature indicates that alliances have **greatly benefited consumers in connecting markets**, by lowering average fare and reducing transfer time. Some negative impacts have been found, but are limited to hub to hub markets, with no other competitors and/or airport access barriers.

Given the risk of anti-competitive trust, competition authorities review alliances on a case by case basis to determine what impacts they have on competition in the marketplace. If net impacts are positive, alliances are usually approved and granted antitrust immunity.

2.1.1.4.4. Economic impact of air service agreements

The impact of air transport market liberalisation has been well discussed in the economic literature. A study showed that international agreements and liberalisation led to a 17% increase in air traffic.[126]

The economic literature concludes that liberalisation of international air service agreements resulted in **more**

intense competition, lower costs, new demand, and overall traffic growth.

- **Connectivity for individuals and business**

Given the importance of face to face information exchanges and the coordination role of a large firm headquarter, the ability to travel quickly from the head office to an attractive foreign city centre close to specialized providers is essential. The **availability of direct intercontinental flights** is then a major determinant in the **location choices of large firms' headquarters** in Europe: a 10% increase in the supply of intercontinental flights results in a 4% increase in the number of headquarters of large firms located in the corresponding area.[127]

- **Social protection**

The comprehensive agreement, like the EU-Qatar agreement initialled in March 2019 and pending signature, can include provisions on social matters, and committing the Parties to improve social and labour law and policies. To do such, a Joint Committee may raise any issue, potential differences and mechanisms to quickly resolve any disputes.[128] Thus, the aviation agreements are also used as a **tool to promote the European social model** to countries in exchange for an access to the EU internal market.

- **Employment and economic benefit**

Frequent service to a variety of destinations, reflected in a high level of passenger enplanements, facilitates easy face-to-face contact with businesses in other cities, attracting new firms to the metro area and stimulates employment at established enterprises. The empirical results from several studies show a clear economic benefit from aviation. A 10% increase of departing passengers in a metropolitan region increases local employment in the services sector by 1%.[129] A 10% increase in international air services led to a 0.07%

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[126] *InterVISTAS Consulting Inc, Economic Impacts of Air Service Liberalization, 2015*

[127] *Germa Bèl, Xavier Fageda Getting there fast: globalization, intercontinental flights and location of headquarters - Journal of Economic Geography 8 (2008)*

[128] *EC, Transport modes, Air, EU and Qatar reach aviation agreement, March 2019*

[129] *Jan K. Brueckner, Airline Traffic and Urban Economic Development, Urban Studies, 2003*

increase in GDP.[130] A 10% increase in connectivity was associated with an increase in GDP per capita of 0.5%.[131]

With the most populated country and a major trading partner, China is the perfect country to reap the benefits of aviation market opening. In May 2019, the EU and China signed a horizontal aviation agreement and a BASA.

- **Competition and fares**

The emergence and growth of low-cost carriers (LCC) was made possible through liberalization and brought significant positive impacts to the airline industry. The fast growth of LCCs has let to increased competition and reduced fares in the EU liberalized market. A study shows that the EU single aviation market resulted in a 34% decline in discount fares in real terms.[132] On the other hand, existing regulations on route entry, ownership and effective citizen control have constrained the expansion of LCCs in many markets, preventing the full benefit of agreements from being fully realised.[133]

Since the EU-US agreement was signed in 2007, the improved competition lead to an average saving to the passengers of 230€ per passenger.[134]

- **Traffic development**

Since the signature of the EU Air Transport agreement with the Western Balkan States, the market has grown by 165%. In the case of Morocco, it has grown by 150%. Since the conclusion of the agreements with US and Canada the combined growth between the EU and these markets has been more than 15 million seats.[135]

- **Network**

The agreements allow carriers to better structure their networks to cover intra/intercontinental markets. The optimal benefits will only be achieved if ownership restrictions are eased, allowing cross-borders optimization.

Putting aside the efforts of the EU to improve flight efficiency within Europe with the Single European Sky, the biggest inefficiencies can be found in international flights where some countries are lacking agreements. For instance, Russia usually restricts fly over concessions to one airline per country.

- **Other obstacles – limits**

However, only **specific conditions** are needed to reach a positive impact from an aviation agreement.

For instance, the hubbing trend during the '00 and the weak financial state of the Scandinavian airlines resulted in traffic reductions between US and Scandinavia after the 1992 agreements.[136]

The comparison between Morocco, Turkey, US and Russia showed that many other factors have a critical influence, like **passenger entry restrictions** and the physical and operational characteristics of a partner's market. On the supply side, small countries with few airports, or countries underinvesting in the development of airport infrastructure, offer **limited options for new routes**. Similarly, even with an agreement, regulatory limitations like **airline ownership, charging and capacity allocation rules** can prevent non-local players to participate in the market. Finally, **geography and adequacy for the LCC business model** can prevent a true

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[130] *InterVISTAS Consulting Inc., "Measuring the Economic Rate of Return on Investment in Aviation", December 2006*

[131] *InterVISTAS Consulting Inc. "Economic Impact of European Airports"*

[132] *"European Experience of Air Transport Liberalisation", Joint Presentation by the European Union and the European Civil Aviation Conference to the 5th Worldwide Air Transport Conference (ICAO), 24-29th March 2003.*

[133] *ICAO, Economic Commission, Air Transport Liberalization and the Economic Development of the Countries, ATRS, 2016*

[134] *European Commission, US factsheet, EU-US Air Transport Agreement*

[135] *MEMO, Q&A: EU – Qatar aviation agreement, March 2019*

[136] *Cosmas, A., Belobaba, P., Swelbar, W., 2010. The effects of open skies agreements on transatlantic air service levels. Journal of Air Transport Management 16(4), 222-225*

disruption in the market. For instance, the geographic restrictions of trans-Atlantic flights appear to have limited the LCC carrier's entry drastic price reduction.[137]

De facto, we can conclude that liberalisation is **a necessary rather than sufficient condition** for traffic growth.

According to the European Commission, only 45% of the 2017 EU related traffic was covered by external aviation agreements. Given that **in the last 5 years the effective progress of the negotiation was limited**, and that the most growing markets are very regulated, the EU **must continue the negotiations** with third countries to unlock a very large economic benefit.

[137] *European Commission, Joint Research Centre, Four Shades of Open Skies: EU and four main external partners, 2015*

2.1.2. Airport Traffic Developments

Case Study: Slots constraint in Amsterdam

The Netherlands is the most densely populated country in Europe at 488 people per square metre. In such a country, regulation on special planning and environmental concerns is an extremely important factor for stakeholders. Officially known by the name Amsterdam Airport Schiphol, this airport is of great importance in Europe. Found in the Netherlands and located twenty minutes from Amsterdam city, it is an international airport connecting to many notable European airports and the home base for many intercontinental airlines such as KLM, Arkefly, Transavia, Amsterdam Airlines and Martinair.

Amsterdam-Schiphol today

Owned by Royal Schiphol Group, Schiphol airport is the third largest European airport with a 2018 market share of 11.7% within the European top ten and delivering its services to 71.1 million passengers. However, it is believed that Schiphol is set to drop out of the top three European airports by 2020 as it is overtaken by Frankfurt Airport, which is unhindered by similar slot limits.

		Growth	Market share
London LHR	80.1	2.7%	13.2%
Paris CDG	72.2	4.0%	11.9%
Amsterdam AMS	71.1	3.7%	11.7%
Frankfurt FRA	69.4	7.8%	11.4%

FIGURE 31: TOP THREE EUROPEAN AIRPORTS MARKET SHARE (OUT OF THE TOP TEN)

Over the last decade, Schiphol airport has seen a steady increase in the number of aircraft movements (as depicted in Figure 32). The breakdown of these movements in shown in **Error! Reference source not found.**.

		Growth	Market share
London LHR	80.1	2.7%	13.2%
Paris CDG	72.2	4.0%	11.9%
Amsterdam AMS	71.1	3.7%	11.7%
Frankfurt FRA	69.4	7.8%	11.4%

FIGURE 32: TOTAL AIRCRAFT MOVEMENTS AMSTERDAM

In 2018, Schiphol was able to offer a total of 327 direct network destinations in 98 countries, served by a total of 108 airlines. Of these destinations, 135 were intercontinental. As the hub for KLM and its regional affiliate KLM Cityhopper, KLM and its codeshare partners served 217 destinations.

2.1.2.1. Worldwide hub competition & capacity constraints: Amsterdam-Schiphol case

Case Study: Slots constraint in Amsterdam (continued)

Schiphol's capacity shortage

Currently, Schiphol is limited to 500,000 movements annually. However, after October 2020, the number of flights at Schiphol has been permitted to grow under the condition that Schiphol's environmental footprint (especially noise) is reduced. One of the ways currently being considered is through the utilisation of quieter aircraft however it is doubtful that this alone would be enough to permit an increased number of movements. Also, as has been seen in recent years, smaller and quieter aircraft are being replaced by larger more polluting aircraft in Schiphol's schedule to service larger numbers of passengers with the same number of aircraft movements.

It was originally hoped that the opening of Lelystad airport, which lies about 50 kilometres (30 miles) east of the Dutch capital, would ease some of the pressure on Schiphol. However, the opening has been delayed until 2023 by the Dutch Parliament and the European Commission because of opposition to all extra flights and arrangements over the increase in air traffic movements, as well as plans forcing budget airlines to move from Schiphol to Lelystad. Another key criterion for the Commission is the availability of good public transport between the two airports. It is believed that Lelystad airport is hard to reach by public transport and there are currently no plans to give it a train station.

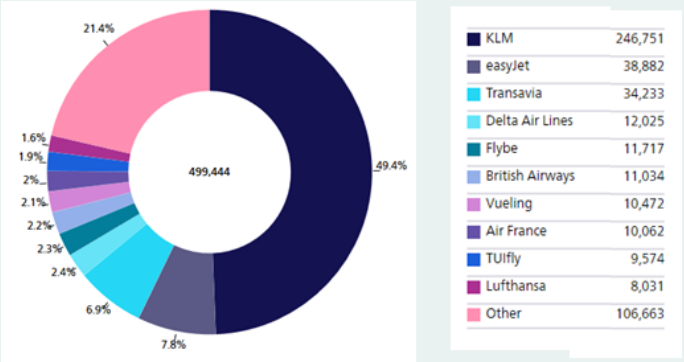

FIGURE 35. AMSTERDAM AIRPORT BREAKDOWN OF AIRCRAFT MOVEMENTS (SOURCE: SCHIPHOL GROUP)

Competitiveness of the hub

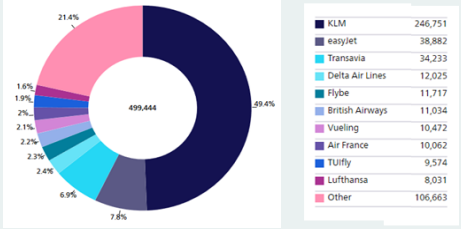

FIGURE 36. AMSTERDAM AIRPORT PASSENGERS' COUNTRY OF RESIDENCE (SOURCE: SCHIPHOL GROUP)

The hub operation at Schiphol Airport facilitates the operation of a large number of intercontinental destinations that are not viable with only local traffic. Despite the huge capacity, the airport is built in a unique way, applying the single terminal concept. This allows the minimum connection times to be shorter compared to hubs of similar size, going down to 40 minutes for certain connections.

With 67% of passengers residing outside of the Netherlands, it is evident that the demand of connecting passengers forms a large part of the service on offer. Movement limits has an impact on hub operations and a substantial number of routes cannot be viably operated with only local traffic. These intercontinental routes are therefore likely to be reduced or even cancelled if the hub operation at Schiphol Airport disappears. A similar effect could also be faced within the European feeder routes.

A study by SEO Amsterdam Economics , commissioned by the Ministry of Infrastructure and Water Management, estimated that: In the short-term, the loss of the hub operation at Schiphol Airport results in a decrease in value added of more than four billion euro and the loss of 55,000 jobs.

Without connecting passengers most intercontinental destinations currently served from Schiphol Airport cannot be operated viably. The same holds for an important part of the European network. To be able to operate a premium hub network of high-quality connections sufficient peak hourly capacity is essential. In that light, the Dutch government foresees in the implementation of a traffic distribution rule that aims at the distribution of leisure traffic from the inbound and outbound peaks at Schiphol Airport to Lelystad

Case Study: Slots constraint in Amsterdam (continued)

Impact on KLM

As evidenced by the large share of KLM with respect to Air transport movements, Schiphol airport is the hub of KLM and any capacity constraints are likely to have a major impact on the airline. **In light of this, KLM is already taking steps to diversify its offering with the announcement of a high-speed rail replacement service for one of its popular short-haul routes between Amsterdam and Brussels.** The 93-minute rail connection from Brussels Midi Station is set to commence in March 2020 as KLM reduces the daily frequency on the route from five to four. This is the latest move in KLM's "Fly Responsibly" campaign designed to highlight the company's commitment to make aviation a more environmentally sustainable industry. It will also help appease politicians in the airline's home country as in 2019, a group of Dutch parliamentarians called for an end to the Brussels-Amsterdam route on environmental grounds.

However, there could be other reasons for KLM seeking to cut the number of short-haul flights to and from Schiphol. As one of Europe's business airports, Schiphol departure slots are extremely valuable. So much so that last year the European Commission forced KLM to hand over some of their slots to Norwegian on competition grounds. Cutting down on short-haul connections could be the best solution for KLM not losing out on more long-haul business.

2.1.2.2. Metropolitan airport systems: what is the trend for low-cost peripheral airports?

Conclusion 18 – Decrease in traffic for some low specialised airports

In some metropolitan areas (Barcelona, Frankfurt, Glasgow), secondary airports specialising in low-cost are losing traffic. Main airports are able to offer both capacity and attractive fares for these airlines. Convergence of operating models between legacy and low-cost airlines also favoured progressive transfer of low-cost operation to main airports.

: The possible closure of secondary airports could have a detrimental impact on the local economy.

: Transfer of LCC to main airports leads to a more competitive environment at the hub airports, allowing consumers to benefit from lower fares and a wider range of services.

: The shift of low-cost operations to main airports could have negative consequences for local employment.

Sharp growth of low-cost airlines allowed development of secondary airports. There is no established definition of 'secondary airport'[138]. In this specific case, we are considering secondary airports located on the outskirts of major metropolitan areas, which have experienced strong growth in their traffic with low-cost airlines (e.g. Paris-Beauvais, Barcelona-Girona, Düsseldorf-Niederrhein, Frankfurt-Hahn, etc.).

Initial features of the low-cost model included withdrawal of all avoidable costs and complex processes. Secondary airports usually offer low charges and simple operational processes for passengers and aircraft.

Airport choice is a complex phenomenon integrating several parameters:

- Quality of ground access including means of transportation available, comfort and time to access the airport;
- Airlines, destinations, frequencies and fares available from each airport;
- Geographical location of origins and destinations of passengers.

The success of low-cost airlines has been largely linked to the induction effect they have had on air transport demand[139]. The very low fares enabled a whole category of the population to have access to air transport. To the extent that new customers demanded very low rates, their price sensitivity was very high. The corollary of a very high sensitivity to the price of demand is generally a very low value of time. Therefore, airport access is a secondary consideration if the price stays low. This combination of factors stimulated traffic of secondary peripheral airports.

However, intense competition led to a convergence of models between airlines. Lower fares became also available at main airports. There are several reasons for this price convergence:

- **Legacy airlines streamlined their models and offered more low fares** through discounts, and customisation of services (fare without luggage, etc.)
- **Main airports adapted their charges and operations to attract low-cost airlines.** Among the various actions, low-cost dedicated passenger terminals, new concepts of operation ('WiWo'[140] aircraft parking stands, pre-boarding spaces at gates) and strong development of incentives schemes and marketing support were at the heart of the progressive transfer of low cost traffic from secondary to main airports.

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[138] *Wong, et al., 2019, p.97*

[139] *Combe, 2019, p.92*

[140] *'WiWo' refers to 'Walk-In/Walk-Out' aircraft parking stands. These stands have no passenger boarding bridges. Passengers are walking from/to aircraft. They use front and rear doors of the aircraft. Therefore, boarding/deboarding process is shorter.*

TABLE 16. MULTI-AIRPORTS SYSTEMS IN EUROPE*

Country	City	Airports	Main	Second	Third	Fourth	Fifth	Sixth
United Kingdom	London	**6**	LHR	LGW	STN	LTN	LCY	SEN
France	Paris	**4**	CDG	ORY	BVA	XCR		
Germany	Düsseldorf	**4**	DUS	CGN	DTM	NRN		
Sweden	Stockholm	**4**	ARN	BMA	NYO	VST		
France	Lyon	**3**	LYS	GNB	EBU			
Italy	Milan	**3**	MXP	LIN	BGY			
Spain	Barcelona	**3**	BCN	GRO	REU			
United Kingdom	Birmingham	**3**	BHX	CVT	EMA			
Austria	Vienna	**2**	VIE	BTS				
Belgium	Brussels	**2**	BRU	CRL				
France	Strasbourg	**2**	SXB	FKB				
France	Toulouse	**2**	TLS	CCF				
Germany	Berlin	**2**	TXL	SXF				
Germany	Frankfurt	**2**	FRA	HHN				
Germany	Munich	**2**	MUC	FMM				
Iceland	Reykjavík	**2**	KEF	RKV				
Italy	Rome	**2**	FCO	CIA				
Italy	Venice	**2**	VCE	TSF				
Norway	Oslo	**2**	OSL	TRF				
Poland	Warsaw	**2**	WAW	WMI				
Spain	Tenerife	**2**	TFS	TFN				
United Kingdom	Belfast	**2**	BFS	BHD				
United Kingdom	Glasgow	**2**	GLA	PIK				
United Kingdom	Manchester	**2**	MAN	LPL				

* Boxes in blue represent peripheral airports with a strong specialisation on low-cost traffic
Source: Analysis Egis

The table here above shows the main European metropolitan airports systems including low-cost specialised airports located in the outskirts of metropolitan areas. London is major airport system with six airports around its metropolitan area. Some airports are clearly low-cost airlines oriented (LTN, SEN, STN).

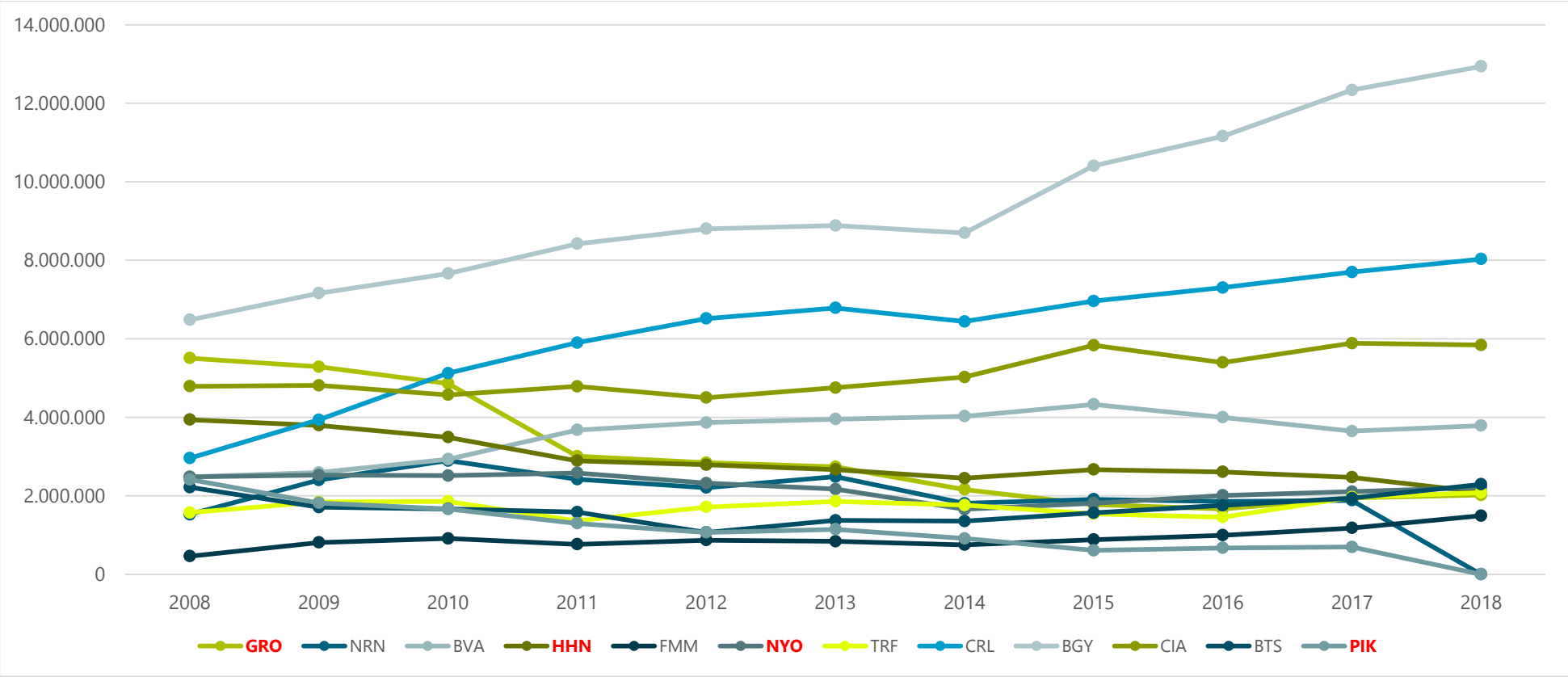
The table and diagram hereafter show traffic evolution of selected low-cost specialised airports between 2008 and 2018 (or 2017). **Some airports have experienced spectacular traffic growth (FMM, CRL, BGY).** Milan-Bergamo (BGY) and Brussels-Charleroi (CRL) were probably the airports that benefited most from the development of low-cost airlines, notably Ryanair and Wizz Air. These are very important bases for Ryanair, which has even decided to operate small hubs.

On the other hand, some airports also experienced equally dramatic drops in traffic (GRO, HHN, NYO, PIK). An airport like Barcelona-Girona (GRO), which was a strong base for Ryanair, lost 63% of its traffic between 2008 and 2018. The airline has chosen to transfer the majority of operations to Barcelona's main airport (BCN). In Frankfurt-Hahn (HHN) traffic also gradually eroded with a 47% drop over the same period. Stockholm-Skavsta experienced a more limited fall in traffic. Glasgow's secondary airport is now virtually off the map; in 2008, Glasgow-Prestwick (PIK) handled 2.4 million passengers. Ten years later, the airport only handled 0.7 million passengers (-71% over the period).

The evolution of traffic distribution within the same airport system depends largely on the development policy of the operators. They can choose to further attract low-cost carriers by offering them facilities and fares that are compatible with their operating model. **It seems that secondary airports systematically loose traffic when the main airport operator chooses to attract low-cost airlines.** This raises the question of the future of these airports in the medium term (at least some of them).

TABLE 17. TRAFFIC 2008-2018 OF SELECTED SECONDARY LOW-COST SPECIALISED AIRPORTS

IATA Code	City	Airport	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Variation	Source
GRO	Barcelona	Girona	5 507 294	5 286 970	4 863 785	3 007 649	2 844 571	2 736 867	2 160 646	1 775 318	1 664 763	1 946 816	2 019 876	-63,3%	AENA
NRN	Düsseldorf	Niederrhein	1 523 990	2 402 083	2 896 730	2 421 108	2 208 429	2 487 843	1 807 543	1 909 704	1 854 108	1 885 811	n.a.	23,7%	ADV
BVA	Paris	Beauvais	2 484 635	2 591 864	2 931 796	3 677 794	3 862 562	3 952 908	4 024 204	4 330 019	3 997 678	3 646 523	3 787 086	52,4%	UAF
HHN	Frankfurt	Hahn	3 940 159	3 793 710	3 493 451	2 894 109	2 790 961	2 667 402	2 447 140	2 667 000	2 609 156	2 472 198	2 092 868	-46,9%	ADV
FMM	Munich	Memmingen	462 000	810 000	911 609	764 782	869 937	838 971	750 000	883 490	996 714	1 179 875	1 492 553	223,1%	FMM Airport
NYO	Stockholm	Skavsta	2 479 887	2 525 227	2 513 046	2 583 934	2 321 908	2 169 587	1 658 238	1 813 032	2 008 372	2 106 773	2 214 159	-10,7%	NYO Airport
TRF	Oslo	Torp	1 572 942	1 842 311	1 858 462	1 359 346	1 712 738	1 856 897	1 762 848	1 540 557	1 455 122	1 963 630	2 082 116	32,4%	TRF Airport
CRL	Brussels	Charleroi	2 957 026	3 937 187	5 123 404	5 901 007	6 516 427	6 786 163	6 439 957	6 959 302	7 303 720	7 698 767	8 029 680	171,5%	CRL Airport
BGY	Milan	Bergamo	6 482 590	7 160 008	7 661 061	8 419 948	8 801 392	8 882 611	8 696 085	10 404 625	11 159 631	12 336 137	12 937 881	99,6%	BGY Airport
CIA	Rome	Ciampino	4 790 956	4 811 201	4 571 076	4 787 011	4 499 107	4 752 975	5 024 994	5 834 201	5 395 699	5 885 812	5 839 737	21,9%	CIA Airport
BTS	Vienna	Bratislava	2 218 545	1 710 018	1 665 704	1 585 064	1 067 933	1 373 078	1 355 625	1 564 311	1 756 808	1 942 069	2 292 712	3,3%	BTS Airport
PIK	Glagsow	Prestwick	2 415 755	1 817 727	1 662 744	1 297 119	1 067 933	1 145 836	913 685	610 837	673 232	696 309	n.a.	-71,2%	UK CAA



2.1.2.3. Regional airports: from regional connectivity to European hyper-competition to attract low-cost airlines

Conclusion 19 – Smaller airports (< 1 million passengers per year) are losing traffic

Smaller airports (<1 million passengers per year) lose the most traffic in EU. Competition is fierce between smaller airports. All regional airports are in competition with each other. FSNC progressively withdrew from regional airports. Low-cost airlines took advantage of this intense competition to negotiate generous marketing support and incentives schemes.

: The arrival of LCC at regional airports creates employment and stimulates the local economy.

: The increasingly competitive environment in which regional airports are operating ensures high consumer bargaining power.

: The trend whereby small airports lose market share has a detrimental effect on local employment.

Several researchers have observed the effects of low-cost airlines on the connectivity of regional European airports[141]. The strong development of low-cost airlines, quite logically, had an effect on full service network carriers (FSNCs).

The latter have gradually reduced their offer from/to secondary airports, particularly airports that had only one route from/to a hub. While low-cost airlines have sometimes considerably increased traffic at these secondary airports, the nature of the service also deeply changed.

"[…] *the level of competition faced by the FSNC on a route can gave a negative effect on the quality of connectivity that is offered.* […] *LCC entry in a city-pair market already served by an FSNC hub feeder service can have detrimental effects if the goal of the region is to maintain onward connectivity via an alliance hub*"[142]

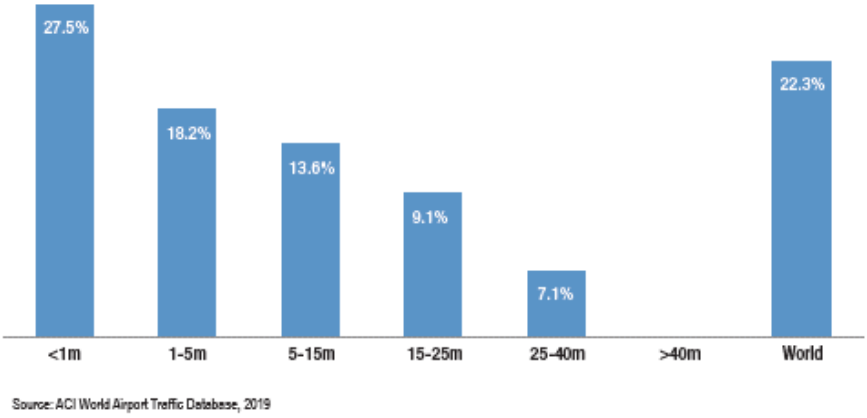


FIGURE 37. PROPORTION OF AIRPORTS THAT EXPERIENCED A LOSS IN PASSENGER TRAFFIC VOLUME BY SIZE CATEGORY (2007-2018) (SOURCE: ACI, 2019)

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[141] *Ziegler, et al., 2017*

[142] *ibid, 2017, p.73*

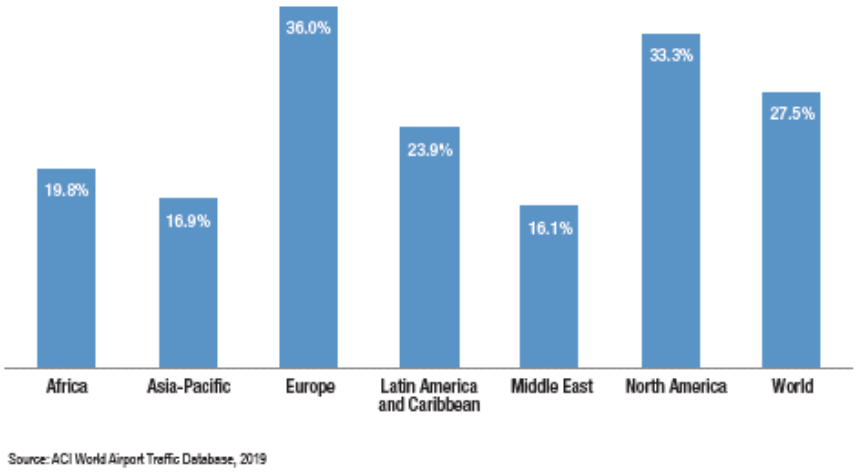

FIGURE 38. PROPORTION OF AIRPORTS THAT EXPERIENCED A LOSS IN PASSENGER TRAFFIC VOLUME BY REGION FOR AIRPORTS LESS THAN 1MPAX (2007-2018) (SOURCE: ACI, 2019)

The two ACI graphs above show that airports with less than one million passengers per year are losing the most traffic in the world. Europe is particularly affected by this phenomenon. More than a third of the airports of this size lost traffic between 2007 and 2018. Same ACI report also showed strong growth of mid-size major airports (<40 Mpax).

Low-cost airlines have chosen to develop in the blind spots of FSNCs, particularly in regional metropolitan areas. Since FSNCs were favouring hub and spokes routes networks, transversal direct routes between large regional cities were dropped. LCCs have chosen to occupy this market segment.

To the extent that low-cost airlines have significantly improved the direct connectivity of major regional cities, airports serving small and medium-sized cities have largely been challenged. The consequences on the geography of travel are manifold:

- **Through the effect of low prices, LCCs have been able to significantly expand the catchment areas of the major regional airports.** Airport catchment areas are now calculated within a two-hour radius, as the very low prices of LCCs are able to compensate longer ground access times.
- **Airports serving small and medium sized cities do not have the volume of demand to attract low-cost airlines (except niches).** With competition from large regional airports, services to smaller airports are increasingly threatened (route closures, transition to PSOs when feasible, etc.). From a competitive point of view, small airports are now struggling to develop their traffic. Some low-cost airlines are taking full advantage of these difficulties by demanding more and more marketing support from small airports. To control this phenomenon, guidelines have been put in place by the European Commission[143].

From a socio-economic and regional planning policy point of view, the concentration of flows, economic activities towards the major metropolises refers to the more global phenomenon of metropolisation (or metropolitan revolution)[144]. Small and medium-sized cities, as well as isolated rural areas, are losing their economic influence and attractiveness. Some economy or geography researchers do not hesitate to talk about the drying up of these territories. The air transport sector is largely dependent on

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[143] *See Communication from the Commission — Guidelines on State aid to airports and airlines (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014XC0404%2801%29)*

[144] *Metropolisation or Metropolitan revolution is a process of strengthening the power of large metropolises, through population growth, the density of communication networks, the concentration of key economic activities in all fields (production, research and culture, in particular) (Ghorra-Gobin, 2015).*

the phenomenon of metropolisation, insofar as the latter contributes to economic development (it fulfils a demand).

In more detail, the combination of the development of LCCs and the metropolisation of the economy is changing regional connectivity in the following ways:

- **FSNCs mostly offer high frequency, low capacity, expensive connectivity from regional airports to a hub and beyond (via the hub).** Connectivity is therefore very broad in terms of destinations, but often expensive for travellers. Business travellers can access to numerous destinations. Connectivity to a hub is an essential element of a region's attractiveness to businesses.
- **Low-cost airlines have favoured a different model with larger aircraft, lower frequency, lower fares, and selectivity on high-potential city-pairs and niche markets.** In other words, while the volume effect of low-cost airlines has led to greater financial (and social) accessibility of air transport, the latter has specialised in specific clusters of destinations. As a result, geographic connectivity has become distorted, with wide variations between city-pairs.

For regional airports consequences are the following:

- **Regional airports (and their local authorities) that finance the routes of low-cost airlines (marketing support, incentives) largely favoured inbound traffic in order to benefit from induced economic effects (tourism).** For instance, in France, south-western regional airports largely favoured traffic from/to United Kingdom to develop second home properties and tourism. Such airports have sometimes a better connectivity from/to United-Kingdom than from/to the rest of France.
- **Low cost airlines business model targets niche and/or high-volume point-to-point markets.** Thin markets cannot be chased by these airlines. Most of the thin city-pairs potential could only be developed via hub or very low frequencies.

This selectivity of regional air accessibility on specific niches and segments does not favour the economic attractiveness of small and medium-sized cities. A company will be reluctant to set up in an area that does not offer good transport accessibility. The economic development of these territories is therefore based solely on their intrinsic assets (e.g. landscapes, heritage, specific economic activities developed on a long period, etc.). The least endowed territories will therefore find it very difficult to develop their air traffic, as demand will remain low (tautological principle).

From a citizen point of view, it also affects accessibility of territories, which rely on public policies and state aids (e.g. PSO). To travel from/to a small or medium-sized cities with an attractive fare, a European citizen will have to travel to the nearest major regional airport (up to two hours to access an airport offering low fares routes). **This raises the question of the quality of ground access, particularly for categories of the population that may have difficulties to travel autonomously (students, retirees). The induction effect of the LCCs will not have benefited the entire population.**

2.1.3. Airlines Developments

Ever since, the EU airline market has undergone all kinds of changes in airline structure and composition. The last two decades, we have witnessed the substantial influx of LCCs, the bankruptcy of some carriers and a few major mergers and takeovers. Especially the former has changed the EU airline landscape to a large degree, leading to lower prices for consumers, but also for substantial competitive pressure on incumbent airlines. Already in the beginning of the last decade there were signs that the LCC business model as it existed at that time was reaching its growth limits.[145] Next to an outline of the most recent bankruptcies and commercial partnerships between airlines and their competitive implications, this section will shed light on whether LCCs have been able to reach further growth of market share and, if yes, how they succeeded to do so.

2.1.3.1. The airlines market consolidation and its effect on competition

Conclusion 20 – European airlines market is highly competitive

Competition between airlines is more intense in Europe than in other comparable regions of the World (e.g. Northern America, China, etc.). Turnover of airlines' creation and ceasing of operations is high, especially for small airlines. Top 10 airlines market is consolidating with mergers & acquisitions and/or bankruptcies.

: Intensive competition results in lower prices, while market consolidation provides mergers with significant market power and therefore the possibility to increase air fares.

Conclusion 21 – Are the leisure and regional airlines market segments threatened?

There is a higher turnover of airlines on the regional or leisure segments. Market seems to be consolidating around two 'types' of airlines: full service network carriers (excl. regional airlines) and low-cost airlines.

: Market consolidation leads to mergers with significant market power and higher prices.

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[145] *See for example Wit, J.G. de & Zuidberg, J. (2012) – The growth limits of the low cost carrier model. Journal of Air Transport Management, 21, 17-23.*

The following airlines ceased operation since 2014.

TABLE 18. LIST OF EUROPEAN (EU+) AIRLINES CEASED OPERATIONS SINCE 2014[146]

Airlines marked with ^ are virtual airlines (no AOC)
Airlines marked with * have very limited commercial operation and mainly focus on business and/or general aviation

1. **LGW (Germany)** in April 2020
2. **Flybe (United Kingdom) in March 2020**
3. **Air Italy (Italy) in February 2020**
4. **Ernest Airlines (Italy) in January 2020**
5. **Thomas Cook Balearics (Spain) in December 2019**
6. **Astra Airlines (Greece) in November 2019**
7. **Adria Airways (Slovenia) in September 2019**
8. **XL Airways France (France) in September 2019**
9. **Aigle Azur (France) in September 2019**
10. **Thomas Cook Airlines UK (United Kingdom) in September 2019**
11. **WOW Air (Iceland) in March 2019**
12. **Bulgarian Eagle (Bulgaria) in February 2019**
13. **Germania (Germany) in February 2019**
14. **BMI Regional (United Kingdom) in February 2019**
15. **PrivatAir (Switzerland) in December 2018**
16. **Cello Aviation (United Kingdom) in December 2018**
17. **Small Planet Airlines Poland (Poland) in November 2018**
18. **Small Planet Airlines (Lithuania) in November 2018**
19. **Primera Air Nordic (Latvia) in October 2018**
20. **Primera Air (Denmark) in October 2018**
21. **Cobalt Air (Cyprus) in October 2018**
22. **Small Planet Airlines Germany (Germany) in October 2018**
23. **VLM Airlines Slovenia (Slovenia) in September 2018**
24. **Azur Air Germany (Germany) in September 2018**
25. **Waves* (United Kingdom) in September 2018**
26. **Skywork Airlines (Switzerland) in August 2018**
27. **VLM Airlines (Belgium) in August 2018**
28. **Sparrow Aviation (Sweden) in June 2018**
29. **NextJet (Sweden) in May 2018**
30. **ASL Airlines Switzerland (Switzerland) in February 2018**
31. **FlyViking (Norway) in January 2018**
32. **Aviavilsa (Lithuania) in 2018**
33. **Adria Airways Switzerland (Switzerland)** in December 2017
34. **Welcome Air (Austria)** in December 2017
35. **Air Berlin (Germany)** in October 2017
36. **Air Norway (Norway)** in October 2017
37. **Monarch Airlines (United Kingdom)** in October 2017
38. **Thomas Cook Airlines Belgium (Belgium) in October 2017**
39. **Fly Marche (Italy) in August 2017**
40. **JetXtra.com^ (United Kingdom) in July 2017**
41. **FlyKiss (France) in May 2017**
42. **Citywing^ (United Kingdom) in March 2017**
43. **Bergen Air Transport* (Norway) in 2017**
44. **Höga Kusten Flyg^ (Sweden) in 2017**
45. **Denim Air (Netherlands) in November 2016**
46. **European Coastal Airlines (Croatia) in October 2016**
47. **Air Vallée (Italy) in June 2016**
48. **Avies (Estonia) in April 2016**
49. **Limitless Airlines (Croatia) in 2016**
50. **Dubnica Air* (Slovakia) in 2016**
51. **Atlantique Air Assistance (France) in December 2015**
52. **Minoan Air (Greece) in November 2015**
53. **Estonian Air (Estonia) in November 2015**
54. **InterSky (Austria) in November 2015**
55. **Virgin Atlantic Little Red (United Kingdom) in September 2015**
56. **SkyGreece Airlines (Greece) in August 2015**
57. **Greenland Express (Denmark) in August 2015**
58. **B&H Airlines (Bosnia and Herzegovina) in July 2015**
59. **Air Lituanica (Lithuania) in May 2015**
60. **Air Croatia (Croatia) in April 2015**
61. **Eurolot (Poland) in March 2015**
62. **Ten Airways (Romania) in March 2015**
63. **Cyprus Airways (Cyprus) in January 2015**
64. **Hermes Aviation (Greece) in 2015**
65. **CityLine Hungary (Hungary) in 2015**
66. **Hamburg Airways (Germany) in December 2014**
67. **Helitt Líneas Aéreas (Spain) in October 2014**
68. **FlyRomania (Romania) in September 2014**
69. **Cyprus Airways (Cyprus) in January 2015**
70. **Hermes Aviation (Greece) in 2015**
71. **CityLine Hungary (Hungary) in 2015**
72. **Hamburg Airways (Germany) in December 2014**
73. **Helitt Líneas Aéreas (Spain) in October 2014**
74. **FlyRomania (Romania) in September 2014**

TABLE 19. LIST OF ESTABLISHED EUROPEAN (EU+) AIRLINES SINCE 2014

1. **Air Horizont (Malta)** in 2014
2. **Chair Airlines (Switzerland)** in 2014
3. **Bosnian Wand Airlines (Bosnia and Herzegovina) 2014**
4. **European Coastal Airlines (Croatia)** in 2014
5. **Fly Romania (Romania)** in 2014
6. **Hermes Aviation (Malta)** in 2014
7. **Norwegian Air International (Ireland)** in 2014
8. **Olympus Airways (Greece)** in 2014
9. **Primera Air Nordic (Latvia)** in 2014
10. **Air Andorra (Spain)** in 2015
11. **Andorra Airlines (Spain)** in 2015
12. **Cargo Logic Air (United Kingdom)** in 2015
13. **Cobalt Air (Cyprus)** in 2015
14. **Ernest Airlines (Italy)** in 2015
15. **Flyest (Estonia)** in 2015
16. **Holiday Jet (Switzerland)** in 2015
17. **Limitless Airways (Croatia)** in 2015
18. **Nordica (Estonia)** in 2015
19. **Norwegian Air UK (United Kingdom)** in 2015
20. **Orange2Fly (Greece)** in 2015
21. **Small Planet Airlines (Germany)** in 2015
22. **Tus Airways (Cyprus)** in 2015
23. **Air Belgium (Belgium)** in 2016
24. **ALK Airlines (Bulgaria)** in 2016
25. **Azur Air (Germany)** in 2016
26. **BRA Braathens Regional Airlines (Sweden)** in 2016
27. **Cyprus Airways (Cyprus)** in 2016
28. **Electra Airways (Bulgaria)** in 2016
29. **Eurowings Europe (Austria)** in 2016
30. **FlyViking AS (Norway)** in December 2016
31. **GetJet Airlines (Lithuania)** in 2016
32. **Star East Airline (Romania)** in 2016
33. **Sundair (Germany)** in 2016
34. **VLM Airlines Slovenia (Slovenia)** in 2016
35. **Air Mediterranean (Greece)** in 2017
36. **Bulgarian Eagle (Bulgaria)** in 2017
37. **Corendon Airlines Europe (Malta)** in 2017
38. **Easyjet Europe Airline (Austria)** in 2017
39. **Easyjet UK Limited (United Kingdom)** in 2017
40. **Fly2Sky Airlines (Bulgaria)** in 2017
41. **Gowair Vacation Airlines (Spain)** in 2017
42. **Level (Spain)** in 2017
43. **Level Europe (Austria)** in 2017
44. **Scandinavian Airlines Ireland (Ireland)** in 2017
45. **Thomas Cook Airlines Balearics (Spain)** in 2017
46. **Thomas Cook Aviation (Germany)** in 2017
47. **Wizz Air UK (United Kingdom)** in 2017
48. **Air Italy (Italy)** in 2018
49. **Air Leap (Norway)** in 2018
50. **Buzz (Poland)** in 2018
51. **Freebird Airlines Europe (Malta)** in 2018
52. **Great Dane Airlines (Denmark)** in 2018
53. **Lauda (Austria)** in 2018
54. **Norwegian Air Sweden (Sweden)** in 2018
55. **Air Antwerp (Belgium)** in July 2019
56. **Holiday Europe (Bulgaria)** in 2019
57. **Isla Air Express (Spain)** in 2019
58. **Malta Air (Malta)** in 2019

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[146] *It should be noted that Germany experienced a strong adjustment in the market of its airlines in 2012 and 2013: Cirrus Airlines (2012), Contact Air (2013), Augsburg Airways (2013), and OLT Express (2013) ceased operations.*
^ Virtual airline

Since 2014, 74 European airlines ceased operations:

- 4 airlines in 2020 (ongoing)
- 10 airlines in 2019
- 18 airlines in 2018
- 12 airlines in 2017
- 6 airlines in 2016
- 15 airlines in 2015
- 9 airlines in 2014

The breakdown of end of operation by type of company is as follows:

- **Legacy:** 4 airlines
- **Low-cost:** 6 airlines
- **Leisure/Charter:** 21 airlines
- **Regional:** 37 airlines
- **Other (Cargo, etc.):** 6 airlines

The European airline market is highly competitive compared to other major geographical areas (notably North America). Nevertheless, traffic is concentrated on a small number of legacy and low-cost operators. Over the period 2014-2020 the balance of creations and bankruptcies is -16. This aggregate data covers several trends.

- **The European air transport market is consolidating around several operators (or groups of operators).** In 2018, among the 20 biggest European airlines (by passenger traffic), 71% of the passenger traffic was operated by only five operators (Ryanair Holdings, Lufthansa Group, IAG, Air France-KLM, and Easyjet)[147]. Eight of these top 20 airlines are LCCs148. There is therefore a wide dispersion of small and medium-sized operators. The main lesson of the last few years is the consolidation of the weight of LCCs as leading operators.
- **Among the major or medium-sized operators, bankruptcies have been resounding in recent years (Air Berlin, Thomas Cook, etc.).** This confirms a trend towards consolidation in the operators' market. Certain niches (leisure, regional, VFR) are now being challenged by low-cost airlines in particular.
- **The market for small regional operators has a (very) high turnover**. Fewer and fewer regional operators are being created. Risk in this segment is too high to attract the interest of investors and entrepreneurs. Although LCC have sometimes been able to replace regional operators (with larger volumes, better affordability, but reduced frequency), some thin city-pairs no longer have a regional operator (for more details, see 2.1.4.1).
- **While on the one hand the major airlines groups are consolidating their financial results and their traffic, on the other hand they seem to be multiplying brands and airline operator certificates (AOCs).** For instance, Ryanair Group now holds five AOCs (Buzz, Lauda, Malta Air, Ryanair DAC, and Ryanair UK). Brexit is an obvious administrative reason for some airlines (e.g. Easyjet, Ryanair) to maintain bases and presence in EU.

  However, amongst the groups of airlines operating under multiple AOCs, two different strategies seems to be emerging: operation under different AOCs but with the same branding, such as EasyJet, or operations under different AOCs and with different branding, such as the airlines of the IAG group. We highlighted the following potential explanations.

  - *Diversification of brands and services*

    Example: Air France-KLM group has different AOCs for different services. Amongst the two main airlines of the group (Air France and KLM), different subsidiaries are AOC holders and are proposing different services: Air France and KLM are offering a high quality service while Transavia is proposing low-cost flights and services to their customers.

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[147] *Calculation through CAPA analysis and Airlines' results.*

[148] *Ryanair Holdings, Easyjet, Wizz Air, Norwegian Air Shuttle ASA, Jet2.com, SmartWings Group, Volotea, and Blue Air.*

- *Administrative, Financial & Legal reasons*

  Example: In 2017, EasyJet opened a new subsidiary in Austria (EasyetJet Europe Airline Gmbh) to continue its operations across and within Europe even after the Brexit.

  Beyond the specific case of Brexit, the compartmentalisation of legal entities makes it possible to manage each company separately, and to avoid the transfer of risks from one entity to another:

  - A legal decision, agreement or contract can thus be limited to a single legal entity (e.g. trade union negotiation, court decision, etc.).
  - In the event of financial difficulties, it is simpler to separate (bankruptcy) an entire entity without impacting the rest of the group. In particular, Norwegian Air Shuttle ASA was able to close its Danish and Swedish subsidiaries recently, without impacting the parent company based in Norway.

- *Change of image towards consumers?*

  Example: This explanation remains more exploratory. In 2019, Ryanair acquired the startup Malta Air along with its AOC. With this new AOC, Ryanair will change the registration of some of its aircraft based in Malta and will diversify its destination with the objective to open new routes outside of Europe and especially in North Africa. With this acquisition and the previous acquisition of Lauda in Austria and Buzz in Poland, Ryanair is seeking to diversify its brand and to recreate a new image among European passengers.

2.1.3.2. The further evolution of the LCC business model

Conclusion 22 – Towards a convergence of business models between FSNC and LCC?

Low-cost carriers (LCC) are consolidating their activities through opening routes at major airports, offering additional services (flex fares, priority, etc.) and connecting flights at some major bases. At the same time, full service network carriers (FSNC) are offering 'no-frills' fares and services (hand luggage only, no change, no refund, no snack and beverages). Additionally, FSNC groups developed LCC subsidiaries and independent LCCs started partnering with other airlines to offer long-haul connecting flights. LCC business model is now split into two sub-models; LCC model which is progressively converging with FSNC, and ultra-low cost carrier (ULCC) which sticks to the original low-cost business model.

: The emergence of different types of LCC business models provides market differentiation and a wider range of offers for consumers.

As said, the LCC business model has shown signs of saturation in the past. Although, lately we have still seen an increase in LCC market share throughout the EU. EU-wide LCCs gained 4 percentage points in terms of passengers served between 2016 and 2019. Recently, LCCs have found several ways to attract additional passengers. Several of those ways are moving the LCCs away from the classical LCC business model. Most remarkably, also ultra LCC (ULCC) Ryanair is adopting strategies that are not in line with that classical approach. The other large ULCC is doing less so, most likely because they still profit from the above average increase in demand for air travel in Eastern Europe. In other words, to date, there is no such need for Wizz Air to adopt alternative growth strategies. Below, we will elaborate on the current and most profound business model changes.

2.1.3.2.1. Serving transfer passengers and codesharing

For a long time already, the transfer segment is an indispensable part of the network carrier's business model. After all, network carriers are able to operate a much larger network at a much higher frequency by actively targeting the transfer passengers. Some routes of EU network carriers operate with up to 90 per cent transfer passengers. For that, aiming at transfer passengers is a way to substantially increase the total number of passengers. At the same time, organising a transfer passenger system is complex and costly and therefore initially not something LCCs worry about.

Up to COVID-19, we witnessed an increase of serving the transfer segment among all kinds of LCCs. Initially, it mainly were low-cost subsidiaries of network carriers and LCCs with own long-haul operations that were involved in some form of hubbing.[149] Thereafter, however, also the rather classic LCCs cautiously entered the transfer market. In some instances, the LCC aims at online connections within its own network and sometimes it involves a codeshare agreement with a third airline. Some profound examples:

- **Ryanair:** In 2017, Ryanair started to offer connecting flights at two of its Italian bases: Rome Fiumicino and Milan Bergamo.[150] Later that year, it also introduced connecting flights at Porto. In 2019, Ryanair extended its connecting flights service to Brussels Charleroi. All in all, Ryanair slowly expands its connecting flights service, although at the vast majority of its bases, there is no such service in place. Moreover, OAG traffic analyser points out that numbers of connecting passengers (excluding self-connect) at the four Ryanair bases were very limited in 2019. Given the fact that there is no active coordination between in- and outbound (banks of) flights, that is hardly surprising. After all, the average quality of the possible connections is likely to be low (i.e. relatively long transfer times).

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[149] See for example Fichert, F. & Klophaus, R. (2016) – Self-connecting, codesharing and hubbing among European LCCs: From point-to-point to connections? Research in Transportation Business & Management, 21, 94-98.

[150] See for example *https://corporate.ryanair.com/news/ryanair-launches-connecting-flights-at-milan-bergamo/*

- **Easyjet:** At a large number of its bases Easyjet offers 'Worldwide by Easyjet', a program, where passengers can self-connect to flights of their worldwide partners, including airlines like Norwegian, Virgin Atlantic, Cathay Pacific, and Westjet.

  In addition, in January 2020, Easyjet signed an extensive codeshare agreement with Etihad Airways, enabling passengers flying at the UAE carrier to connect to the Easyjet network at ten European airports. At the other hand, Easyjet customers can book tickets to Abu Dhabi at Etihad flights.

- **Norwegian:** The major LCC that combines an extensive intra-European network with a long-haul, mainly North Atlantic, network is Norwegian. In order to profitly operate the long-haul operations, Norwegian is forced to offer connecting flights to feed its long-haul network. Over the period January 2014 to April 2019, transfer shares at its North Atlantic operations were over 30 per cent at Oslo Gardermoen, little over 25 per cent at Stockholm Arlanda, and almost 20 per cent at Copenhagen.[151] In November 2019, Norwegian has suspended all long-haul flights from Copenhagen and Stockholm Arlanda, concentrating its long-haul operations at Oslo Gardermoen. See paragraph 2.1.3.2.3 for a detailed analysis of the long-haul low-cost concept.

- **Low-cost subsidiaries:** Vueling, Eurowings, and Transavia are examples of low-cost subsidiaries which networks are connected to the networks of their respective parent companies, Iberia/IAG, Lufthansa, and KLM. The low-cost daughters are increasingly used to expand the networks of the network carrier parent. In addition, Vueling operates its own connecting hub at Barcelona El Prat.

To conclude, it seems likely that to a certain extent, adopting some kind of hubbing strategy and cooperation with other airlines will be seen among LCCs in the future as well. LCCs have found out that such strategies can help them to further increase their market shares and increase the scale and scope of their operations. At the same time, the division of inbound and outbound flights over a typical weekday do not show strong signs of coordination between those two. On the contrary, the diagrams of Easyjet, Ryanair, and Vueling at London Gatwick, Milan Bergamo, and Barcelona El Prat more or less show typical LCC high-utilization pictures with an outbound peak in the early morning, an inbound peak in the late evening, and no profound inbound and outbound peaks during the day (see Figure 33). Only Norwegian shows a picture that starts with inbound flights followed by an outbound peak (see Figure 34), which is typical for network carriers that have large numbers of their aircraft overnight at outstation to feed the early morning peak at their respective hubs.

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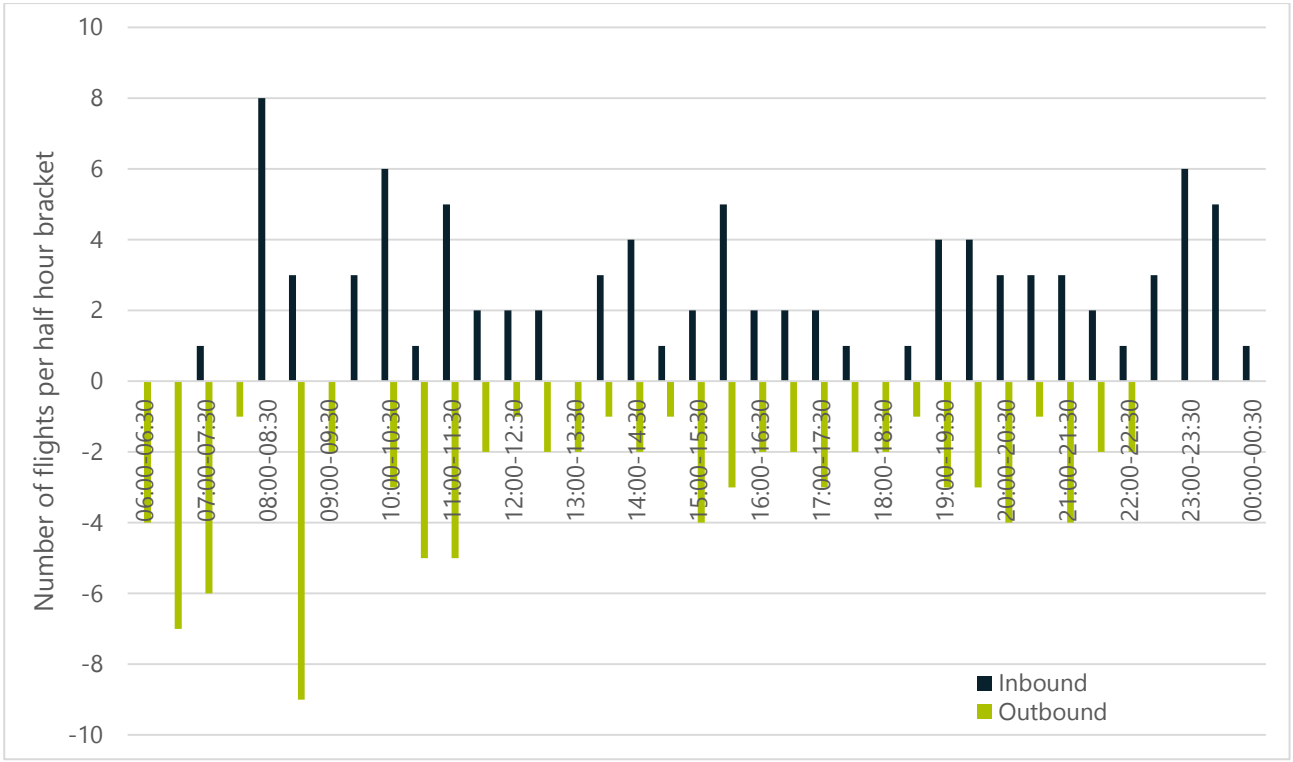
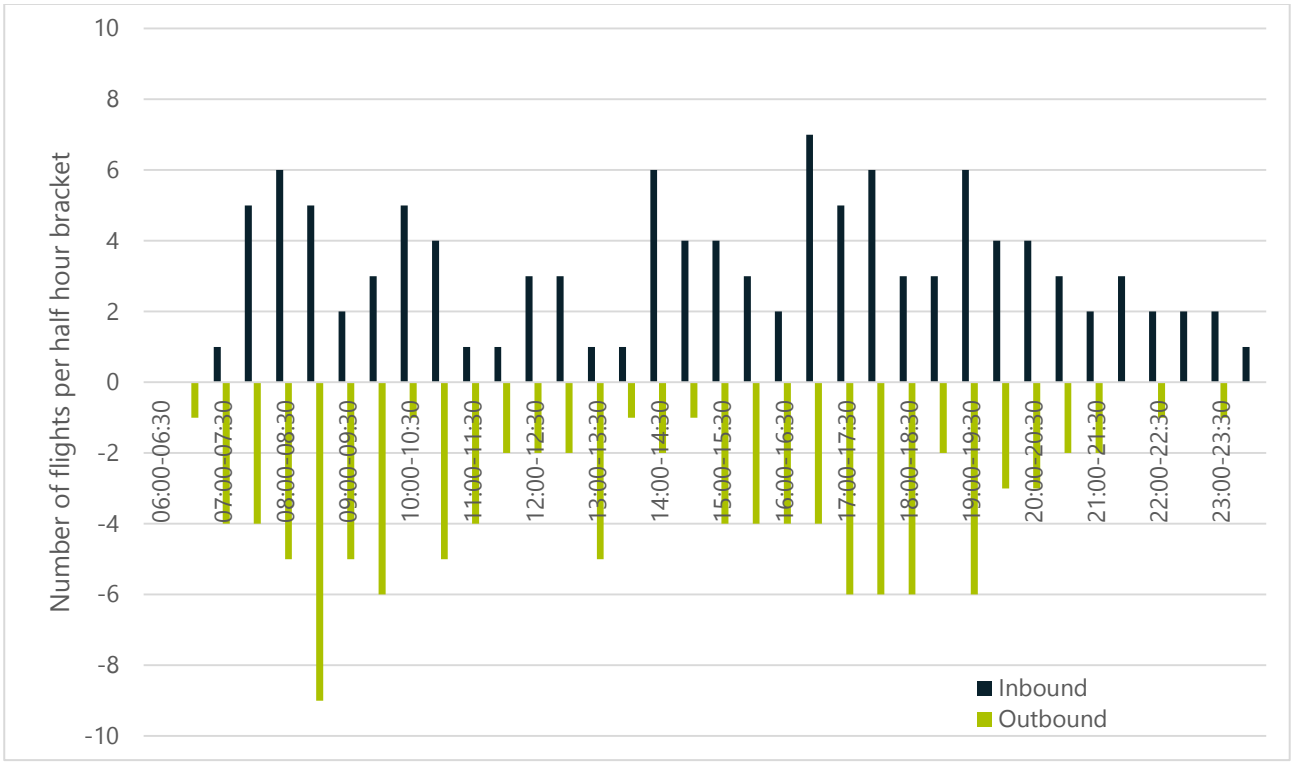
[151] *See Zuidberg, J. & Wit, J.G. de (2020) – Long-haul low-cost networks in the North Atlantic airline market and the ongoing viability challenge. Transport Policy, forthcoming.*

FIGURE 39 DIVISION OF INBOUND AND OUTBOUND RYANAIR FLIGHTS AT MILAN BERGAMO



Source: OAG, 10 February 2020

FIGURE 40 DIVISION OF INBOUND AND OUTBOUND NORWEGIAN FLIGHTS AT OSLO GARDERMOEN



Source: OAG, 10 February 2020

2.1.3.2.2. Operating at primary airports

Conclusion 23 – Some secondary LCC specialised airports serving major metropolitan areas are losing traffic

Major airports are capable of offering competitive fares and terminals to attract LCC. LCC are competing with FSNC from main airports. Some secondary airports located around major metropolitan areas and specialised on low-cost traffic lost traffic over the last ten years against major airports (Barcelona, Frankfurt). However, this phenomenon is not applicable to all LCC specialised airports serving major cities (Brussels, Milan, Paris, Rome, etc.).

: Secondary airports located around major metropolitan areas create jobs and strengthen the local economy.

: The availability of both hubs and secondary airports allows consumers to choose the most suitable airport and possibly shorten their total travel distance and time.

: Attracting LCC will create additional employment in certain regional areas.

In order to achieve further growth, LCCs may shift capacity from secondary to primary airports to benefit from the higher demand at the latter.[152] In Europe, especially Ryanair has tapped into major airport markets to deploy its increasing aircraft capacity. Barcelona El Prat (2010), Brussels Zaventem, and Rome Fiumicino (both 2014) were the first profound examples of entering into major airport markets next to the already existing operations from competing secondary airports. After that, Ryanair started operations from Milan Malpensa (2015), Hamburg, Oslo Gardermoen (both 2016), Frankfurt Main (2017), Berlin Tegel (2018).

Given the widely acknowledged claim that connectivity (and, with that, accessibility) of airports is a main driver of regional economic development, it is worthwhile to have a view on the impact on the respective secondary airports. This is especially relevant in the 'LCC's shift to primary airport context' because LCCs are often seen as the type of airline that offers air connectivity to rather peripheral regions.[153] In other words, if an airport (region) is left by a dominant LCC, it is insecure whether the airport network will be operated by an alternative airline.

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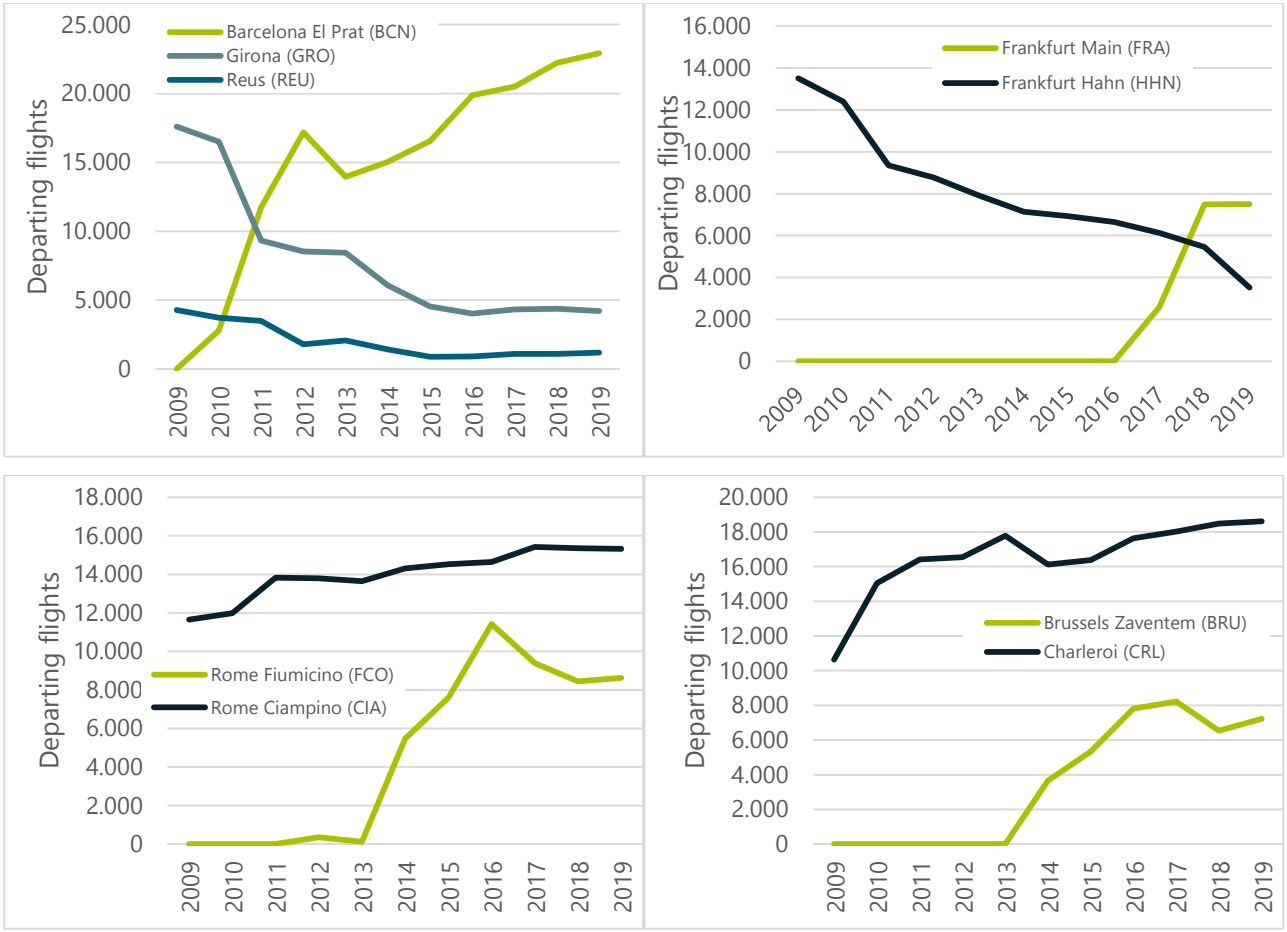
[152] *See for example Dobruszkes, F., Givoni, M., & Vowles, T. (2017) – Hello major airports, goodbye regional airports? Recent changes in European and US low-cost airline airport choice. Journal of Air Transport Management, 59, 50-62.*

[153] *See for example Calzada, J. & Fageda, X. (2019) – Route expansion in the European air transport market. Regional Studies, 53(8), 1149-1160.*

FIGURE 41 SOME SECONDARY AIRPORTS SUFFER FROM PRIMARY AIRPORT ENTER, WHEREAS OTHERS DO NOT APPEAR TO BE AFFECTED



Source: Analysis SEO based on OAG schedules analyser

A view on the secondary airports possibly affected by the move of Ryanair to the abovementioned primary airports results in a mixed picture: some secondary airports have suffered, while some did not witness any decrease in Ryanair activity (see Figure 35). It shows that especially Girona, but also smaller Reus, faced a substantial decrease in Ryanair activity after the entry of the LCC at the main airport serving Barcelona. Frankfurt Hahn is also affected by an ongoing decrease in the number of Ryanair flights. Although, in this case, the decline already started before Ryanair entered the primary Frankfurt Main (FRA) airport. Apparently, Ryanair already moved capacity from Frankfurt Hahn to other airports in its network because of demand issues. The introduction of the German air travel tax (Luftverkehrsteuer) may play a role here as well.[154] On the other hand, the secondary airports of Rome (Ciampino), Brussels (Charleroi), and Milan (Bergamo) did not encountered any decrease in Ryanair activity after the LCC opened aircraft bases at Fiumicino, Zaventem, and Malpensa respectively.

As pointed out, implications for secondary airports are not unambiguous. It should be noted, however, that dominant LCCs partly abandoning secondary, regional airports may be harmful for, among others, an airport's financial viability, incoming tourism, regional economic development, and/or local consumer welfare.

[154] *See Zuidberg, J. (2015) – The implications of air travel taxes. Journal of Airport Management, 10(1), 64-72.*

2.1.3.2.3. Long-haul low-cost

Conclusion 24 – Long-term viability of the LHLCC concept still needs to be proven

Long-haul low-cost carrier (LHLCC) recently developed in Europe (Frenchbee, Eurowings, Level, Norwegian, etc.). Such type of airlines already exists in Asia and Pacific. Cost advantage of the LCC model is lower on the long-haul, since fuel cost is the key driver. Development of narrow-body long-haul aircraft could open new markets for LCC.

: The emergence of long-haul low-cost carriers ensures a better implementation of the European low-cost segment in the global aviation market.

: The emergence of LHLCC is beneficial for consumers as low airfares will arise on long-haul segments.

: The development of new airlines in Europe creates additional jobs, for example, additional pilots must be hired in order to comply with regulatory rest periods.

The long-haul low-cost carrier (LHLCC) segment still is not fully embedded in the European aviation industry. From a European perspective, the focus lies on the North Atlantic market, at which mainly Norwegian tries to gain substantial market shares. In the summer of 2019, Norwegian had a market share (measured in ASKs) on the North Atlantic market of little over 6 per cent. Other LHLCCs, such as Eurowings, Level, and Westjet, had a joint market share of almost 2 per cent.[155] This indicates that the former is to date the only serious LHLCC competitor on the North Atlantic market.

Although the market share of Norwegian increased from 1.5 per cent in 2015, the Scandinavian LCC still struggles to become financial viable. Recently, Norwegian has issued a statement that it drops its long-haul flights from both Stockholm and Copenhagen from the end of March 2020,[156] which will most likely lead to a decrease in market share on the North Atlantic market. At the other hand, Norwegian and JetBlue, the US LCC, have signed a letter of content to interline at JetBlue's bases at New York JFK, Boston Logan, and Fort Lauderdale.[157] This will substantially increase the number of destinations in the US Norwegian can offer.

To conclude, the (long-term) viability of the LHLCC concept still needs to be proven. It is often stressed that the relative cost advantage at the longer haul is considerably smaller than on the short-haul, which makes it harder for LCCs to effectively compete with network carriers on the long-haul market. In addition, network carriers have started with hand baggage only (HBO) fares at long-haul flights[158] and with relatively high-density seatings (e.g. British Airways from London Gatwick at routes at which they compete with Norwegian[159]).

On the other hand, the introduction of narrow body aircraft with relatively long ranges might open up market for LHLCCs that are too small to serve with larger wide body aircraft. Although the delay of the Boeing 737MAX does not really accelerates this development.

2.1.3.2.4. Other strategies: passenger loyalty programs, differentiated pricing strategies, and GDSs

Other strategies that have been adopted by LCCs and that have led to a further convergence of the LCC and network carrier business models include the adaptation of passenger loyalty programs by all major LCCs: *Ryanair Choice*, *Wizz Discount Club*, Easyjet's *Flight Club*, *Vueling Club*, and *Norwegian Reward*.

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[155] *See Zuidberg, J. & Wit, J.G. de (2020) – Long-haul low-cost networks in the North Atlantic airline market and the ongoing viability challenge. Transport Policy, forthcoming.*

[156] *See* https://simpleflying.com/norwegian-copenhagen-stockholm-long-haul/, *accessed at 11th of February 2020.*

[157] *See* https://simpleflying.com/norwegian-jetblue-interline-agreement/, *accessed at 11th of February 2020.*

[158] *See Hunt, J. & Truong, D. (2019) – Low-fare flights across the Atlantic: Impact of low-cost, long-haul trans-Atlantic flights on passenger choice of Carrier. Journal of Air Transport Management, 75, 170-184.*

[159] *See Zuidberg, J. & Wit, J.G. de (2020) – Long-haul low-cost networks in the North Atlantic airline market and the ongoing viability challenge. Transport Policy, forthcoming.*

In addition, most LCCs offer some kind of differentiated prices, including flex(i) fares. Such fares normally include a higher baggage allowance, seat reservation, fast track services, and/or the possibility to change flight times and/or days.

2.1.3.3. General remarks and implications

The sum of some major bankruptcies and still increasing shares of (the large) LCCs has led to a further concentration at the EU airline market. In 2016, the top 25 airlines accounted for little over 65 per cent of the direct connectivity offered from EU airports. This share has increased to 73.5 per cent in 2019.[160] At the same time, total direct connectivity from EU airports increased substantially between 2016 and 2019 (see 1.2.3 Direct connectivity).

In general, consumers will benefit from shorter average travel times and/or more travel options as a result of increasing connectivity levels. Should this increase in connectivity lead to more competition, average fares might decrease leading to additional benefits for consumers. However, next to an increase in the number of flights, there is also a market concentration trend visible, which might have the opposite effect on ticket prices.

At a more detailed level, differences between consumers in different member states and/or around different airports will most likely exist. For example, in Eastern Europe, connectivity increased more than in Western Europe, leading to higher average benefits for consumers in Eastern Europe. At an even more granular level, regional differences within countries might exist as a result of the aforementioned developments regarding, for example, airline bankruptcies and the move of LCCs to primary airports.

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[160] *Please note that airlines that operate as own entities are taken into account individually. If, for example, the IAG group, the Lufthansa Group and Air France-KLM were taken as one entity each, the share of both 2016 and 2019 would be higher. Although, the development towards a more concentrated airline market will not look substantially different.*

2.1.4. Connectivity of Peripheral Regions & Bordering Countries

2.1.4.1. Public Service Obligations (PSO) & Regional Airlines: is the market lacking in operators?

Conclusion 25 – Thin routes segment is lacking in profitability and operators

Regional airlines creation/bankruptcies turnover is higher than for other types of airlines. Independent regional airlines are progressively withdrawing from commercial flights towards wet-lease only activities. Number of regional operators capable of serving thin routes is limited.

: The depletion of regional airlines can be detrimental to the local economy of areas around airports.

: The progressive withdrawal of regional airlines increases market power for FSNC and LCC, resulting in higher fares.

: The bankruptcy of regional airlines causes major job losses, both directly and indirectly.

Conclusion 26 – Alternative concepts of regional airlines and services are emerging

Public service obligation (PSO) scheme is the preferential mechanism to subsidise non-profitable thin routes essential for the local economic development and connectivity of European regions. Some local governments and airports launched local virtual airlines to ensure balanced connectivity of the region with a homebased carrier. This new model may imply state aids, but also new forms of funding (local companies, crowdfunding).

: Public service obligation scheme is beneficial for the local economy, both in terms of development and interconnectivity.

: The PSO scheme brings consumers balanced and optimal connectivity of the route network.

: The PSO scheme brings a certain stability in terms of job security to the employees of the European aviation market.

2.1.4.1.1. Overview of PSOs

Over the last decade, the European Union has harmonised its policy for the various air services under a public service obligation (PSO) with the following definition[161]:

FIGURE 42. VIKING DHC-6-400 TWIN OTTER OPERATED BY LOGANAIR ON OUTER HEBRIDES PSO ROUTES IN SCOTLAND (© CLÉMENT MARQUIS, 2017)

"A Member State, following consultations with the other Member States concerned and after having informed the Commission, the airports concerned and air carriers operating on the route, may impose a public service obligation in respect of scheduled air services between an airport in the Community and an airport serving a peripheral or development region in its territory or on a thin route to any airport on its territory any such route being considered vital for the economic and social development of the region which the airport serves. That obligation shall be imposed only to the extent necessary to ensure on that route the minimum provision of scheduled air services satisfying fixed standards of continuity, regularity, pricing or minimum capacity, which air carriers would not assume if they were solely considering their commercial interest."

PSO "*was initiated by the European Commission to secure efficient competition among operators and an acceptable service supply to air travellers in the regions to the cheapest possible cost*"[162]. In its interpretative guidelines on the regulation, European Commission (2017d) identified 179 routes under PSO in the following thirteen Member States: Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Greece, Ireland, Italy, Portugal, Spain, Sweden and United Kingdom. In September 2019, number of routes under PSO scheme remained roughly the same (176 routes).

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[161] *Regulation (EC) No 1008/2008 of the European Parliament and of the Council of 24 September 2008 on common rules for the operation of air services in the Community frames the common rules to develop such air services.*

[162] *Bråthen, Eriksen, 2018*

TABLE 20. NUMBER OF ROUTES UNDER PSO SCHEME PER MEMBER STATE (SOURCE: EUROPEAN COMMISSION, 2019)

Country	Number of PSOs
Croatia	10
Cyprus	1
Czech Republic	3
Estonia	3
Finland	3
France	37
Greece	28
Ireland	3
Italy	11
Lithuania	1
Portugal	20
Spain	23
Sweden	11
United Kingdom	22

The concept of PSO existed under other names (e.g. "Ligne d'aménagement du territoire" in France) prior the harmonisation by the European Commission in 1992. Previously, each member state had its own doctrine on the implementation of PSOs. Therefore, the Commission leaves Member States enough freedom to define their approach to PSOs[163]:

- **Three types of routes can be under a PSO scheme.** A route can cumulate several types;
  - Routes to an airport serving a peripheral region;
  - Routes to an airport serving a development region;
  - Thin routes to any airport (< 100,000 passengers per year).
- **PSO routes to be intra-EU only;** Svein Bråthen, and Knut Sandberg Eriksen[164] estimated that 90% of the routes under an PSO scheme were domestic. Although international routes under PSO are relatively rare today, they could nevertheless develop further in the coming years, particularly after 2024[165]. Depending on the application of EC's guidelines on state aid to airports and airlines (2014/C 99/03) after 2024, EU Member States could use more often PSO scheme to open new routes instead of other types of support to airlines (incentives, marketing support, etc.).
- **The route is "considered vital for the economic and social development of the region which the airport serves";** The Commission offers Member States a high degree of flexibility to assess vital character of routes. Among the various perceptions of the vital nature of a route, the Commission highlights two approaches:
  - *A route to a small island or a remote region;* isolated areas must be served for economic, social, or even health reasons (access to hospitals, etc.).
  - *A route to a small or medium city;* this options gives Member States the freedom to implement PSO routes for small cities which need support for their economic and social development.

[163] *Dobruzskes, 2007*

[164] *Bråthen, Eriksen, 2018, p. 248*

[165] *Grimme, et al., 2018, pp.135-137*

Beyond the European Union, the concept of PSO also exists. More specifically, among the countries associated with the European Union, some have developed similar schemes.

- **In United Kingdom, Crown Dependencies (Channel Islands, Isle of Man)** are not part of the EU. However, the insularity of the Crown dependencies makes it necessary to have good connectivity with the mainland. "Lifeline Routes" were implemented. For instance, in Alderney these lifeline routes are covered through a public service agreement (PSA) for two routes (Alderney-Guernsey, and Alderney-Southampton).
- **Norway implemented a very ambitious programme for thin routes.** Some sixty routes benefit from a public service obligation regime. Norway has the largest number of routes under a PSO scheme of EU+ countries. France is second with 39 routes[166]. Norway is a very mountainous region with a harsh climate in winter. PSOs are essential to maintain accessibility to some remote areas all year round. Widerøe is the main operator for such routes. Air Leap, Airwing, and Lufttransport are secondary operators.
- **Iceland also implemented PSO services** for the same geographical and climatic reasons as Norway. Routes are operated from Reykjavík airport (the main airport is located at Keflavík, 50km south of Reykjavík) and Akureyri airport. Air Iceland Connect is the main operator for such routes. Eagle Air and Norlandair are secondary operators.
- **Finally, Faroe Islands implemented Helicopters domestic lifeline services** to connect the smallest islands of the archipelago. The national airline, Atlantic Airways, operates two helicopters.

2.1.4.1.2. Recent Developments: Consolidation of the operators & Alternative ways to develop the traffic

Consolidation of the Regional Airline Market

Over the past five years, the regional airline market has consolidated. 37 European regional airlines ceased operations in the last five years. These airlines do not have the critical size to support variations in fuel price, competition of low-cost airlines and the shortage of crews trained on regional aircraft.

TABLE 21. LIST OF EUROPEAN REGIONAL AIRLINES CEASED OPERATIONS IN THE LAST FIVE YEARS[167]

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[166] *Bråthen, Eriksen, 2018*

[167] *It should be noted that Germany experienced a strong adjustment in the market of its airlines in 2012 and 2013: Cirrus Airlines (2012), Contact Air (2013), Augsburg Airways (2013), and OLT Express (2013) ceased operations.*

1. **LGW (Germany)** in April 2020
2. **Flybe (United Kingdom)** in March 2020
3. **Astra Airlines (Greece)** in November 2019
4. **Adria Airways (Slovenia**) in September 2019
5. **BMI Regional (United Kingdom)** in February 2019
6. **Waves (United Kingdom)** in September 2018
7. **Skywork Airlines (Switzerland)** in August 2018
8. **VLM Airlines (Belgium)** in August 2018
9. **Sparrow Aviation (Sweden)** in June 2018
10. **NextJet (Sweden)** in May 2018
11. **FlyViking (Norway)** in January 2018
12. **Adria Airways Switzerland (Switzerland**) in December 2017
13. **Welcome Air (Austria)** in December 2017
14. **Air Norway (Norway)** in October 2017
15. **Fly Marche (Italy)** in August 2017
16. **FlyKiss (France)** in May 2017
17. **Citywing (United Kingdom)** in March 2017
18. **Bergen Air Transport (Norway)** in 2017
19. **Höga Kusten Flyg (Sweden)** in 2017
20. **Denim Air (Netherlands)** in November 2016
21. **European Coastal Airlines (Croatia)** in October 2016
22. **Air Vallée (Italy)** in June 2016
23. **Avies (Estonia)** in April 2016
24. **Dubnica Air (Slovakia)** in 2016
25. **Atlantique Air Assistance (France)** in December 2015
26. **Minoan Air (Greece)** in November 2015
27. **Estonian Air (Estonia)** in November 2015
28. **InterSky (Austria)** in November 2015
29. **Greenland Express (Denmark)** in August 2015
30. **B&H Airlines (Bosnia and Herzegovina)** in July 2015
31. **Air Lituanica (Lithuania)** in May 2015
32. **Eurolot (Poland)** in March 2015
33. **Helitt Líneas Aéreas (Spain)** in October 2014
34. **Central Connect Airlines (Czech Republic)** in June 2014
35. **Air Croatia (Croatia)** in April 2015
36. **Air Alps (Austria)** in February 2014
37. **Krohn Air (Norway)** in February 2014

At the same time, two trends seem to be emerging for regional airlines:

- **Regional subsidiaries (or franchises) of legacy airlines are streamlining their operation:** European regional subsidiaries are widely used as hub feeders. Since they work almost exclusively for their parent company, the regional subsidiaries are more exposed to market fluctuations. Depending on the route, the transfer rate of passengers to the hub of the parent company can be high. A prorate[168] applies to the regional segment, which is significantly lower than the rate that the subsidiary could charge on a point-to-point ticket.

Therefore, regional subsidiaries are rarely profitable. Legacy airlines regularly launch cost reduction to limit losses of regional subsidiaries. Among the different actions, fleet rationalisation and network simplification are the two ways[169] to reduce costs:

- Fleet rationalisation; higher aircraft capacity, limited number of different aircraft types, etc. The main outcome of these actions led to the removal of turboprops/low capacity aircraft from the fleets (<70 seats aircraft in particular) which are mostly operated on thin routes (including PSOs)
- Network simplification; closure of low-traffic and/or low-profit routes, closure of non-hub feeding routes. PSOs are generally low-traffic routes and/or non-hub feeding routes. Thus, major airlines progressively dropped PSO routes from their network.

Legacy operators seem to reduce their involvement on minor regional routes that they used to operate through regional subsidiaries or wet-lease. However, this niche segment is not really the core business of such airlines.

This segment was therefore left to independent operators. The connectivity of regional airports may have been reduced as a small independent operator may encounter more irregular operations (small fleet) and does not systematically sign interline agreements to offer connecting flights.

- **Business model of European regional airlines could evolve towards a "white flag" model:** the market for American regional airlines is different from the European market. US regional airlines are independent and work for several legacy airlines at the same time. For instance, Republic Airways operates almost 200 Embraer 170 and 175 aircraft for three US legacy airlines; American Airlines (under American Eagle brand), United Airlines (under United Express brand) and Delta Airlines (under Delta Connection brand). This non-exclusive subcontracting model allows regional operators to limit their risks (they are not dependent on a single client) and to achieve economies of scale.

In Europe, this model seems to be gradually emerging. On one hand, regional operators are likely to abandon marketing of flights in favour of wet-lease contracts. The following regional airlines announced termination of flights commercialised under their own brand:

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[168] *Airlines engaged in the interlining of passengers and cargo depend on settlement agreements to assist in the determination of each airline's revenue. These agreements are referred to as the Multilateral Prorate Agreement-Passenger and the Multilateral Prorate Agreement-Cargo.*

[169] *Among various measures to lower their costs, airlines are also trying to limit cost of crews or maintenance.*

- **Great Dane Airlines (Denmark) in September 2019;** this recent new airline initially launched its operation with scheduled (Dublin, Edinburgh, Nice) and charter flights from/to Aalborg airport. Changes in the equity of the airline redirected its strategy towards wet-lease operation only.
- **Nordica (Estonia/Poland) in June 2019;** the airline initially operated scheduled flights from/to Tallinn airport. Nordica decided to stop scheduled operation because of a tough competition and overcapacity from/to Estonia.
- **Cityjet (Ireland) in March 2017;** the Irish airline was a subsidiary of Air France from 2000 until 2014. Intro Aviation bought the airline to restructure it. In 2017, the regional airline Cimber (Denmark) was acquired by Cityjet. Cimber operated regional flights on behalf of SAS with a fleet of 11 Bombardier CRJ900s. Cityjet subsequently announced that it would focus on the wet-lease market without any exclusivity for a specific airline, holding or alliance. In 2018, Cityjet joined forces with Air Nostrum, a Spanish airline that operates under exclusive franchise for Iberia (Iberia Regional brand). Since then, Cityjet/Air Nostrum has been the only major regional airline operating for all three major airline alliances. In 2019, the airline had contracts with the following legacy airlines: Air France, Brussels Airlines, Iberia and SAS.
- **Aer Arann/Stobart Air (Ireland) in March 2014;** Stobart Air is the result of the takeover of the Irish regional airline Aer Arann by the British logistics group Stobart in 2010. Only Aer Arann operated flights under its own brand until 2008. Stobart Air's business model was directly oriented towards wet-leasing and charter activities. From 2010, Stobart Air signed a franchise agreement with Aer Lingus under the Aer Lingus Regional brand. The diversification of the wet-leasing contracts took place in 2014 with the signing of a five-year agreement with Flybe. In addition to these two important franchise agreements, Stobart Air operated more punctually for KLM (provision of Embraer 190/195). In 2019, Stobart Group, through its subsidiary Stobart Aviation (which owns Stobart Air), joined forces with Virgin Atlantic and Cyrus Capital Partners to create Connect Airways. The latter became the parent company of Flybe and Stobart Air. The COVID-19 crisis led to the bankruptcy of Flybe. This subsequently ended franchise agreement between Flybe and Stobart Air. Connect Airways entered administration in March 2020. Stobart Air future remains uncertain for now.
- **Carpatair (Romania) in 2014;** Carpatair was created in 1999. It operated scheduled between Romania and Europe, as well as charter/wet-lease operations until 2014. The airline filed for insolvency in 2014 and restructured towards charter and wet-leasing operations only.

On the other hand, operators are moving closer together to achieve profitability (critical mass):

- LGW and WDL Aviation have created a joint brand called German Airways in October 2019 (no merger);
- Connect Airways (Stobart Aviation, Virgin Atlantic and Cyrus Capital Partners) bought Flybe in October 2018;
- Air Nostrum and Cityjet announced in July 2018 their merger (holding company to be created);
- Twinjet bought Hex'Air in 2016 and became the biggest Beechcraft 1900D operator in Europe;

Combination of both trends could draw a "white-label" model for European regional airlines. This emerging trend needs to be confirmed in the forthcoming years.

What funding for PSOs?

Subsidised PSO routes (not all PSO routes receive subsidies) require the support of Member States and their local authorities to cover operating losses. For instance, in France, a PSO service with a daily round-trip on a 50-seater aircraft for a 60-90 min flight sector generally costs between 1.5 and 2.5 million Euros of subsidies each year for a traffic comprised between 30,000 and 45,000 passengers (~€50 per passenger). Marketing support for low-cost airlines is variable. However level of subsidies is much lower (~€5-20 per passenger.

With the contraction of public budgets, the financing capacity of Member States (including local governments) for PSOs has decreased. If isolated regions that are entirely relying on air services to maintain connectivity seem to keep strong funding for their PSO air services (no alternative), intermediate regions such as rural, small and medium cities dropped PSO routes. To compensate the loss of a direct route to a capital city (or a major regional metropolitan area) low-cost airlines were particularly targeted by regional airports. The instability of PSO routes in these "intermediate" regions is therefore much higher (see "route churn" concept)

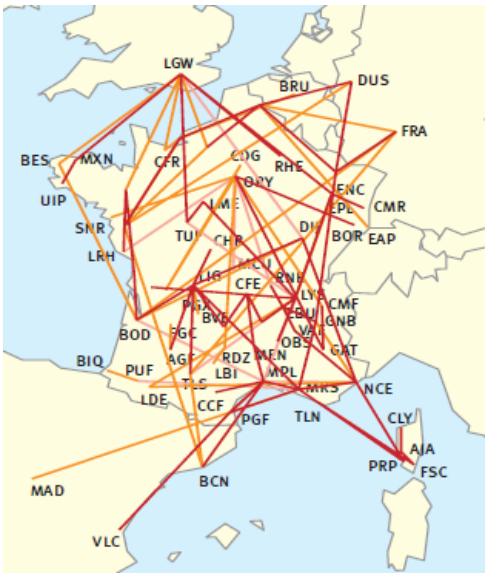

FIGURE 43. PSO ROUTES DROPPED IN FRANCE UNTIL 2005 (SOURCE: DOBRUZSKES, 2007)

The general growth of the aviation sector in Europe has made it possible to transfer some of these routes to the competitive market or to high-speed rail (particularly in the case of France). In other cases, the connectivity of regional platforms has evolved. Previously, they were linked to a major capital (national or regional) with the possibility of a daily return trip. Regional airports have turned to low-cost airlines. The geography of destinations and the frequency of flights have changed towards low frequency/international/leisure routes.

Low-Cost Airlines & Public Service Obligation: a difficult co-existence

Low-cost airlines business model favours simple processes and avoids bureaucracy. A survey conducted by Rico Merkert and Basil O'Fee in 2016[170] showed that low-cost airlines were not particularly keen to answer request for proposals (RFP) on PSO routes. However, it should be noted that low-cost airlines already answered and won PSO RFPs in the past:

- Wizz Air has been operating since April 2017 five routes from Budapest under a PSO scheme. However, these routes are not intra-EU routes. Therefore, these are not PSO as per EC regulation.
- Blue Air operated one PSO route in Italy until 2018 between Sardinia (Alghero) and mainland Italy (Rome);
- Ryanair operated the London-Stansted <> Toulon route under a PSO scheme in the past (Grimme, *et al.*, 2018, p.136). The airline is operating one route between Larnaka and Brussels.

Most of PSO routes are low-traffic/high frequency services. Aircraft types operated by low-cost airlines are not compatible with such configuration of the service. By contrast, low-cost airlines could possibly respond to calls for tenders from PSOs for the territorial continuity of populated islands (e.g. Corsica, Crete, Sardinia, etc.) for which the traffic volume is sufficient to fill Airbus A320 or Boeing 737 aircraft.

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[170] *Merkert, O'Fee, 2016*

Regional virtual airlines: an alternative model to PSOs?

Recently, virtual airlines have emerged to serve regional airports. A virtual airline is not entirely an airline since it only holds the commercial part of the company (brand, website, customer relationship, distribution, etc.). Operations are chartered to a (real) airline through a wet-lease contract.

This organisation makes it possible to separate the commercial risk of routes operated from the rest of the airline. In the event of bankruptcy, the commercial part does not lead to the operational part falling. This structure also allows opening equity to third parties such as the State, local authorities or private companies.

For small regional airports, virtual airlines model presents the following assets:

- Local region can specifically brand the virtual airline to promote the territory;
- Financial risk on such routes can be spread over various shareholders which could be public, private, or even through crowdfunding;
- Once set up, a virtual airline can organise itself more flexibly than via a PSO scheme, which requires public tendering and a certain rigidity of operations over a long period (up to five years).

Among existing regional virtual airlines, the following are representative examples:

Air Leap is the trading name of the Norwegian virtual airline Air Leap AS and the Swedish airline Air Large European Aviation Project AB. The company is 100% owned by Ryggefjord AS.

Both airlines were founded in 2018 to operate regional services between Oslo and Ørland (Norwegian PSO route), as well as between Stockholm and regional cities in Finland (Mariehamn and Turku) and Sweden (Jönköping, Karlstad and Örnsköldsvik).

On the Norwegian market, the virtual airline is wet-leasing the Swedish structure which operates four Saab 340B (33-36 seats) aircraft. In this scheme, the virtual airline is set up for administrative matters (Norway is not part of the European Union). The commercial risk is integrally borne by a single shareholder. On the other hand, most routes are PSOs.

Alsie Express is a virtual airline based in Denmark. It is a subsidiary of the business aviation airline Air Alsie. Alsie Express was founded in 2013 to operate a regional route between Copenhagen and Sønderborg (196 km only), previously operated by Cimber Sterling until its bankrupt in 2012. This route is not listed as a PSO.

Alsie Express signed a distribution and interline agreement with FlexFlight to appear on global distribution systems (GDS). The company also sells its tickets online but does not have direct access to GDS (only through FlexFlight). It is therefore a light commercial structure, separate from operations to protect Air Alsie's core business (business aviation) from the commercial flights' financial risks.

Rhein-Neckar Air is a virtual airline based in Mannheim (Germany). After the bankruptcy of Cirrus Airlines in January 2012, the small Mannheim airport was left without any regular routes. The Mannheim/Ludwigshafen/Heidelberg region has many companies and there is strong local demand for regular routes from this airport, which is only 60 minutes from Frankfurt airport by car (40 minutes by train). Rhein-Neckar Air is an association created by local companies in the Mannheim region (BASF, SAP, Heidelberg Cement, Züdzucker, etc.). The company markets scheduled flights to Berlin, Hamburg and Sylt (seasonal)

FlyBAIR is a startup airline based in Bern (Switzerland) to begin operation in May 2020. After the bankruptcy of Skywork Airlines in August 2018, Bern Airport was left with a very small network of routes. The company is a 100% subsidiary of Bern Airport (Flughafen Bern AG).

FlyBAIR is a virtual airline in charge of the marketing. Ground operational activities are carried out by the Swiss company Lions Air. The aircraft are leased and operated by the German company Zeitfracht, which owns in particular German Airways (wet-lease operator).

A crowdfunding campaign is underway to diversify the company's funding sources. Individuals can become shareholders of the company.

2.1.4.2. Connectivity of Peripheral Regions & Bordering Countries: the low-cost takes it all?

Conclusion 27 – Outermost regions are much more connected with EU than local areas

Most of outermost region first O&D remains an EU country. Local/Regional connectivity is poor and/or expensive.

: Poor regional connectivity results in non-optimal connections between outermost regions and their citizens.

: **A low regional connectivity has detrimental consequences for consumers, both in terms of customer satisfaction and travel time.**

Connectivity of peripheral regions and bordering countries can be broken down under the following regions:

- **Outermost regions (ORs) of the European Union:**
- France: French Guiana, Guadeloupe, Martinique, Mayotte, Reunion and Saint-Martin
- Portugal: the Azores and Madeira
- Spain: the Canary Islands
- **Major European island states and regions of the European Union:**
- Cyprus
- France: Corsica
- Greece: Crete
- Italy: Sardinia and Sicily
- Malta
- Spain: Balearic Islands
- **Balkans, Central & Eastern Europe Member States:** Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.
- **Bordering Countries:**
- Balkans: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia,
- Northern Africa: Algeria, Egypt, Morocco, Libya and Tunisia
- Eastern Mediterranean Countries: Jordan, Israel, Lebanon, Syria, Turkey
- Former USSR Republics located near EU: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine

Each region presents singularities of evolution that could be reflected in key trends. It will be difficult to comprehensively address the realities of each geographic region. Nevertheless, our analyses have identified transversal trends.

2.1.4.2.1. Connectivity of Outermost Regions: beyond the sole EU accessibility?

The impacts of competition on EU connectivity

The following figure shows average base fares (source: Sabre) between outermost regions and their respective continental countries (i.e. Portugal for Madeira).

The diagram shows three categories:

- For the **isolated regions closest to continental Europe (the Canary Islands, Madeira and the Azores)**, medium-haul airlines, particularly low-cost airlines, can serve the regions. As distances are shorter, prices are generally lower and vary only slightly. The competitive environment is stabilised. Although part of the offer may be under a public service obligation contracts, competition has lowered prices.
- In **Guadeloupe and Martinique**, the competition is intense and the market is mature. Therefore, fares are stabilised at a relatively low level (same as other competitive destinations in the region). In particular, competition has increased with the arrival of low-cost long-haul airlines and the introduction of very low promotion offers (fares without luggage, etc.).
- The last category concerns less mature long-haul markets (**French Guiana, Mayotte and Reunion Island**. Saint-Martin is a particular case[171].). The level of competition in these markets has intensified recently with a significant drop in prices. Historically, Air France, Air Caraïbes and Air Austral were the oligopoly operators. The arrival of low-cost long-haul airlines such as Corsair, French Bee, Level or XL Airways[172] has broken the oligopoly and considerably improved the affordability of flights.

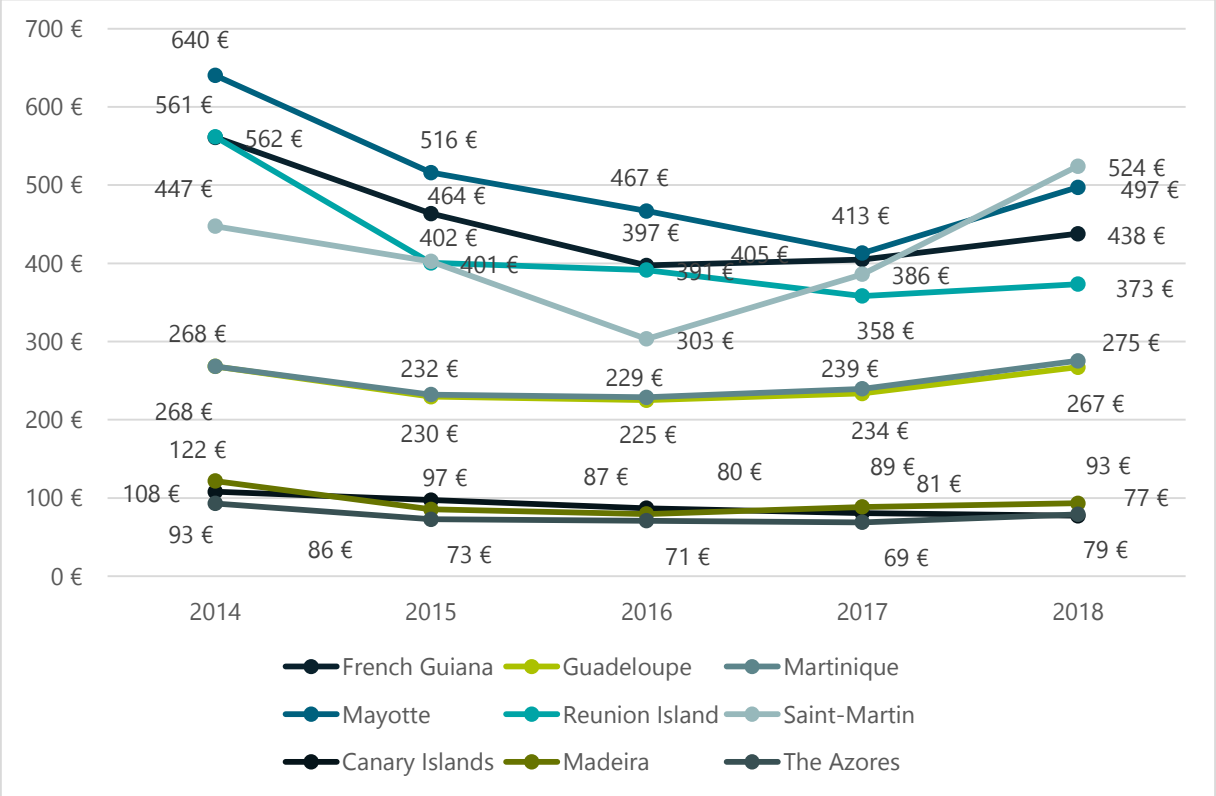

FIGURE 44. AVERAGE BASE FARE ONE-WAY BETWEEN OUTERMOST REGIONS AND THEIR RESPECTIVE METROPOLITAN TERRITORY (SOURCE: SABRE)

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[171] *The island of Saint-Martin is divided in two parts between France and Netherlands. The main airport is located on the Dutch part of the island. Therefore, most of the traffic is passing through the Dutch part of the island. The French airport of Grand Case has a short runway and no direct long-haul route.*

[172] *XL Airways ceased operation in 2019.*

About connectivity with neighbouring regions outside the European Union

Outermost regions are located in the heart of other large geographical regions of the planet (America, Africa and the Indian Ocean). The question of their connectivity therefore goes beyond the mere accessibility of continental Europe. Madeira and the Azores are less concerned, although connectivity with North or South America is at stake.

For the other regions, the accessibility of neighbouring countries, located sometimes just a few tens of kilometres away, is rather poor (low frequencies, very high prices). Figure 45 hereunder shows typical weekly capacity from French outermost regions. The main capacity, with a few exceptions[173], is offered from/to France (local or metropolitan).

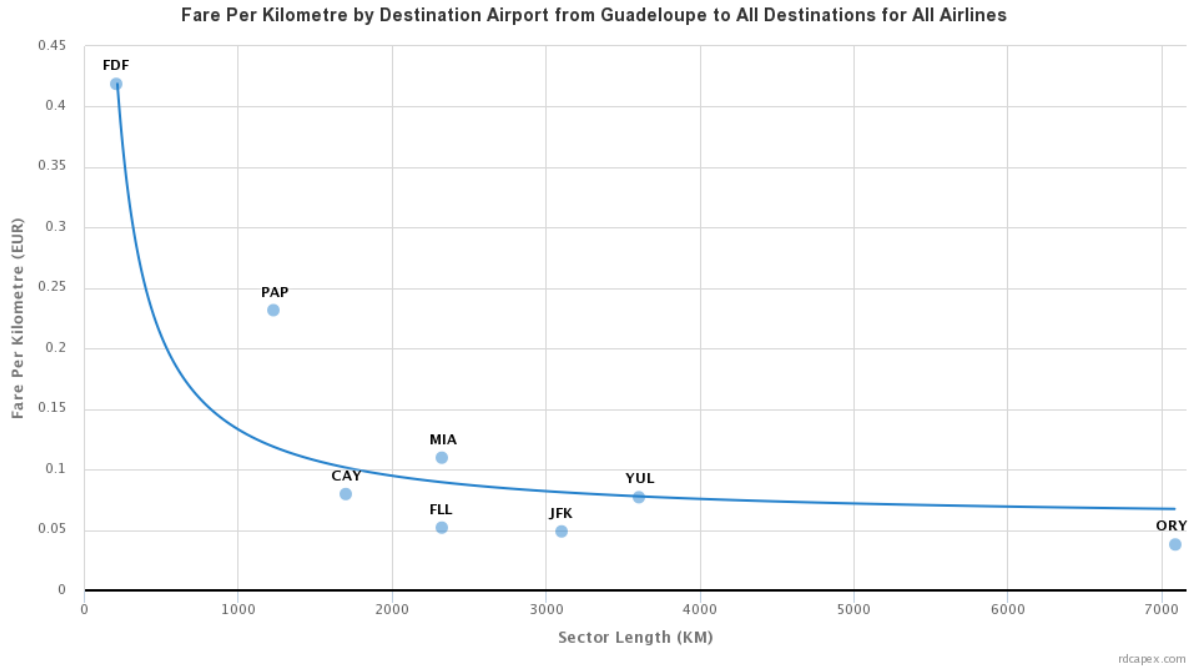
TABLE 22. TYPICAL WEEKLY CAPACITY FROM FRENCH OUTERMOST REGIONS IN WINTER 2020 (SOURCE: SABRE)

Region	France (Overseas)	France (Metropolitan)	Other (Local)	Other (World)	TOTAL
French Guiana	3 336	3 564	3 336	236	**10 472**
Guadeloupe	12 973	19 068	5 988	259	**38 288**
Martinique	11 079	16 738	4 472	332	**32 621**
Mayotte	1 834	0	3 099	0	**4 933**
Reunion Island	1 834	12 370	15 909	599	**30 712**
Saint-Martin	3 416	0	0	0	**3 416**

Note: Mayotte offers a direct route from/to France (Metropolitan). When we consulted the database, the flights probably had not yet been loaded into the reservation systems. On the other hand, not all flights to/from France (Metropolitan) are direct to Mayotte (some frequencies stop over in Reunion Island or Kenya). The runway at Mayotte airport is too short to provide a year-round non-stop service to France (Metropolitan).

The Figure 40 shows that the lowest fare per kilometer offered from Guadeloupe is Paris-Orly (ORY), whereas local fares (Fort-de-France, Port-au-Prince, Cayenne, Miami, New York, etc.) could be relatively high. Travelling a short distance can therefore sometimes be very expensive.

FIGURE 45. FARES 2019 PER KILOMETRE FROM GUADELOUPE (SOURCE: RDC)



[173] *Mayotte and Saint Martin airports runways are too short to offer a real long-haul connectivity. Reunion Island has an homebased airline (Air Austral) which is able to offer routes in the region.*

There are several explanatory factors:

- The **economic agreements with neighbouring countries are limited**, outermost regions still exchange with their metropolitan territory in the vast majority of cases. For example, a company based in Reunion Island will tend to purchase goods and services from/to Metropolitan France for practical reasons (cost, regulations, language, etc.).
- **Bilateral agreements between States offer little room to increase the volume of traffic and/or intensify competition**. However, the implementation of open skies agreements does not generate traffic either, as demand remains limited for the time being (little economic exchange).
- As a result, **traffic volumes are too low for operators to achieve critical mass**. PSO scheme is not applicable to compensate thin demand since it scope only covers intra-EU routes.
- **The regional economy is not conducive to the development of air transport.** Neighbouring countries' economy generates low demand for air transport as well as local economy of outermost regions does not favour development of local air routes (e.g. Tourism from/to Europe is the main driver of the local economy).

2.1.4.2.2. Connectivity of the large Mediterranean islands: seasonality and opening to low-cost traffic

Conclusion 28 – Seasonality of connectivity can be important for Mediterranean islands

Without a PSO, some Mediterranean islands are poorly accessible during winter. Low-cost airlines offered additional international (or regional domestic) connectivity to those islands. Low-season market still needs stimulation.

: Poor connectivity of Mediterranean islands during low-seasons is disadvantageous for the local population in terms of connections to the European mainland and vice versa.

: The lack of connections between mainland Europe and the Mediterranean islands may lead to consumer dissatisfaction.

: Stimulating the low-season market could create additional job opportunities and boost both the local economy and European aviation.

Asymmetrical connectivity

One of the key issues in the connectivity of the large Mediterranean islands is the seasonality of traffic. For the most touristic regions, connectivity can be very high in summer and very low in winter, with an increased use of PSOs (where applicable).

Figure 41. Summer/Winter Weekly Frequencies Ratio from Mediterranean Islands Regions & States (Source: Sabre). Crete has the highest seasonality with five times as many weekly frequencies in summer as in winter. Cyprus, Malta and Sicily have the lowest seasonality of weekly frequencies.

With the exception of the mature regions/states (1.4-1.6), the ratio is falling. Winter connectivity has been growing overall since 2018. This leads towards a better connectivity for local residents during the low season.

Weekly Departing Flights 2020			
Region/State	**6-12 January**	**20-26 July**	**2020**
Corsica	173	592	3,4
Sardinia	331	753	2,3
Sicilia	937	1346	1,4
Malta	381	537	1,4
Cyprus	632	1016	1,6
Crete	167	850	5,1
Balearic Islands	1086	3386	3,1
Weekly Departing Flights 2019			
Region/State	**7-13 January**	**22-28 July**	**2019**
Corsica	176	681	3,9
Sardinia	308	1110	3,6
Sicilia	1025	1617	1,6
Malta	334	568	1,7
Cyprus	583	1041	1,8
Crete	186	910	4,9
Balearic Islands	1217	4223	3,5
Weekly Departing Flights 2018			
Region/State	**8-14 January**	**23-29 July**	**2018**
Corsica	181	706	3,9
Sardinia	275	999	3,6
Sicilia	949	1403	1,5
Malta	303	540	1,8
Cyprus	601	1038	1,7
Crete	154	938	6,1

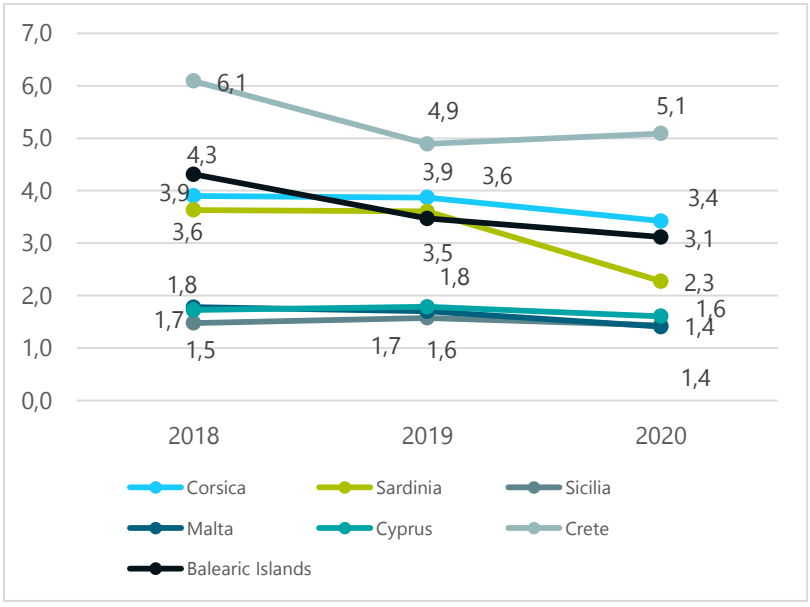


FIGURE 46. SUMMER/WINTER WEEKLY FREQUENCIES RATIO FROM MEDITERRANEAN ISLANDS REGIONS & STATES (SOURCE: SABRE)

Note: 2020 data is the pre-COVID programme.

Impact of low-cost airlines

If implementation of PSOs maintained good connectivity of Mediterranean major islands, some regions also developed their traffic via competitive market. Development of low-cost airlines was particularly at the heart of this development. The latter positioned on domestic market and offered year round routes.

To illustrate this trend, the two following tables show number of competitors between Top 10 Italian cities and Sardinia or Sicily. The main outcomes are the following:

- **Competition is intense on major city-pairs** (i.e. Milan and Rome), particularly in Sicily. Historical operators (Alitalia and Air Italy) are now challenged (even sometimes overwhelmed) by low-cost operators (Easyjet and Ryanair from Milan and Rome)
- **Development of low-cost airlines led to the opening of new routes from regional cities of Italy**. Therefore, connectivity diversified beyond the sole Milan and Rome city pairs. Blue Air[174], Easyjet, Ryanair, and Volotea were particularly involved in these routes.
- Although year-round accessibility of island regions is a key issue (economic, health, social, security), **opening up the competition on PSO regulated markets (PSO including a monopoly) could be a stake for the most developed city pairs** (e.g. Corsica). The trend is already marked with the partial opening to competition of the Azores, Crete, the Canary Islands or Madeira.

TABLE 23. NUMBER OF YEAR ROUND COMPETITORS BETWEEN SARDINIA/SICILY AND TOP 10 ITALIAN CITIES (SOURCE: AIRLINES' SCHEDULES)

Origin	Destination	Number	Airlines
Catania	Bari	1	Volotea
Catania	Bologna	2	Alitalia, Ryanair
Catania	Florence	1	Vueling
Catania	Genoa	1	Volotea
Catania	Milan	4	Air Italy, Alitalia, Easyjet, Ryanair
Catania	Naples	2	Easyjet, Volotea
Catania	Rome	2	Alitalia, Ryanair
Catania	Turin	2	Blue Air, Ryanair
Catania	Venice	2	Easyjet, Volotea
Comiso	Milan	1	Ryanair
Comiso	Turin	1	Blue Air
Palermo	Bari	1	Volotea
Palermo	Bologna	1	Ryanair
Palermo	Florence	1	Vueling
Palermo	Genoa	1	Volotea
Palermo	Milan	4	Air Italy, Alitalia, Easyjet, Ryanair
Palermo	Naples	2	Easyjet, Volotea
Palermo	Rome	2	Alitalia, Ryanair
Palermo	Turin	2	Ryanair, Volotea
Palermo	Venice	1	Volotea
Trapani	Milan	1	Alitalia
Trapani	Rome	1	Alitalia

Origin	Destination	Number	Airlines
Alghero	Bologna	1	Ryanair
Alghero	Milan	2	Alitalia, Ryanair
Alghero	Rome	1	Alitalia
Alghero	Turin	1	Blue Air
Cagliari	Bari	1	Ryanair
Cagliari	Bologna	1	Ryanair
Cagliari	Genoa	1	Volotea
Cagliari	Milan	4	Air Italy, Alitalia, Easyjet, Ryanair
Cagliari	Naples	1	Volotea
Cagliari	Palermo	1	Volotea
Cagliari	Rome	2	Alitalia, Ryanair
Cagliari	Turin	1	Volotea
Olbia	Milan	2	Air Italy, Easyjet
Olbia	Rome	1	Air Italy

[174] *Blue Air is a Romanian low-cost airline founded in 2004. It initially developed its network from Romania (Bucharest, Bacău, and Iași) but also opened bases in Cyprus (Larnaca) and in Italy (Turin). The latter base was particularly linked to an OSP contract from/to Alghero.*

2.1.4.2.3. Connectivity trends in Central and Eastern Europe and their similarities to neighbouring countries of EU

Conclusion 29 – Introduction of liberal agreements with neighbouring countries develops low-cost carriers

EU air transport market is a mature market, especially in Western and Northern Europe. Eastern and Southern EU member states already experience a sharp growth in their traffic and connectivity and the competition can be intense in some countries (e.g. Poland). Access to EU neighbouring countries offers European LCC new development opportunities (e.g. non-EU Balkans states, Ukraine, etc.).

: The growth of aviation in Europe boosts the overall economy, employment and access to neighbouring countries.

: Intensive competition leads to lower prices and access to new markets.

: The growth of air traffic and new development opportunities results in the creation of additional job offers.

Conclusion 30 –National airlines rarely resist market opening

Depending on their size and level of competitiveness, national airlines may be threatened by the opening to competition. Arrival of LCC on their market is directly challenging their ability to lower costs.

: The increase in the competitive level due to the arrival of LCC results in lower airfares for consumers.

: National airlines being forced to reduce costs can have a negative impact on its employment.

Conclusion 31 – In some countries, liberal ASA stimulates national initiatives to develop new airlines

Eastern Europe already experienced development of new home-based (low-cost) airlines after joining the EU (e.g. Sky Europe, Smartwings, Wizz Air). Neighbouring countries could experience the same (e.g. Albania, Ukraine) with the creation of new low-cost airlines.

: The creation of new low-cost airlines is beneficial for the inhabitants of Eastern Europe in terms of connection with surrounding countries.

: LCC development in Eastern Europe results in access to new markets and an increase in the level of competition resulting in lower prices for consumers.

: New job opportunities will emerge during the further development of the aviation sector in Eastern Europe.

About Central & Eastern Europe

Among various trends of the air transport market on peripheral and bordering countries and regions, impact of liberalisation is essential.

Several Central & Eastern European countries joined EU in 2004, 2007, and 2013. Before joining EU, air transport market of each country was regulated. Researchers[175] observed the effects of such liberalisation after ten years. The main trends were the following:

- **Traffic sharply grew to offer better connectivity from capital cities, but also from major regional cities mainly to United Kingdom, Ireland, Germany and Benelux countries.** "In the pre-accession period, in the years 1989-2004, air transport in theses transports developed very slowly. Significant growth in aircraft operations and passengers movements was observed in the air transport industry only during preparation for the accession of CEE countries to the European Union and integration with its structures"[176].

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[175] *Jankiewicz, Huderek-Glapska, 2016*

[176] *ibid., 2016, p.46*

More than the transition to a market economy, integration into a single market has been the real trigger. The opening up of the European labour market was a decisive factor in the development of air traffic from Central & Eastern Europe. Traffic has experienced very strong growth, with the particularity of also developing regional and secondary airports. This was particularly the case in Poland, with a very rapid development of regional airports (Gdańsk, Katowice, Kraków, Poznań and Wrocław).

Open destinations are mostly international. Migrant workers and VFR traffic have been the core of traffic demand. The British Isles (Ireland and the United Kingdom, which have opened up their labour markets), Germany and the Benelux countries were the main clusters of destinations.

- **New European competitors entered this market and directly challenged historical Central & Eastern Europe operators, mostly national (public) airlines**. "*The airline sector was dominated by national flag carriers (the largest were LOT Airlines in Poland, CSA Airlines in the Czech Republic, and Malév in Hungary).* [...] *Since 2004 the so-called low-cost airlines have been the main driving force behind the changes which broke the monopoly established by national carriers, thereby increasing competition*"[177].

Two players strongly developed their market shares in Central & Eastern Europe: Ryanair and Wizz Air. We can also add Blue Air (Romania), Smartwings (Czech Republic), and Sky Europe (Slovakia. Ceased operation in 2009). This strong development of low-cost airlines in Central & Eastern Europe considerably reduced the weight of the incumbent airlines. The following flag carriers ceased operation:

- FlyLAL (Lithuania) in 2009
- Air Slovakia (Slovakia) in 2010
- Malév (Hungary) in 2012
- Estonian Air (Estonia) in 2015
- Air Lituanica (Lithuania) in 2015
- Eurolot (Poland) in 2015
- Adria Airways (Slovenia) in 2019

Air Baltic, Bulgaria Air[178], Croatia Airlines, CSA Czech Airlines, LOT Polish Airlines and TAROM Romanian Air Transport are the last remaining Flag operators in Central & Eastern Europe.

- Even if LOT Polish Airlines was challenged by Ryanair and Wizz Air, the airline kept a relatively strong position in Poland, especially from/to Warsaw-Chopin (hub).
- Air Baltic succeeded in developing a competitive position in Riga (hub), but also recently in Tallinn, and in Vilnius (point to point for both airports).
- Bulgaria Air is largely challenged by other airlines (Ryanair and Wizz Air). Its competitive position is limited and declining.
- Croatia Airlines maintains a limited position and its privatisation process is ongoing.
- CSA Czech Airlines progressively reduced its activity before Travel Services (now called Smartwings) bought the company
- According to Sabre, in 2019, TAROM Romanian Air Transport is only #3 airline from/to Romania, with 2.2 million passengers carried, after Wizz Air (8.3 million passengers) and Blue Air (2.7 million passengers). Its position is regressing and its hub is limited.

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[177] *ibid., 2016, pp.45-46*

[178] *Bulgaria Air is already a successor to the historical flag carrier, Balkan Bulgarian Airlines that went bankrupt in 2002.*

What could be the trends for neighbouring countries?

EU has put in place agreements with certain neighbouring countries to develop economic exchanges. The implementation of liberal ASAs is a key element. What are the commonalities and differences in air transport market developments between Central & Eastern Europe on the one hand and these neighbouring countries on the other? The first observations are the following:

- **In Morocco, the implementation in 2005 of a comprehensive ASA has considerably stimulated traffic with a structure close to what Poland experienced from 2004 onwards.** Large regional airports have developed strongly, while the largest airport (Casablanca) was the main provider of traffic.

  Low-cost airlines were particularly at the heart of this development: Air Arabia, Easyjet, Ryanair, TUI Fly Belgium are the key low-cost operators in the country. Royal Air Maroc is the national operator in Morocco. Even if the airline is clearly challenged by these new players on the mid-haul market, the airline seems to keep a strong position.

TABLE 24. YEARLY PASSENGER TRAFIC OF THE MAIN MOROCCAN AIRPORTS 2016-2018 (SOURCE: MOROCCAN AIRPORTS)

Rank	Airport	2016	2017	2018
1	Casblanca	8 616 474	9 364 861	9 732 044
2	Marrakesh	3 894 227	4 366 263	5 279 575
3	Agadir	1 334 173	1 544 244	1 922 344
4	Fez	892 974	1 116 095	1 309 481
5	Tangiers	848 643	1 074 177	1 127 541
6	Rabat	873 169	924 686	987 485
7	Nador	640 122	706 979	710 559
8	Oujda	546 398	635 746	675 917
9	Laayoune	182 477	206 274	221 784
10	Dakhla	154 451	168 552	202 645
11	Essaouira	67 977	83 414	104 587
12	Ouarzazate	52 791	65 010	89 024
13	Al Hoceima	45 560	72 044	79 324

- **Ukraine:** In December 2005, Ukraine and the European Community signed a horizontal aviation agreement, allows any EU airline to operate flights between Ukraine and any EU Member State where it is established and where a bilateral agreement with Ukraine exists and traffic rights are available. A Comprehensive Aviation Area (CAA) agreement was then initialled on 28 November 2013. Upon its ratification this fully opens the air transport market between EU and Ukraine.

Recent feedback (from 2015) already shows similarities with Central & Eastern Europe or Morocco. Low cost airlines develop in Ukraine:

- Ryanair opened in 2018 numerous routes from its bases to Kyiv-Boryspil airport with 24 destinations.
- Wizz Air opened bases in 2015 in the secondary city airport of Kyiv-Zhuliany (31 destinations). The airline also opened routes in Lviv (12 destinations), in Odesa (6 destinations), in Kharkiv (7 destinations), and in Zaporizhia (6 destinations).
- Local low-cost airline, SkyUp opened bases in 2019 in Kiev-Boryspil (33 destinations), in Lviv (8 destinations), in Odesa (10 destinations), in Kharkiv (15 destinations), and in Zaporizhia (8 destinations).

This development could generate considerable additional traffic. Germany, the United Kingdom and Central and Eastern Europe are the main destination clusters. Foreign workers and VFR

Case Study

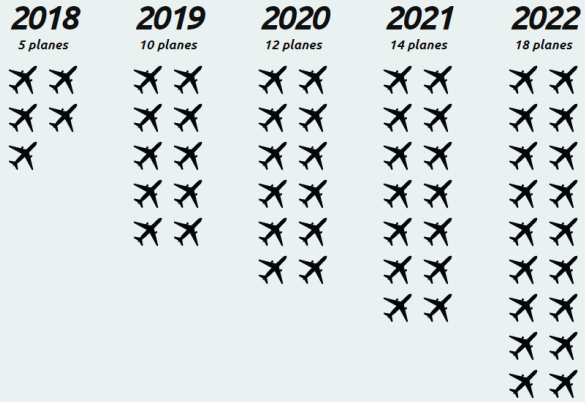
SkyUp *Airlines*

SkyUp is a start-up low-cost Ukrainian airline which began operations in May 2018. The main shareholders of the company are ACS-Ukraine Ltd, Tetyana Alba and Yuri Alba, who also own the tour operator Join UP! which is expected to cooperate with the airline to provide charter flights for holiday packages.

The airline's activity is therefore divided between scheduled flights and a significant volume of charter flights for the Join UP! tour operator. This diversification allows the airline not only to be exposed to competition from other low-cost airlines which are also developing strongly in Ukraine (Wizz Air and, to a lesser extent, Ryanair).

SkyUp operates ten aircraft (2 Boeing 737-700, 6 Boeing 737-800 and 2 Boeing 737-900ER) and plans a progressive extension from Ukraine.

FIGURE 47. SKYUP FLEET FORECAST (SOURCE: SKYUP, 2019)



The establishment of a Ukrainian low-cost airline with a rather ambitious development plan shows an interesting traffic potential.

This type of development resembles Wizz Air, which was

again appear to be the core of demand.

- **Balkans:** non-EU Balkan States (Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Kosovo) signed on 9 June 2006 the European Common Aviation Area (ECAA) agreement with the European Union, Norway and Iceland. The aim of this aviation agreement is the creation of a European Common Aviation Area (ECAA), integrating the EU's neighbours in South-East Europe in the EU's internal aviation market which consists of EU Member States as well as Norway and Iceland.

TABLE 25. O&D 2014-2018 FROM/TO BALKAN STATES (SOURCE: SABRE)

	Year	Passengers	*Variation*	PPDEW	*Variation*		Year	Passengers	*Variation*	PPDEW	*Variation*
ALBANIA	2014	1 731 821	*n.a.*	2 372	*n.a.*	**NORTH MACEDONIA**	2014	1 201 736	*n.a.*	1 646	*n.a.*
	2015	1 827 941	*6%*	2 504	*6%*		2015	1 510 218	*26%*	2 069	*26%*
	2016	1 917 536	*5%*	2 620	*5%*		2016	1 805 300	*20%*	2 466	*19%*
	2017	2 521 400	*31%*	3 454	*32%*		2017	1 889 928	*5%*	2 589	*5%*
	2018	3 310 699	*31%*	4 535	*31%*		2018	2 197 051	*16%*	3 010	*16%*
	Year	Passengers	*Variation*	PPDEW	*Variation*		Year	Passengers	*Variation*	PPDEW	*Variation*
BOSNIA AND HERZEGOVINA	2014	910 020	*n.a.*	1 247	*n.a.*	**MONTENEGRO**	2014	1 321 205	*n.a.*	1 810	*n.a.*
	2015	1 051 459	*16%*	1 440	*16%*		2015	1 338 383	*1%*	1 833	*1%*
	2016	1 201 455	*14%*	1 641	*14%*		2016	1 333 634	*0%*	1 821	*-1%*
	2017	1 488 365	*24%*	2 039	*24%*		2017	1 626 781	*22%*	2 229	*22%*
	2018	1 556 618	*5%*	2 132	*5%*		2018	1 844 310	*13%*	2 526	*13%*
	Year	Passengers	*Variation*	PPDEW	*Variation*		Year	Passengers	*Variation*	PPDEW	*Variation*
KOSOVO	2014	1 080 018	*n.a.*	1 480	*n.a.*	**SERBIA**	2014	3 290 403	*n.a.*	4 508	*n.a.*
	2015	1 176 581	*9%*	1 612	*9%*		2015	3 383 543	*3%*	4 635	*3%*
	2016	1 323 577	*12%*	1 808	*12%*		2016	3 697 594	*9%*	5 051	*9%*
	2017	1 413 691	*7%*	1 937	*7%*		2017	4 152 929	*12%*	5 689	*13%*
	2018	1 660 380	*17%*	2 275	*17%*		2018	4 532 912	*9%*	6 209	*9%*

PPDEW: passengers per day each way

These statistics here above show a sometimes very strong growth depending on the different Balkan countries. Albania showed the sharpest recent growths of traffic.

Depending on the country, the development of traffic from/to the European Union has been more or less rapid since 2017:

- Albania:

  The establishment of the ECAA has considerably increased traffic from/to Albania (Passenger Traffic +31% between 2016 and 2017, +31% between 2017 and 2018). Tirana is today the only Albanian airport with scheduled traffic.

  Italy remains #1 market from/to Albania (2.1 million passengers in 2018), 0.5 Million Albanian citizens live in Italy (source: ISTAT), therefore VFR market is essential between both countries. ECAA intensified competition on this lucrative market, but also in the rest of Europe.

  To a lesser extent, traffic has also increased to the United Kingdom (162,400 passengers in 2018), the United States (159,000 passengers in 2018), Germany (140,600 passengers) or Turkey (129,600 passengers in 2018).

  Due to the strong link with Italy, the main airlines serving Albania are Italian (Blue Panorama Airlines[179], Ernest Airlines[180], Alitalia). The first particularly focused on the Albania market and opened a base in Tirana (eight routes towards major Italian cities).

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[179] *Blue Panorama Airlines is an Italian charter and low-cost airline founded in 1998. The airline has currently a dominant position in Albania (39% Market Share for 1.3 million passengers).*

[180] *Ernest Airlines is an Italian low-cost airline founded in 2016. The airline very recently ceased operations (13 January 2020). Italian civil aviation authority (ENAC) suspended its operating license, since the airline was not able to meet ENAC requirements. In 2018, the airline had 377,500 passengers from/to Albania (11% market share).*

There is a high turnover of national airlines. Albawings and Air Albania are the two main Albanian operators. The first is a low-cost airline which started operations in 2015 and shares its codes with Blue Panorama Airlines. Albawings has three Boeing 737-400/500.

Air Albania was founded on 16 May 2018 by a consortium led by the Albanian and Turkish governments under a public–private partnership. Turkish Airlines is the biggest private investor with 49.12% of shares. For now, Air Albania operates two aircraft (one Airbus A319-100 and one Boeing 737-800) towards Italy (Bologna, Milan and Rome) and Turkey (Istanbul).

For the time being, low-cost airlines from the rest of Europe have not decided to set up bases in Albania. However, Wizz Air has already announced that it will replace Ernest Airlines following the suspension of its operating licence. Ryanair has chosen not to serve Albania for the moment.

- Bosnia and Herzegovina: Bosnia and Herzegovina has experienced sustained and steady growth in traffic, which has been amplified with the entry into force of the ECAA (Passenger traffic +24% between 2016 and 2017).

  Bosnia and Herzegovina has four commercial airports (Sarajevo, Tuzla, Banja Luka and Mostar). Sarajevo and Tuzla handle most of the traffic. Again, low-cost airlines, especially Wizz Air, were at the heart of the growth. The Hungarian airline opened a base in Tuzla (15 destinations). Banja Luka airport receives Ryanair (only airport of Bosnia and Herzegovina to receive Ryanair flights).

  B&H Airlines was the flag carrier founder in 1994. The airline went bankrupt in 2015. A new national ariline, Air Bosnia, starter operations in January 2019 with one Airbus 319-100, and two more to join the fleet.

- Kosovo: Due to the ongoing dispute between Serbia and Kosovo, flights to and from Kosovo are impacted by the refusal of ATC in Serbia, to allow overflights via Serbian airspace. This ultimately results in flight paths avoiding Serbian territory with flights to Pristina having to enter via Albania's or North Macedonia's airspace. This dispute can generally add up to 30 minutes to a flight duration and discussions to overcome this dispute have so far failed.

TABLE 26. TOP 20 O&D FROM/TO PRISTINA AIRPORT IN 2018 (SOURCE: SABRE)

Ranking	Destination Airport	Destination City Name	Destination Country Name	Passengers	PPDEW
1	DUS	DUSSELDORF	GERMANY	199 865	274
2	STR	STUTTGART	GERMANY	155 383	213
3	ZRH	ZURICH	SWITZERLAND	143 348	196
4	MUC	MUNICH	GERMANY	98 576	135
5	GVA	GENEVA	SWITZERLAND	95 267	131
6	BSL	MULHOUSE/BASEL	SWITZERLAND	85 490	117
7	IST	ISTANBUL	TURKEY	81 596	112
8	SAW	ISTANBUL	TURKEY	78 980	108
9	LTN	LONDON	UNITED KINGDOM	55 714	76
10	SXF	BERLIN	GERMANY	46 797	64
11	JFK	NEW YORK	UNITED STATES	36 973	51
12	BRU	BRUSSELS	BELGIUM	36 511	50
13	OSL	OSLO	NORWAY	33 277	46
14	FRA	FRANKFURT	GERMANY	30 995	43
15	BUD	BUDAPEST	HUNGARY	30 294	42
16	HEL	HELSINKI	FINLAND	29 038	40
17	VIE	VIENNA	AUSTRIA	26 979	37
18	CPH	COPENHAGEN	DENMARK	26 967	37
19	LJU	LJUBLJANA	SLOVENIA	25 855	36
20	CDG	PARIS	FRANCE	22 460	31

However, traffic developed sharply and new operators started to serve Pristina which is the only commercial airport for the moment. There a plans to open Gjakova airport, located in Western Kosovo, to commercial traffic. This geographical distribution of the Kosovar diaspora is also reflected in the demand for air transport.

The Kosovar diaspora is important. Turkey, Germany, Switzerland and United States have been the first major countries of emigration for expatriate Kosovar citizens. To a lesser extent, Kosovar citizens live in the United Kingdom, France, Italy, Belgium, Norway and Sweden.

There is only one small flag carrier in Kosovo (Kosova Airlines[181]). Eurowings has a base at Pristina airport (eight destinations). Easyjet, Norwegian, Pegasus and Wizz Air are the other low-cost airlines which already serve Kosovo.

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[181] *Kosova Airlines was established in autumn 2003 by the United Nations Interim Administration Mission in Kosovo (UNMIK) and the Kosovo Government. According to Airfleets database on airlines' fleets, Kosova Airlines has no aircraft. On 10 May 2006, the only aircraft in*

- Montenegro: Montenegro has experienced strong traffic growth since the establishment of the ECAA (+22% between 2016 and 2017, +13% between 2017 and 2018). Pogodorica and Tiva airports are the two main gateways to Montenegro. Berane airport could be redeveloped in the medium-term.

  The geography of air transport in Montenegro shows strong relations with Serbia (Belgrade is the first destination in 2018 with 387,600 passengers) and Russia (four Russian airports in the top 5 airports served from Montenegro).

  National Carrier, Montenegro Airlines, still keeps the biggest market share in the country (516,700 passengers in 2018), followed by Air Serbia (191,100 passengers in 2018), Ryanair (143,400 passengers in 2018), Wizz Air (126,200) and Aeroflot (115,900 passengers in 2018).

  Montenegro air transport market appears to be still in transition, with strong traffic growth but limited competitive opening. Tivat is the closest airport to the coast and touristic areas. However, capacity and operational constraints of the airport considerably limit its development.

  Depending on the development of airport capacity and the opening to competition, the country's air traffic and connectivity could develop further.

- North Macedonia: Since 2014, North Macedonia has experienced a rapid and steady development of its air traffic (up to +26% between 2014 and 2015).

  There is no national carrier in North Macedonia. MAT Macedonian Airlines was the last known flag carrier. It went bankrupt in 2009.

  Wizz Air was the main operator with 1.3 million passengers in 2018 from/to North Macedonia[182]. The airline operates a base at Skopje airport with 31 destinations served.

  Germany, Switzerland and Sweden are the most served countries. Again, VFR segment is essential in the demand.

TABLE 27. TOP 20 O&D FROM/TO NORTH MACEDONIA IN 2018 (SOURCE: SABRE)

Ranking	Destination Airport	Destination City Name	Destination Country Name	Passengers	PPDEW
1	ZRH	ZURICH	SWITZERLAND	203 118	278
2	MLH	MULHOUSE/BASEL	SWITZERLAND	143 802	197
3	MMX	MALMO	SWEDEN	101 972	140
4	LTN	LONDON	UNITED KINGDOM	84 592	116
5	BTS	BRATISLAVA	SLOVAKIA	73 465	101
6	GOT	GOTHENBURG	SWEDEN	62 837	86
7	CGN	COLOGNE	GERMANY	60 880	83
8	FMM	MEMMINGEN	GERMANY	59 513	82
9	SAW	ISTANBUL	TURKEY	56 866	78
10	DTM	DORTMUND	GERMANY	51 984	71
11	IST	ISTANBUL	TURKEY	51 356	70
12	HHN	FRANKFURT	GERMANY	50 704	70
13	SXF	BERLIN	GERMANY	50 468	69
14	CRL	BRUSSELS	BELGIUM	47 617	65
15	CPH	COPENHAGEN	DENMARK	46 186	63
16	EIN	EINDHOVEN	NETHERLANDS	46 154	63
17	HAM	HAMBURG	GERMANY	42 743	59
18	BUD	BUDAPEST	HUNGARY	41 568	57
19	HAJ	HANOVER	GERMANY	39 328	54
20	NUE	NUREMBERG	GERMANY	38 971	53

the Kosova Airlines fleet, a Boeing 737-700, which was wet leased from the German airline Hamburg International, was returned to that airline, and Kosova Airlines ceased operating flights. The airline however continues to work with other airline companies flying into Pristina (Eurowings, Sunexpress, etc.).

[182] *Source: Sabre, MIDT, 2018.*

- Serbia: Among the Balkan countries, Serbia is probably the market that has experienced the most limited growth, although it remains above the European average. It has a relatively powerful national operator (Air Serbia).

  Belgrade is the main airport of Serbia (6.1 million passengers in 2019. Air Serbia and Wizz Air both operate bases), followed by Niš (422,300 passengers in 2019. Wizz Air operates a base), and Morava (recently converted military airport)

  Germany (622,700 passengers in 2018), Switzerland (423,500 passengers), Montenegro (387,600 passengers), Sweden (258,200 passengers) and United States (238,500 passengers) were the Top 5 countries from to Serbia in 2018 (Source: Sabre). VFR segment drove the core demand from/to these countries.

  Air Serbia remains #1 airline operating from/to Serbia with 1.1 million passengers in 2019. This dominant position therefore limits competition of low-cost airlines. However, Wizz Air is also sharply developing in Serbia (728,000 passengers in 2018).

  Air Serbia ownership is shared between the Government of Serbia (51%) and Etihad Airways (49%). The significant presence of Etihad Airways in the airline's capital is reflected in the provision of technical and human resources, as well as the possibility for the airline's passengers to fly code-share to numerous destinations via Abu Dhabi.

  In terms of connectivity, the presence of a strong "legacy" operator makes it possible to benefit from a more diversified connectivity (variety of destinations), but probably less affordable than a low-cost airline which, for profitability purposes, would tend to focus on the most demanded destinations and segments (e.g. countries with a strong diaspora, touristic destinations, etc.).

2.1.5. Multimodal Mobility

In the last five years, multimodality has seen an increased uptake within Europe, with the Commission committed to reducing carbon dioxide (CO_2) emissions, congestions and air pollution, to improve the quality of life of European Citizens and to reach the goals set by the Paris Agreement[183]. 2018 was the "European Year of Multimodality" – a year during which the Commission emphasized the importance of multimodality to enhance efficiency and sustainability of the EU transport system. Throughout the year, the Commission put together a series of legislative and policy initiatives and events aimed at promoting the functioning of the transport sector as a fully integrated 'system'.

In this section, we have extended the meaning of multimodality to cover the substitution of one mode of transport to another (e.g. rail instead of air). Building a seamless and efficient multimodal transport environment should ultimately facilitate the use of the more sustainable transport modes. The uptake of this has been increasingly notable in continental Western Europe where rail infrastructure is good and distances between urban centres are often short.

Passenger rights in multimodal transport are also a priority for the future. Today's mode-oriented approach, based on five different Regulations, does not bring a satisfactory solution for multimodal passengers. The market for multimodal bookings is still a niche. But, depending on market developments, simplified and more coherent passenger rights across modes might be necessary in the longer term, including a better coverage of passenger rights in the multimodal context, in particular for passengers with disabilities or reduced mobility.[184]

Long distance buses and high-speed trains are providing a convenient alternative to commercial flights. Eurostar reported a record year in 2018. The train operator saw passenger number increase by 7% with the greatest increase in number of business passengers (12%)[185]. Whilst there are far too many parameters to coherently answer the 'Plane vs Train debate', especially for routes over distances such as from London to Amsterdam, Brussels and Paris, the increased uptake should be recognised and considered.

We approach multimodal issues from two angles:

- **Modal competition** between air transport and other means of transport. The point here is to address the issues of modal choice and alternatives; to what extent do land transport modes compete with aviation?
- **Intermodality** between air transport and other means of transport. Modal complementarity between air transport and other means of transport will be addressed. Therefore, smooth transition (connection) between transport modes will be essential.

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[183] 12 December 2015, The European Union has played a key role in brokering historic agreement in Paris, where 195 countries adopted a new universal, legally binding global climate deal: *https://ec.europa.eu/commission/presscorner/detail/en/IP_15_6308* .

[184] See Exploratory study on passenger rights in the multimodal context (2019): *https://op.europa.eu/en/publication-detail/-/publication/f176da6f-d9ca-11e9-9c4e-01aa75ed71a1*

[185] *https://www.independent.co.uk/travel/news-and-advice/eurostar-2018-results-financial-performance-channel-tunnel-train-london-amsterdam-paris-a8807936.html*

2.1.5.1. Trends on modal competition

Conclusion 32 – The high-speed rail network is developing but covers only a small part of the territory

HSR developed on major city-pairs in Western Europe (Benelux, France, Germany, Italy, Spain, etc.). The modal shift has not been total and, for longer distances, air transport remains competitive. In some countries, high-speed line equipment is tending to slow down for cost reasons (France).

: The further expansion of HSR will continue in Europe fuelled by increasing climate awareness among residents.

: HSR development on city-pairs ensures optimal connectivity and a higher level of competition between different transport options, thereby lowering fares.

: Further development of HSR in Europe creates additional employment in the rail sector.

Conclusion 33 – Raise of environmental stakes is redeveloping rail transport in some countries

Flygskam (Swedish word for "flight shame") and general raise of environmental stakes are already impacting domestic air traffic in Scandinavia. On the shortest city-pairs, some airlines are considering removing some flight frequencies in favour of rail frequencies.

: The shift from plane to train for domestic traffic is favourable for the climate and will reduce citizens' dissatisfaction regarding the environmental impact of aviation.

: The removal of certain air frequencies may result in reduced connectivity for domestic travel and cause dissatisfaction among passengers, especially business travellers.

: Reducing flight frequencies could lead to loss of jobs in airlines.

Conclusion 34 – Bus and low-cost train services challenge LCC on some city-pairs

Development of alternative low-cost means of transport (car-pooling, bus services, low-cost train services) can compete with air transport.

: Development of alternative low-cost means of transport leads to increased connections between cities and creates new opportunities for their citizens.

: The emergence of alternative low-cost means of transport will lead to an increased competitive environment for airlines and a reduction of fares for domestic and intra-European traffic.

: Emergence of employment in other departments of the European transport sector.

2.1.5.1.1. Competition with high-speed rail (HSR)

Overview

Europe has a particularly dense rail network, part of which offers speeds in excess of 200 kph. Most of recent reports and research have focused on the competition between high-speed rail (HSR) services which speed is above 250 kph and airplane services.

We have chosen to broaden our analysis following the definition of high-speed rail[186] by the worldwide railway organisation (UIC). Even if the impact on modal competition of high-speed rail services (250 kph and above) is obvious (increasing market shares for train services again airplane services), a better structuration of "lower speed" HSR infrastructures and services (between 200 and 250 kph) also stimulates modal competition between air and rail.

The two figures hereafter present the infrastructure and the service components of the European HSR:

- **Figure 48 shows that length of fastest (above 270 kph) high-speed lines remains limited.** Belgium, France, Germany, Italy, Netherlands and Spain are the only countries to offer such networks.
- **Figure 49 shows that most of the high-speed train can also run on "classic" networks which are interconnected with high-speed lines.** This broadens modal competition to city pairs which are not directly linked with a high-speed railway infrastructure.

HSR makes it possible to compete directly with air transport. Short-haul flying is often seen as a mostly tedious, uncomfortable experience with lots of queuing and waiting. Adding this to the growing number of consumers that have become more conscious about the environmental impact of air travel, the popularity of HSR as an alternative to short-haul flying has steadily been growing. In combination with the renewed interest in night trains in Europe, railways do have a solid basis to compete with aviation.

Compared to air travel, for journeys less than 1,000 kilometres, HSR means less hassle because of direct connection between city centres, lighter security and luggage regulations, and a much more comfortable journey. Often advertised effect of HSR is that it will be a key technology for greener transportation.

On many city pairs, HSR now has a much higher market share than air travel. For example, between Madrid and Barcelona, 65%[187] of the market has moved to HSR, while (following the launch of high-speed services of Italo - NTV and Ferrovie dello stato in Italy) between Milan and Rome HSR has a market share of 75%.[188] With many search engines and price comparison websites now showing HSR as an alternative when booking flights, it is clear the demand, or at least interest for the insight, is there.

For domestic flights, HSR can often have a time advantage over other transportation modes. Reducing the check-in and pass through to departure time at railway stations in comparison to airports. The structure of the network and distribution of the population along also act as critical factors for profitability of HSR lines in competition to air carriers.

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[186] *The worldwide railway organisation (UIC) defines high-speed rail as the following:*

"High-speed rail is not merely a technical subject; rather, it encompasses a complex reality involving various technical aspects such as infrastructure, rolling stock, energy and operations and cross-sectoral issues such as financial, commercial, socio-economic, managerial and training aspects. The high-speed rail system combines these various elements using highly sophisticated technology. […]

High-speed rail combines many different elements which constitute a "whole, integrated system": infrastructure (new lines designed for speeds above 250 km/h and, in some cases, upgraded existing lines for speeds of up to 200 or even 220 km/h), rolling stock (specially-designed train sets), telecommunications, operating conditions and equipment, etc. In view of the fact that many high-speed trains are also compatible with the conventional network, the term "high-speed traffic" is also frequently understood to signify the movements of this type of train on conventional lines but at speeds lower than those permitted on the new high-speed infrastructure."

[187] https://www.airlinetrends.com/2018/10/26/spanish-regional-airline-air-nostrum-wants-to-operate-high-speed-rail-routes/

[188] https://italospa.italotreno.it/static/upload/ann/annual-report-2017.pdf, https://www.moodys.com/research/Moodys-assigns-B1-rating-to-Nuovo-Trasporto-Viaggiatori-SpA-NTV--PR_367817

FIGURE 48. MAP OF THE EUROPEAN LONG-DISTANCE RAIL NETWORK BY SPEED LIMIT (SOURCE: BERNESE MEDIA)

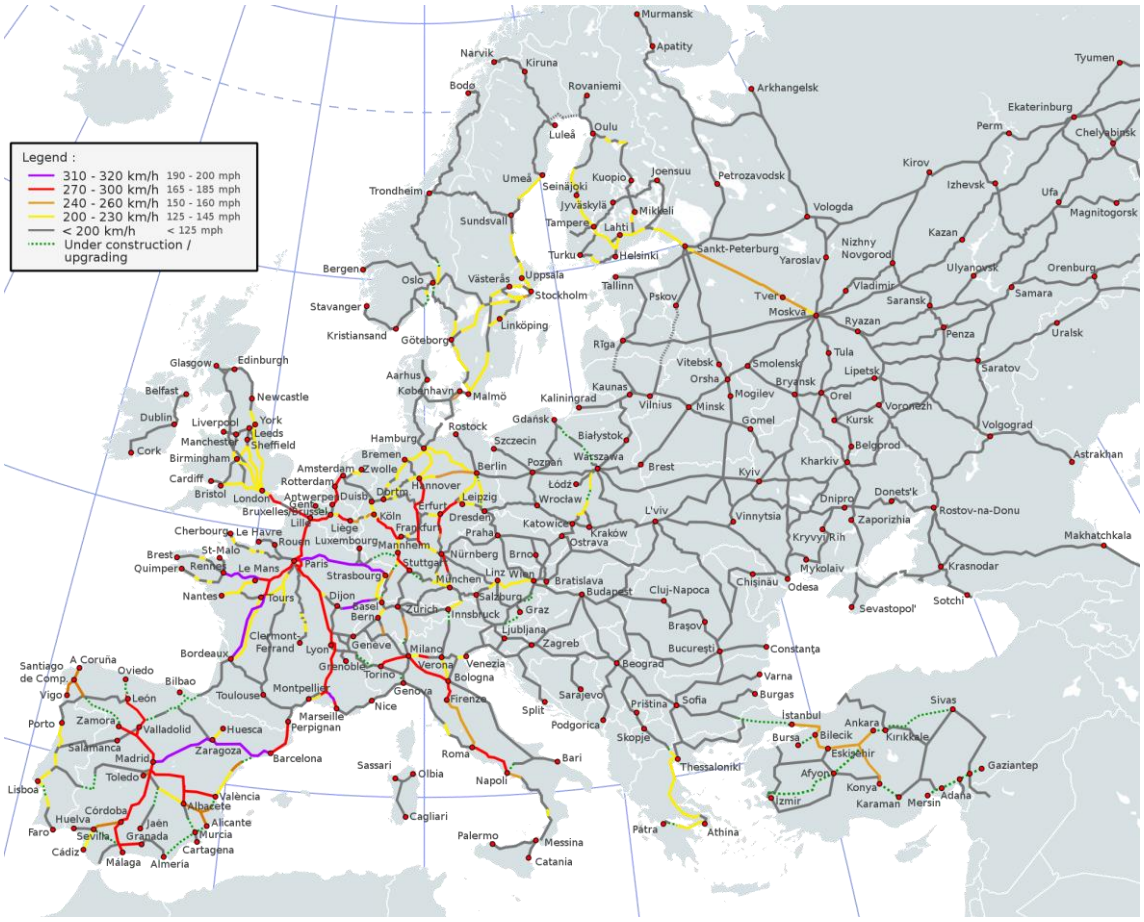
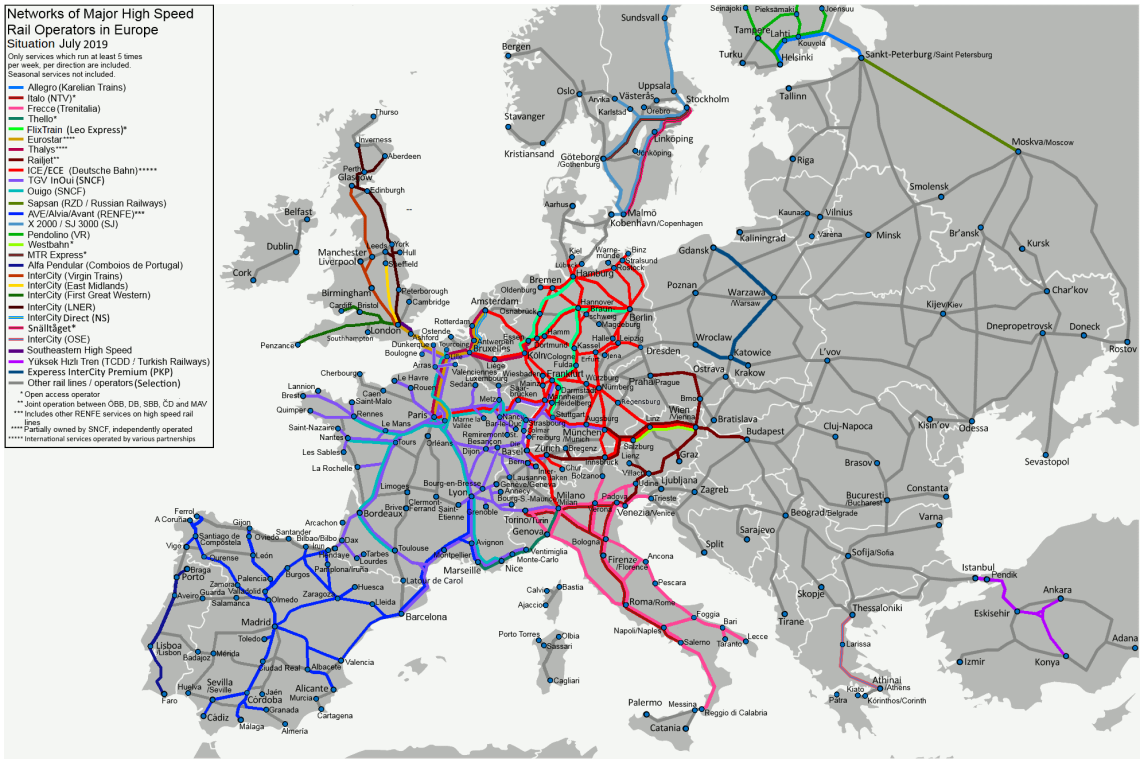


FIGURE 49. MAP OF HIGH-SPEED TRAIN SERVICES IN EUROPE AS OF JULY 2019 (SOURCE: BERNESE MEDIA)



What are the impacts and limits of high-speed rail on air transport?

The various econometric analyses on competition between these two modes of transport have shown that the average journey time for an equal distribution of demand between the two modes was around three hours. Since railway operators were mostly national monopolies, domestic traffic was the main beneficiary of the high-speed line projects. Gradually some international city-pairs were also involved (Eurostar, Thalys, etc.)

Logically enough, for point-to-point travel, the high-speed train has sometimes replaced the airplane. **However, air transport operators' reaction** to the introduction of new high-speed rail services was variable from one city-pair to the other[189]:

- **Full service network carriers operating a hub maintain air services**, especially if the distance between cities is important (>300km) and/or if there is no direct high-speed train station at the hub airport. On this type of service, point-to-point passengers are sometimes very limited whereas transfer passengers are the core demand for the route.
- **For high-volume city-pairs and routes to/from a hub, air transport has been able to maintain a service, sometimes shuttle services** (e.g. Barcelona-Madrid, Milan-Rome, Paris-Bordeaux, Paris-Marseille, Paris-Montpellier, etc.). On the Paris-Marseille axis, the capacity of the rail infrastructure cannot handle all the transport demand. Road and Air transport can therefore offer additional capacity.

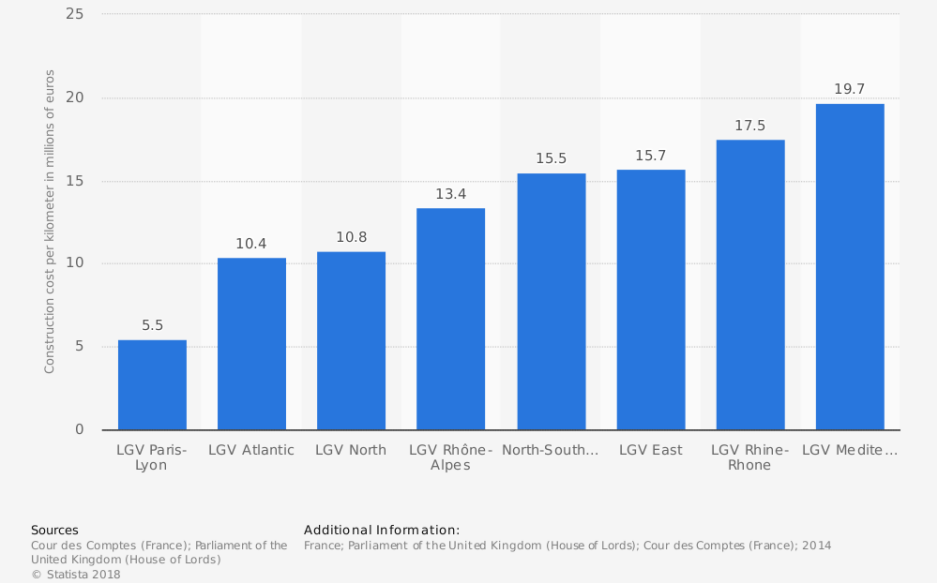
Other parameters however explain continuation of air services in direct completion with HST:

- **Price is also a parameter, which may favour continuation of air services in head-on competition with high-speed rail.** In particular, a service such as Eurostar or Thalys is, on average, more expensive than air travel, especially for low-cost airlines.
- **For large metropolitan areas, the peripheral geographical location of an airport can be appreciated by the inhabitants and companies located in the suburbs.** This is particularly the cases of cities like Amsterdam, London, or Paris. This favours persistence of air services.

In terms of investment, high-speed line (HSL) projects require large amounts of money. **There has been a slowdown in high-speed railway projects**: earlier HSL projects are generally the most profitable (strong demand). The internal rate of return on subsequent projects then becomes lower and lower. In Western Europe, **the combination of the crisis in public finances and the low profitability of HSL's new projects has led to the postponement** (e.g. Bordeaux-Toulouse HSL) **or even cancellation of some projects**.

[189] *Dobruszkes, 2011*

FIGURE 50. COST OF CONSTRUCTION PER KILOMETRE OF HSL IN FRANCE IN 2014 (SOURCE: STATISTA)



With the forthcoming opening of the competition, train operators are also diversifying their offer towards low-cost services[190].

- **In France, SNCF launched OuiGo in April 2013**, a low-cost high-speed train service mainly operating from secondary peripheral railway stations with densified trains.
- **Thalys, the operator of the international train service between Paris, Brussels, Amsterdam, Cologne and Düsseldorf, launched a low-cost brand, Izy in 2016.** This service only covers the Paris <> Brussels city pair. It uses the conventional speed railway network in France to lower fares.
- **In Germany, FlixMobility launched in 2018 FlixTrain**, a low-cost regular speed train service operating Berlin-Stuttgart, Cologne-Hamburg, and Aachen-Leipzig routes.
- **In Spain, Renfe planned to launch in April 2020 Avlo,** a low-cost high-speed train service on the Madrid-Saragossa-Barcelona route. However, due to the coronavirus pandemic, Renfe chose to postpone the launch of services until further notice. The first Avlo service was due to introduced with three round trips per day between Madrid and Barcelona with an intermediate stop in Zaragoza. A fourth round trip was to be added in May with a fifth in September.

Can environment and capacity issues replace plane on some city-pairs?

Recent events, particularly in Belgium, France, the Netherlands, and Sweden have shown that the shortest air routes are the subject of strong criticism when the train (particularly high-speed trains) is a largely competitive alternative (Amsterdam-Brussels = 210 kilometres. Brussels-Paris = 312 kilometres).

KLM operates up to five daily flights between Amsterdam and Brussels. The Dutch airline removed one daily connection and replaced it by a Thalys connection operated since end of March 2019. Brussels airlines removed all its flights between Amsterdam and Brussels but offers Plane+Train connection via a partnership with AccessRail (distribution company selling train tickets via GDS).

For the Paris <> Brussels city-pair, Air France removed its air route. The airline dropped any direct point to point service but partnered with SNCF to proposer its connecting passengers a combined air & rail service via Paris-Charles de Gaulle airport train station, so passengers can take connecting flights from/to Paris-Charles de Gaulle airport.

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[190] *Delaplace, Dobruszkes, 2015*

Brussels Airlines maintained a daily flight between Brussels-National airport and Paris-Charles de Gaulle airport. Even if Brussels airport has a train station, no high-speed rail service if offered from the airport. Consequently, the airline maintained an air service (one daily flight) to offer connecting flights via Brussels for passengers from/to Paris. Point to point demand is very low on this route (<10% of the passengers on the route in 2018 according to Sabre).

On short distances and durations (~2 hours), subject to an easy connection between train and plane, replacing some air routes by train could have two impacts:

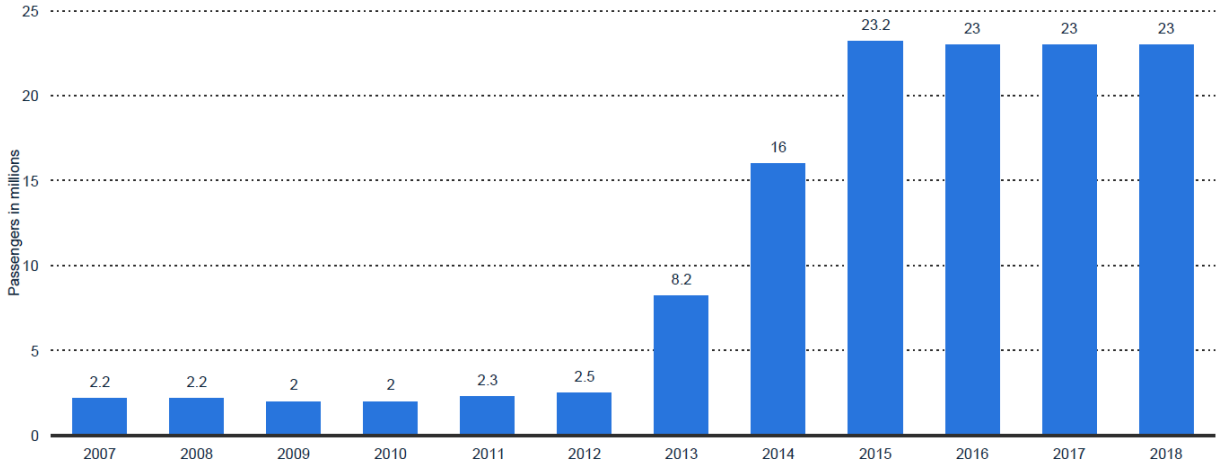
- Optimisation of slots utilisation at airports;
- Lower greenhouse gases emissions.

2.1.5.1.2. How interregional bus services challenge regional airports and low-cost airlines

The scientific literature has extensively studied the modal competition between HST and Airplane. However, it has only studied very little of the competition between airplanes and other modes of transport. "*Most recent papers focus on the interaction between air transportation and high-speed rail, probably because high-speed rail represents a contemporary revolution in transportation technology that has been promoted in various countries around the world, attracting interest from both scholars and policy makers*"[191]. France (in 2015) and Germany (in 2012) recently opened long-distance bus services to competition. Ireland, Sweden or United Kingdom opened long-distance bus services earlier. The bus has established itself as a credible low-cost alternative to the private car, train and plane, to which carpooling must now be added.

Development of efficient interurban bus services with stops at the airports deeply modified catchment areas of airports. If bus could not be an appropriate mean of transport for high revenues and/or business passengers, it becomes attractive to passengers willing to pay the lowest fare. Therefore, presence of long distance bus services from airports allows to reach final destinations located sometimes two hours or more from the airport by road.

FIGURE 51. NUMBER OF PASSENGERS IN SCHEDULED LONG-DISTANCE BUSES IN GERMANY FROM 2004 TO 2018 (IN MILLIONS) (SOURCE: STATISTA)



For instance, Air France (via its subsidiary Hop!) partnered with the French coach operator Blablabus to offer combined bus and plane tickets from/to five French cities (Aix-les-Bains, Chambéry, Grenoble, Saint-Chamond and Saint-Étienne) via Lyon-Saint-Exupéry airport.

The development of these services directly affected regional airports. The latter offer less routes, at higher fares and without proper public transport accessibility including coach services. Therefore, a regional airport could be less accessible (geographically and financially) for passengers, especially leisure and vesting friend and relatives (VFR) demands, than a bigger airport located in the region (roughly < 2 hours).

[191] *Albalate, Fageda, 2019, pp.70-71*

To a lesser extent, for passengers with very high price sensitivity, **the long-distance bus may be in head-on competition with the airplane, including LCC**[192]. To some extent, modal competition between air, road and rail leads to a new hierarchy between modes in terms of affordability. While the airplane was the most expensive mode, the latter tends, according to city-pairs, to be sometimes a cheaper alternative than the train (e.g. Paris <> London, Paris <> Lyon or Paris <> Amsterdam). Bus is becoming the 'last-resort' alternative for budget-constrained customers. Depending on the routes, it could be in competition with low-cost airlines.

"*The average long-distance bus passenger is budget-constrained. According to Pierre Gourdain, former General Manager France-Belgium of FlixBus, '40% of the French cannot afford a train ticket. We have a public service that has become a kind of luxury. Long-haul bus rides are a new way to travel in France with less than 5 cents per kilometre' (author's translation)*"[193].

[192] *Burgdorf, et al., 2018*

[193] *Blayac, Bougette, 2017, p.51*

2.1.5.2. Is intermodality still a distant dream?

Conclusion 35 – Liberalisation of rail transport could favour intermodality

Opening up the rail transport market to competition could favour multimodal operators.

: Multimodality ensures seamless travel and optimal travel time, increasing customer satisfaction.

Conclusion 36 –Innovation in ticket distribution could promote intermodality

New ticket distribution solutions can offer end-to-end bookings including several operators and transport modes.

: End-to-end bookings optimise the consumer's travel itinerary both in terms of time and distance.

We already indicated that the development of long-distance bus services makes it possible to develop air-road intermodality in large catchment areas, sometimes to the exclusion of smaller airports. This paragraph briefly outlines the key issues of intermodality for airports and airlines.

2.1.5.2.1. Air-Rail Intermodality: current services

Air-rail intermodality is generally the aspect most discussed in the literature. Several airlines and rail companies are already working together to provide travellers with a seamless 'intermodal' connection, effectively using high-speed rail as feeder service to long-haul flights.

- **In Germany**, DB launched 'Rail&Fly' service, which is booked through a partner airline or a travel agent. Some fifty airlines are partners in the scheme. Lufthansa also launched 'Express Rail' to access 14 German cities from/to its Frankfurt hub.
- **In Switzerland**, CFF and Swiss partnered to offer 'AirTrain' on two routes; Basel <> Zurich, and Lugano <> Zurich.
- **In France**, SNCF launched 'TGV Air' service with 10 airlines from both Paris-Charles de Gaulle and Paris-Orly (via Massy train station) airports to 20 French train stations.
- **In Belgium**, Air France, KLM and Thalys partnered to offer air/rail services via both Paris-Charles de Gaulle and Amsterdam airports.
- **In Spain,** Iberia offers 'Train & Fly' service between Madrid (Atocha or Chamartín) train stations and nine destinations (Saragossa, Valladolid,

Case Study: Lufthansa Express Rail

Lufthansa Express Rail is a collaboration between the airline and Deutsche Bahn (a German railway company) and provides passengers with an integrated booking from 8 destinations throughout Germany to and from Frankfurt Airport.

This means reserved seats on the train, remote baggage check-in, plus a guaranteed connection. Lufthansa expanded its Express Rail service to 14 German destinations by October 2019.The advantage of taking a rail-air link is that, should the train be delayed, Lufthansa will rebook passengers free of charge.

FIGURE 52. MAP OF CURRENT AND FUTURE LUFTHANSA EXPRESS RAIL DESTINATIONS (SOURCE: LUFTHANSA)

Seville, Cordoba, Malaga, Segovia, León, Palencia and Zamora). Five more destinations will be soon offered.

The table hereunder shows top 10 airports O&D from/to Brussels-South and Lille-Europe train stations. It is assumed that most of the passengers are using Paris-Charles de Gaulle airport and Amsterdam-Schiphol train stations.

According to Sabre, about 230,000 passengers used in 2018 the train from/to Brussels-South train station and then took the plane (to AMS our CDG). About 97,000 passengers did the same from Lille-Europe station in 2018 (via CDG only). Data from Sabre is incomplete, as it does not count pre-routing passengers who book a train ticket themselves.

We assume that, since not all the airline offer air & rail services, most of air-rail transfer passengers are buying separate train tickets and cannot be seen through Sabre. A city like Lille (Northern France) is probably mostly served by neighbouring airports (Brussels-National, Brussels-Charleroi, Paris-Charles de Gaulle, etc.) rather than Lille airport.

The two figures hereafter show extracts of O&D passengers from Sabre in 2018 who travelled from/to Brussels-South train station and Lille-Europe train station. We know for these two airports that air passengers are using these stations as their first (or last) leg for their journeys, sometimes with combined 'TGV Air' air and rail tickets.

If such extracts show key destinations, Sabre only catches a limited part of the traffic. Therefore, this information remains limited[194].

TABLE 28. TOP 10 AIRPORTS O&D FROM/TO BRUSSELS-SOUTH TRAIN STATION IN 2018 (SOURCE: SABRE)

Ranking	IATA Code	City	Country	Passengers
1	MRU	Mauritius	Mauritius	9 626
2	CDG	Paris	France	7 972
3	JNB	Johannesburg	South Africa	5 731
4	FIH	Kinshasa	Congo Democratic Republic	4 937
5	RUN	Saint-Denis de la Réunion	France	4 259
6	CKY	Conakry	Guinea	4 218
7	BKO	Bamako	Mali	4 002
8	PVG	Shanghai	China	3 867
9	TNR	Antananarivo	Madagascar	3 611
10	SCL	Santiago	Chile	3 603

TABLE 29. TOP 10 AIRPORTS O&D FROM/TO LILLE EUROPE TRAIN STATION IN 2018 (SOURCE: SABRE)

Ranking	IATA Code	City	Country	Passengers
1	ALG	Algiers	Algeria	5 111
2	PVG	Shanghai-Pudong	China	2 072
3	GVA	Geneva	Switzerland	2 043
4	CMN	Casblanca	Morocco	1 988
5	MAD	Madrid	Spain	1 483
6	TUN	Tunis	Tunisia	1 332
7	LIS	Lisbon	Portugal	1 160
8	BCN	Barcelona	Spain	1 157
9	RUN	Saint-Denis de la Réunion	France	1 095
10	YUL	Montréal-Trudeau	Canada	1 082

[194] *Sabre MIDT does not adjust railway data in its tool so the information remains partial (tickets issued through Sabre GDS).*

2.1.5.2.2. Can liberalisation & distribution innovation disrupt intermodality?

Liberalisation of rail transport

Opening up rail transport to competition has been a much longer process than for air transport. This process is still ongoing. Council Directive 91/440/EEC of 29 July 1991 on the development of the Community's railways set out the basis[195] of this process. Until 2010, the opening up of passenger rail transport was not mandatory[196]. From 2010, international transport (e.g. Eurostar, Thalys, Thello) was opened to competition. From 2020, domestic services will be opened to competition.

Gradual implementation of the 'fourth railway package[197]' is allowing for competition. This can be competition "for" the market through a public tender, or "in" the market under an "open access" regime.

The 'market pillar' of the fourth railway package, which was adopted in December 2016, includes:

- Regulation (EU) 2016/2338 amending Regulation (EU) 1370/2007, which deals with the award of public service contracts for domestic passenger transport services by rail ('PSO Regulation[198]')
- Directive 2016/2370/EU amending Directive 2012/34/EU, which deals with the opening of the market of domestic passenger transport services by rail and the governance of the railway infrastructure ('Governance Directive')
- Regulation (EU) 2016/2337 repealing Regulation (EEC) 1192/69 on the normalisation of the accounts of railway undertakings

The rules of internal competition between air and rail transport sectors are not the same in Europe. Even if the level of competition gradually increased, operators can be seated on monopolies (e.g. domestic long distance train services in France). As a result, rail operators have mainly managed their monopoly rents without any particular commercial innovation, especially with other transport sectors (except bus).

For now, current air-rail one-off partnerships maintain a strict separation between the companies, in particular the ownership of the customer file. To the extent that the different modes of transport are liberalised (or about to be liberalised), an integrated mobility offer (with multimodal operators) could emerge.

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[195] *As a reminder, and secondary to the subject of this report, the Directive has imposed to separate (for accounting purposes) the rail infrastructure manager from the rail transport operator. and to guarantee the full independence of the infrastructure manager's essential functions (charging and capacity allocation), particularly for integrated companies. This fundamental prerequisite made it possible to organise the gradual opening up to competition (several operators on the same infrastructure).*

[196] *"However, some countries opened markets to entry long before that. In Sweden, competitive tendering was introduced for subsidised services in 1990. In Britain, virtually all passenger services were subjected to competitive tendering over the period 1994–7. In Germany, states were given the power to competitively tender contracts for regional services from 1994, and there has been a trend towards competitive tendering in that country." (Nash, et al., 2019, p.12)*

[197] *The fourth railway package is a set of six legislative texts designed to complete the single market for rail services (single European railway area). Its overarching goal is to revitalise the rail sector and make it more competitive vis-à-vis other modes of transport. It comprises a 'technical pillar' and a 'market pillar'. The 'market pillar' sets up the rules for operators to access competition on the market.*

[198] *Some regulatory parallelism with the airline industry is applied.*

Can distribution favour multimodality or even intermodality?

One of the main barriers to the development of intermodality is ticket distribution. Travellers have to book a separate ticket for each mode of transport. The compartmentalisation between each mode encourages operators to develop their own distribution solutions.

Partnerships are gradually developing, particularly between rail and air. In concrete terms, these partnerships allow airlines to issue a single ticket that includes the segment(s) made by train. Passengers benefit from the same travel guarantee, including the protection of a connection in the event of a delay on one of the segments. Sometimes loyalty programmes also apply to segments made by train (i.e. miles, status, etc.)

Insofar as they enjoyed a monopoly, few rail operators chose to distribute their tickets via Global Distribution Systems (GDS). However, services such as Eurostar or Thalys have favoured (at least partially) the distribution of their tickets via GDS (as a reminder, access to GDS is charged and generates additional distribution costs). Travellers then benefit from a passenger name record (PNR) and the journey can be followed from end to end.

The development of fare comparison platforms has also played a role in the way travel is planned. Low-cost airlines introduced one-way fares, while legacy airlines tended to overcharge the purchase of one-way tickets as an incentive for travellers to book their entire trip with them. The parallel development of fares comparison platforms speeds up this trend allowing customers to book one operator for the inbound leg and another for the outbound leg. Some of these platforms even offer the capacity to offer a single booking (same PNR) so the customer could be protected in case of any disruption on the inbound or the outbound travel (e.g. if the inbound travel is cancelled, the outbound travel could be changed or refunded without any additional fee).

While these same platforms began by integrating air fares first, the long-distance train appears more and more in queries (e.g. Paris <> Amsterdam). Therefore, on certain routes, it is quite possible to book alternatively the plane and the train for the same journey.

Further integration in distribution could lead to a better intermodality of journeys. However, the following limits remain:

- **Physical intermodality at airports remains (in most cases) poor.** Since airports are mostly located far from city centres. These, do not benefit from equipment and infrastructure located inside the city centre. Only a few airports are connected with urban transport networks (metro lines, etc.). Even fewer airports have a connection to a long-distance train station (including HST). Beyond the sole cost an interconnection between a train station and an airport, displacement of networks and construction of new networks to ease intermodality is a major investment. Therefore, not all airports could enjoy a true intermodality. The EU has also undergone actions to increase more targeted investments into physical infrastructure. This is in the aim of increasing the links between single modal networks. For example, the EU provides financial support[199] to multimodal transport[200].
- **Customer ownership (and customer records ownership) is a key element in the competitiveness of transport operators.** Each operator limits the disclosure of its commercial information. For example, the various air-rail intermodal services on offer have to be booked (in most cases) directly on the airlines' websites. Distribution and commercial relations remain on the airline's side. In this type of scheme, the railway company is only an operator chartered by the airline. In a system such as code-sharing, railways companies could for instance sell tickets that include air travel.
- For the time being, **there is little shareholdings by airlines in the equity of railway companies and vice versa.** Integrated (multimodal) mobility operators do not yet exist, at least airlines are not already included in such companies[201]. The creation of a multimodal transport operator would provide a complete travel experience for customers.

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[199] *https://ec.europa.eu/transport/themes/infrastructure/news/2019-03-28-investment_en*

[200] *https://ec.europa.eu/transport/themes/logistics-and-multimodal-transport/multimodal-and-combined-transport_en*

[201] *There is better integration between ground transport modes, with e.g. train and bus operators (e.g. SNCF, FlixMobility, etc.).*

TABLE 30. EUROPEAN AIRPORTS WITH A TRAIN CONNECTION

Country	City	IATA Code	HST	Long-Distance	Regional/Local
Austria	Vienna	**VIE**	NO	NO	YES
Belgium	Brussels	**BRU**	NO	YES	YES
Finland	Helsinki	**HEL**	NO	NO	YES
France	Lyon	**LYS**	YES	NO	YES
France	Paris	**CDG**	YES	NO	YES
Germany	Berlin	**BER**	YES	YES	YES
Germany	Cologne-Bonn	**CGN**	YES	YES	YES
Germany	Dusseldorf	**DUS**	YES	YES	YES
Germany	Frankfurt	**FRA**	YES	YES	YES
Germany	Friedrichshafen	**FDH**	NO	YES	YES
Germany	Leipzig-Halle	**LEJ**	NO	YES	YES
Germany	Lübeck	**LBC**	NO	YES	YES
Greece	Athens	**ATH**	NO	NO	YES
Ireland	Kerry	**KIR**	NO	NO	YES
Italy	Palermo	**PMO**	NO	NO	YES
Italy	Pisa	**PSA**	NO	NO	YES
Italy	Rome	**FCO**	NO	NO	YES
Italy	Turin	**TRN**	NO	NO	YES
Lithuania	Vilnius	**VNO**	NO	YES	YES
Netherlands	Amsterdam	**AMS**	YES	YES	YES
Norway	Oslo	**OSL**	NO	YES	YES
Norway	Trondheim	**TRD**	NO	YES	YES
Poland	Gdańsk	**GDN**	NO	NO	YES
Poland	Kraków	**KRK**	NO	NO	YES
Poland	Szczecin	**SZZ**	NO	NO	YES
Poland	Warsaw	**WAW**	NO	NO	YES
Spain	Barcelona	**BCN**	NO	NO	YES
Spain	Málaga	**AGP**	NO	NO	YES
Sweden	Stockholm	**ARN**	NO	YES	YES
Switzerland	Geneva	**GVA**	NO	YES	YES
Switzerland	Zürich	**ZRH**	NO	NO	YES
United Kingdom	Belfast	**BHD**	NO	YES	YES
United Kingdom	Birmingham	**BHX**	NO	YES	YES
United Kingdom	Glasgow	**GLA**	NO	NO	YES
United Kingdom	London	**LHR**	NO	NO	YES
United Kingdom	London	**LGW**	NO	NO	YES
United Kingdom	London	**STN**	NO	NO	YES
United Kingdom	London	**SEN**	NO	NO	YES
United Kingdom	Manchester	**MAN**	NO	YES	YES
United Kingdom	Southampton	**SOU**	NO	YES	YES

Opening up to competition, combined with better integration of distribution, could encourage the emergence of multimodal mobility operators. In Spain ILSA (Intermodalidad de Levante SA), a joint venture Trenitalia - Air Nostrum, was awarded one of the three capacity framework contracts offered as part of the opening to competition of high-speed lines.

2.1.6. Digitalisation, Automation & Technology

2.1.6.1. Introduction

Information technology and automation have long been a part of the aviation industry, helping to facilitate operational and commercial processes. **With the rise of the internet, consumers became able to compare flight availabilities and prices in an instant, leading to more transparency and changing customer behaviour.** More recently, with the use of mobile devices, customers have continuously been connected and able to engage with airlines and other travel stakeholders prior and throughout their journey. Airlines and airports alike have started to re-think their customer relations and the service they provide in order to increase customer ownership and maximize revenue opportunities.

Nowadays (before COVID crisis), airlines and airports spend an amount of 5-6% of their annual revenues on information technology[202]. Their ultimate goal is to enhance the travel experience for passengers and generating new revenue opportunities while reducing the operational costs in all aspects of the value chain. In order to deliver these goals, digital technology and automation needs to be put in place to enable the exchange of information between company departments, systems and stakeholders. For this goal to be achievable, an adequate integration of operational and commercial processes, IT systems and data is required. This in turn becomes a holistic task that requires strategic focus, organisational adjustments and adequate capital investment in IT and data systems.

Information presented in this section refers in most cases to airlines and airports globally. The data may therefore not accurately reflect the situation in the EU. However, it is suggested that the information serves as a good indicator of the state of the deployment of information technology and the use of automation in the EU aviation sector.

2.1.6.2. Airlines

Conclusion 37 – Digital transformation of airlines

Airlines are investing an ever-increasing share of revenues in IT technology. Digital transformation leads to improved passenger experience and cost-effectiveness. A solid organisational structure is indispensable for quick adaptation to new technologies.

: Digital transformation leads to improved passenger experience and satisfaction.

: Automation and digitalisation could lead to the redundancy of particular jobs.

Conclusion 38 – Automation is the future driver of enhanced airport economics

Digitalisation of airports is not considered as a step-by-step plan but a comprehensive business strategy that works towards the achievement of the financial and operational objectives set. Automation of airport facilities results in a capacity increase, enabling to achieve the most optimal airport economics.

: **The digital transformation of airports ensures that passengers enjoy optimal and enhanced airport facilities, thereby increasing customer satisfaction.**

: Automation of airport facilities could result in job losses, for example in the security process.

In the years between 2016 and 2019, airlines' total IT spend as share of revenue has grown by more than 60%, now reaching 5.2% of revenue among airlines worldwide[206]. This figure reflects the increasing priority of investing in information technology and automation, with priorities related to the implementation of cloud services, cyber security, business intelligence, mobile passenger applications and data centres. The investment will enable airlines to harvest business intelligence to provide improve passenger and operational processes, become more cost-effective, enable upsell of their product as well as cross-selling to other service providers at the airport and within the travel value chain.

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[202] *SITA 2019 Air Transport IT Insights*

Modernisation of IT systems

For airlines to maximise the benefits of digital technology it is critical that an agile organisational structure is put in place that allows for the rapid adoption of new customer facing technologies, and the implementation and integration of operational systems (which is usually a more cumbersome process).

According to Accenture[203] putting in place a suitable IT architecture is for 59% of airlines the first priority for their transformation into "a digital airline". In practice, digital transformation is often complicated by legacy technology investment, comprised of comprehensive IT ecosystems that are extremely costly and complicated to replace. Increasingly, the digital landscape of airlines combines relatively standardised off-the-shelf IT suites for the back-office with tailored customer facing applications, aimed at delivering unique airline value propositions to the market quickly.

The digital transformation of airports encompasses their entire scope of activities and must be viewed as a comprehensive business strategy to enable airports to reach their financial and operational objectives, by leveraging innovations in digital technologies. It is a tool to optimise an airport's economics by increasing the capacity of existing facilities, reducing operational expenditures and boosting revenues. All of which should be closely linked with critical business objectives and strategic intent. The assessment is not an additional step or task for airports but rather a bringing together of all key airport plans (i.e., Strategic, Security, Safety, Operations, Financial, IT, Master, Marketing), and determining where and how technology can help to achieve objectives and goals.

2.1.6.2.1. Products & Services

Conclusion 39 – Innovative technologies ensure better customer focus

The implementation of self-services in airports is applied by airlines worldwide. New technologies include an improved baggage tracking system and real-time information allowing airlines to stay in touch with passengers, resulting in increased customer satisfaction. Biometric systems introduce a new form of passenger ID management through facial recognition.

: Introducing new technologies will provide an enhanced travel experience where consumers are in a constant dialogue with the airline.

: The implementation of self-services at airports will, on the one hand, lead to job losses in certain departments but, on the other hand, create new job opportunities in other IT related fields.

Self-services

Over recent years the deployment of self-services at airports and web-check in has become wide-spread, with 90% of airlines worldwide in 2018 offering web-check in, 74% offering to print bag tags at the airport; more than half of airline offering unassisted bag-drop facilities; and 23% using self-boarding facilities[206].

Following IATA Resolution 753[204], airlines have started to integrate RFID technology into bag tags in order to enable the tracking of items at four stages of the baggage journey, i.e. passenger handover to airline; loading to the aircraft; deliver to the transfer area; return to the passenger. Airlines need to share the tracking information with interline journey partners where applicable. Currently, 59% of baggage[208] can be tracked by staff in real time, with the share of airline networks covered by this capability increasing.

As a result of the implementation of these initiatives, airlines were able to measure an improvement in their average passenger satisfaction rating. 60% of those airlines confirm an improved passenger satisfaction rate of up to 20% in 2018 compared to previous year. Of those measuring their average processing speed, 45% saw an increase in performance in 2018 compared to the previous year[206].

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[203] *Accenture 2016, Make Your Digital Connection: From Digital Strategy to Airline Strategy*

[204] *IATA Resolution 753: https://www.iata.org/en/programs/ops-infra/baggage/baggage-tracking/*

Passenger identity management

Recently, airlines and airports around the world have started to launch single-token biometric systems to identify passengers through facial recognition at different points throughout their journey, including check-in, bag-drop, immigration, retail and boarding.

For example, 7% of airlines worldwide have deployed self-boarding gates using only biometric data and a further 33% planning to implement them by the end of 2022[206].

Real-time information

The use of real-time analytics paired with mobile self-service and other digital solutions can empower airlines to be in continuous dialogue with their customers, making for an experience that is relevant and highly personal throughout the entire passenger travel. Being in possession of customer and frequent flyer information and specific travel data, airlines can create offers in real-time and personalise the customer journey[205]. By engaging with other travel stakeholders such as airports, destination services and with their passengers' social media preferences, airlines can create an even richer and more tailored offering.

For example, airlines can determine which cross and upsell opportunities and operational information is relevant at certain points of the customer's journey to enhance the travel experience, while generating additional revenue. Also, in the case of a delay, airlines would be able to send vouchers for food and beverage to their customers while waiting at the airport.

In 2019, the majority of airlines (54%) provide customer service issues to mobile apps and are looking to enrich customer services on mobile apps related to irregular ops (43%) and chatbots services (37%)[206].

In the framework of the Directive 2010/40/EC, which helps to accelerate and coordinate the interoperable deployment of ITS across Europe, Delegated Regulation 2017/1926 requires that transport operators from all modes (including air transport), make their static data accessible through National Access Points. Some Members States have also opted for dynamic data. Access to such data should enable the development of real-time information services.

Integration of/with third-party content

Airlines can join other stakeholders in the travel ecosystem with open application programming interfaces (APIs) and other digital developments. These open platforms can also invite third-party developers to integrate airline data through APIs into their apps, for example ensuring that popular airport and travel apps can obtain valid and up-to-date travel information or can be used as wallets for reservation data or boarding passes, where an individual airline would otherwise not have this reach. Open platforms can, however, present challenges from the perspective of customer ownership and data security, if not adequately managed.

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[205] *Accenture 2016, Make Your Digital Connection: From Digital Strategy to Airline Strategy; Amadeus 2017, Embracing Airline Digital Transformation*

2.1.6.2.2. Travel distribution

Conclusion 40 – Individual customisation as the new revenue management strategy?
Online booking systems allow airfares comparison. As a result, rapid adaptation to customer behaviour becomes more essential. In order to optimally respond to this, a trend has arisen from customer segmentation to individual customisation. Legacy carriers changed their pricing strategy, which resulted in unbundling services causing alignment of fares and making other factors more decisive. A gradual shift from GDS to NDC will lead to more customer interface.

: Online booking systems provide transparency that allows consumers to compare prices and obtain buyer power over airlines.

In the last decade, the growth of e-commerce, mobile channels and corporate booking tools have had a profound effect on the industry. Rather than relying on travel professionals to find and compare airfares and schedules, leisure and business travellers alike are now able to utilise internet-based booking tools and compare airfares and availabilities. As customer behaviour evolves, airlines need to continuously and rapidly adapt their customer engagement. As a result, airlines have started to look beyond customer segmentation to understand what individual customers value when making a booking.

Price appears to be one of the main decisive factors for the choice of flight, even in the traditionally less price sensitive business travel market. **The prevalence of the price criteria has led traditional full-service carriers to largely align their product offering and presentation with that of budget carriers by unbundling services such as catering, baggage and seat selection.** Arguably, this technology-enabled transparency and price competition leads to an alignment of fares, whereby price differences between competitors become marginal and other factors, such as schedules, onboard service and overall customer experience become more decisive again. For airlines competing in the corporate travel market, their ability to engage with key corporate customers and travel management companies and through suitable distribution channels remains part of their value proposition and differentiator.

Over the past twenty years, the landscape of airline distribution has become more diversified than ever. Different channels coexist, including:

- airline direct channels through public airline websites;
- airline direct channels with corporate customers;
- online travel agencies;
- brick-and-mortar travel agencies who often have online channels as well;
- travel management companies for the corporate travel market.

Airlines may connect to the travel agency channel through Global Distribution Systems (GDS) which generally gives them a wide reach, at the same time allowing agencies to access a wide range of airline content. **In an effort to reduce their cost in GDS fees, some airlines have chosen to invest in more customised direct interfaces with individual agencies, or they decided to apply a surcharge to agency bookings. In this context, in 2012 IATA introduced the New Distribution Capability (NDC) which has gained some traction in recent years.**

Before this background, the European Commission states in its review of the Code of Conducts for Computerised Reservation Systems (CRS, more often referred to as GDS) in 2019 "while CRSs continue to be an important player in the distribution of airline tickets, their share of bookings by volume has further decreased since the 2007 impact assessment".[206]

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[206] *European Commission 2020, Commission staff working document evaluation of the Regulation 80/2009 of the European Parliament and the Council of 14 January 2009 on a Code of Conduct for computerised reservation systems*

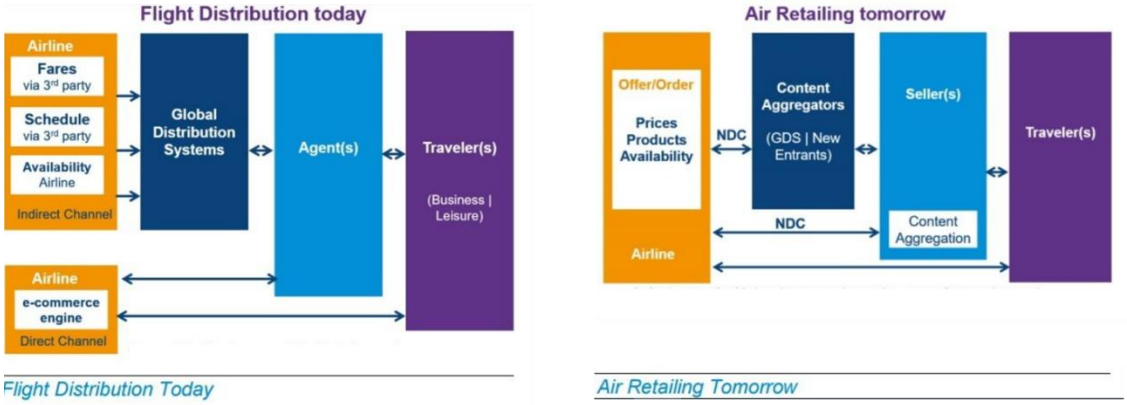

FIGURE 53. TRAVEL DISTRIBUTION LANDSCAPE TODAY AND WITH NDC (© ALTEXSOFT)

Case Study: New Distribution Capabilities (NDC)

Unlike most other industries, airlines only have a limited ability to adapt to their sales model in accordance with the preference of consumers as they have become accustomed to the e-commerce world. Most airlines rely for a large share of their ticket sales on the service of intermediaries, such as GDS, brick and mortar or online travel agencies and travel management companies. As low-cost airlines have built their business model on the appeal of cheap flight tickets to a mainly leisure drive and strong brand identities, many full-service carriers have been able to successfully replicate the direct sales business model within the leisure market segment.

However, a large segment of travel buyers, particularly corporate travellers, still rely on the services of intermediaries such as travel agencies and travel management companies, which traditionally use GDS channels. In this context, it is difficult for airlines to push tailored content, dynamically adjust their pricing or to bring new products to the market.

In order to strengthen customer ownership and pursue ancillary revenues more effectively, as well as to save GDS related costs, IATA therefore launched the New Distribution Capability (NDC) initiative in 2012. This XML-based approach allows airlines to circumvent the traditional GDS channels in favour of providing their content to travel agencies and corporates directly.

The adoption of the new channel has picked up in recent years, with 65 airlines having implemented NDC in 2018. NDC is likely to be more relevant for large airlines and in those markets where they are prevalent, i.e. their home markets. A limitation to the more widespread adoption seems to be the lack of a standard messaging interface, meaning that travel agencies and corporates will need to implement NDC with each airline (or other content provider) individually.

GDS and other travel technology providers are therefore engaging with the industry in order to push NDC standards, meaning that the widespread implementation of NDC will come through the GDS channel. More than being a disruptor of market dynamics, arguably NDC may become an alternative format for the fast exchange of rich and more relevant airline content to the market.

2.1.6.2.3. Disruption management

Conclusion 41 – How communication and mutual cooperation benefit aviation

Data exchange between parties ensures transparency and improved airport operations. Close cooperation with all stakeholders in the industry results in elimination of interruptions and improved customer experience.

: Data exchange ensures close cooperation, minimising interruptions and increasing customer satisfaction.

Digital technology creates the opportunity not only to develop customer-facing processes, but also to greatly enhance operations, allowing for a reduction in operational costs, mitigating the risk and impact of disruptions, and therefore ultimately improving the customer experience.

By exchanging information, comparing data and real-time interactions and analytics, an airline organisation can work together to resolve disruptions more effectively. Information can be shared among flight operations, ground operations, maintenance, marketing, sales, customer service and loyalty to work collaboratively towards mitigating challenges. This coordination can also involve the airport operations control centre in order to overcome disruptions at the airport and ground handling.

2.1.6.2.4. Emerging technologies

Conclusion 42 – Reflection on future digitalisation

Artificial Intelligence remains the main focus for airlines, followed by Blockchain that is on the rise. Limited interest in other emerging technologies.

: Future research and development of new IT technologies exposes new job opportunities in aviation.

Airlines must take a comprehensive view on information technology and automation, leveraging the organisational ecosystem and integrating business processes with technology. Among the emerging technologies identified by airlines as priorities, artificial intelligence (AI) continues to be a focal point for airline investment, with 44% of airlines having a major program (up from 32%) and a further 45% are running a pilot. Blockchain is also on the rise with 72% of airlines investing (compared to 69% in 2018), 15% in a major program and 57% in a pilot.

Investment in other emerging technologies is less common. The majority of airlines have a major program and R&D in mixed reality (7% major, 48% pilot), autonomous machines (14% major, 40% pilot) and in wearable tech. Overall 69% of airlines have a Data Lake strategy implemented or currently being developed. [207]

[207] *SITA 2019, Air Transport IT Insights*

2.1.6.3. Digitalisation & automation airports

Conclusion 43 – The increasing share of digitalisation in airport processes

Investment in airport IT infrastructure integration has doubled between 2016 and 2019. New technologies have been implemented or improved in the security processes and self-service devices. Common Use Technology ensures better operational efficiency and direct engagement with travellers. Data gathering and business intelligence programs are on the rise. Post-COVID adaptation of airlines and airports could increase digitalisation.

: Better operational efficiency of airport processes benefits consumers in terms of customer experience and satisfaction.

: Further development of business intelligence programs will result in employment in research and development areas.

In recent years, airports have invested significantly in the modernisation and integration of their IT infrastructure. This includes the implementation of virtual airport operational control centres (AOCCs) and airport operational data bases (AODB) where the digital systems of all airport stakeholders converge, cost efficient cloud-based solutions, the tracking and optimisation of ground handling and other resources and integration with third-party stakeholders, including air traffic management and government agencies.

Some airports have deployed biometric ID scanners, full-body scanners and 3D-baggage scanners at security check points; self-service devices which can fully automate the airport experience and minimise the human interaction. Common Use Technology (e.g. CUTE, CUPPS, and CUSS) is a facilitating approach in that context. It offers a range of benefits by replacing airline or ground handler specific dedicated passenger processing facilities with shared workstations and printers in each passenger processing points.

As a result, airports are in the process of becoming operationally more efficient and while seeking to exploit a wealth of data and passenger dwell time for commercial purposes. This includes direct engagement with travellers before, during and after the journey, tailored retail experiences enabled by mobile devices and fast internet, and new services such as pay-as-you-go airport lounges, self-connecting or sleeping cubes.

The vast majority of airports have major business intelligence programs in place or are planning to implement in the next two years. Worldwide, 85% of airports investing in biometric identify management, 77% in interactive navigation systems, and 29% investing in artificial intelligence.[208]

The airport industry often is a late adopter of digital technology, likely due to its often monopolistic nature. In addition, technology deployment can be difficult, given the multitude of stakeholders at an airport. However, over the last decade, airports have begun to invest massively in technology. Worldwide, these investments doubled between 2016 and 2019, increasing from USD 7 billion to USD 11.8 billion according to the airport IT provider SITA.

The use of digital technologies can generate important benefits in terms of operational efficiency, customer satisfaction, security and environmental impact while at the same time generating huge amounts of data that can be analysed for future benefit. It impacts the nature of airport processes, leading to automation and redundancy of workforce in some areas, and creating new services and employment opportunities elsewhere.

[208] *SITA 2019 Air Transport IT Insights*

2.1.6.3.1. Business intelligence

Conclusion 44 – The potential of business intelligence implementation at the airport

Business intelligence implies the collection and usage of data. In the future, this technology will be implemented in various domains such as passenger flow management and will result in optimised operational airport processes.

: The use of business intelligence will ensure smoother airport processes which will increase customer satisfaction.

: By collecting data, the transparency between the various departments and their employees is optimised, which benefits interconnectedness and communication.

Business intelligence and analytics refers to the use of data to enhance the operational processes at airports. The majority of airports have implemented or have plans for the implementation of business intelligence[209], with priorities being in the following order:

- Passenger processing and flow management;
- flight operations (for example flight information or prediction);
- baggage processing;
- asset management (check-in assets, aircraft stands, gates);
- airport collaborative decision making; and
- aircraft turnaround.

[209] *SITA 2019 Air Transport IT Insights*

2.1.6.3.2. Passenger flow management

Conclusion 45 – The importance of passenger flow management

Improved passenger flow in airport terminals is becoming essential in view of the predicted growth of aviation. Time monitoring and notifications to passengers ensure a high level of customer satisfaction and a more optimal use of space in the terminal. The positive effect of investments made in passenger flow management has been proven.

: Innovative technologies ensure optimal use of space in the airport, increasing customer satisfaction.

: Optimal use of space in the terminal ensures that processes run more smoothly, which in turn means that employees can work in a more pleasant and less stressful environment.

Passenger flow management is a strategy by which airports aim to enhance the flow of passengers through the terminal. About half of airports plan to implement waiting time monitoring and notifications to passengers' mobile phones or on screens. As a result, the passenger experience can be improved and limited terminal resources and waiting areas can be used more effectively.

Airports confirm positive performance results from their passenger flow monitoring investment in 2018[210]. 74% of airports confirmed a passenger satisfaction increase in 2018 and up to a 20% performance increase (for 63% of airports). 44% of airports measuring 'average processing speed' said the performance had increased up to 20% and 14% confirmed a performance increase greater than 20%.

2.1.6.3.3. Self-service

Conclusion 46 – Self-service devices as an integral part of the airport sector

The implementation of self-service devices at airports is increasing, resulting in a further reduction of operational costs. Self-service equipment is a requirement of LCC so as to be able to offer low airfares.

: The use of self-services ensures more independence of passengers but creates more stressful situations for some customers due to the lack of contact persons at the airport.

: The use of self-services can jeopardize certain jobs, such as those of check-in agents.

Self-service solutions are now very mature, and their deployment has peaked in some cases due to the massive introduction of online and mobile check-in solutions. As of 2019, 81% of airports are using self-check in kiosks and more than half of airports offer bag-tag print kiosks and assisted self-bag drop.

The increasing use of self-service solutions does not only help airports to reduce their operating costs, but it is also a requirement from low-cost airlines in order to sustainably operate their services and being able to offer low fares.

FIGURE 54. EVOLUTION OF AIRPORTS SELF-SERVICE INVESTMENT BREAKDOWN BETWEEN 2016 AND 2019 (SOURCE: SITA)

[210] *SITA 2019 Air Transport IT Insights*

2.1.6.3.4. Mobile technology to facilitate customer experience

Conclusion 47 – Will mobile technology innovations pave the way to better customer satisfaction?

The use of mobile technology streamlines operational processes and maximises revenues. Passengers expect an individual experience and digital engagement. Location based information will uncover new opportunities to meet these expectations. In the future, the importance of smart airport buildings will increase as higher customer satisfaction leads to a larger share of non-aeronautical revenues.

: Mobile technology meets the need for individual experience and digital involvement of passengers, resulting in increased customer satisfaction.

: The rise of smart airport buildings in the future will enable employees to meet the need for digital engagement of customers and operators to obtain a larger share of non-aeronautical revenues.

In the context of mobile technology, through fast and contactless internet and payment, and the processing of biometric information, airports seek to streamline passenger and operational processes[211] and maximise commercial revenues. For example, recent trends towards free and fast internet enable processes and commercial opportunities that are based on the use of personal mobile devices, whereby relevant, location-based information is pushed to passengers. This may enhance the travel experience and create opportunities for the airport and other stakeholders of the airport ecosystem, such as retail and hospitality, for example offering discount vouchers to shops, restaurants or for lounge access. Location information, passenger contacts, apps and other data can be used to market these services in the most effective manner.

Consumers are now expecting digital engagement and personalized experiences in airports. Airports like Schiphol (Netherlands) have embraced digital initiatives that include smart buildings and smart gate planning, as well as omnichannel 24/7 traveller assistance and information, and even food delivery services to the gate.

According to a study from the Airport Council International (ACI), a 1% increase in passenger satisfaction generates an average growth of 1.5% for an airport's non-aeronautical revenue.

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[211] *Eg Use of personal mobile for check-in, navigation, boarding; creating token with biometric information that accompanies the passenger throughout the airport; automated passport control, including touchless; payment; RF-bagtag (what is that really called?*

2.1.6.3.5. Cyber security

Conclusion 48 – Cyber security: The priority of the future

Safeguarding sensitive information that does not concern unauthorised parties is becoming a priority in the airport sector. Currently, the largest share of security-related costs for an airport is allocated to the staff performing these activities. In the future, more electronic equipment such as CCTV and sensors will be needed to guarantee security in and around the airport. Consequently, the risk of cyber-attacks will increase.

: The use of electronic equipment such as CCTV and sensors will allow passengers' safety to be optimised, leading to safer travel.

: Ensuring security through sensors and computers can lead to job losses, but the increasing risk of cyber-attacks will create new opportunities in other security related areas.

Data is becoming a key asset for an airport, steering its investments, capacity planning, operations and many other processes. If data is manipulated so that incorrect information is distilled, decisions may be influenced negatively. In addition, cyber-threat resilience ensures that sensitive information which is stored, such as biometrics, personal details and in-depth airline performances, is kept safe and will not leak to unauthorised parties. Ensuring that data and the systems producing it are safe is one of the basic hygiene tasks airports must accomplish.

Case Study: digital airport

The ACI World Airport IT Standing Committee (WAITSC) believes that the best digital airport has an infrastructure in place on which to build all of its digital capabilities. It has embraced the concept of open data and shares data where this adds value and offers the airport's passengers a personal experience in their journeys.

Additionally, the best digital airport utilizes the power of digital touchpoints enabled with biometrics to make the passenger journey more seamless. Digital airports bring relevant data together for all stakeholders in a virtual control room and generate data through the IoT. At the same time, the best digital airport actively searches for and looks to apply innovation, to generate further value for its clients and monetize technological solutions in new

Physical security and cybersecurity in a congested environment with millions of connected objects and passengers is an increasing priority.[212]

According to the ACI Europe[213], an average 20% of total airport operating costs are related to security, with a large percentage of airport staff working on security related activities.

Security includes physical security and the related need to have critical communication infrastructure in place. An increasing number of Closed-Circuit Television (CCTV) or other security equipment and sensors is needed to ensure passenger safety. Along with security, the growing number of connected devices and increasing digitization makes cybersecurity increasingly important. Integrating the airports' systems within the global ecosystem, giving third parties access to the airport's critical systems, associated to the fact that operators are willing to migrate to the cloud in the next five to ten years, will dramatically increase the risk of cyberattacks.

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[212] *Accenture 2016, Make Your Digital Connection: From Digital Strategy to Airline Strategy*

[213] *Airport Council International 2017, Airport Digital Transformation – Best Practice*

2.1.6.3.6. New technologies

Note: COVID crisis could further impact use of new technologies by airlines and airports.

Conclusion 49 – Electrification of operations as the major technology trend

The most important emerging technology trend is the electrification of airport operations. London Heathrow is the frontrunner among European airports. Future trends include the implementation of the 5G network to replace 4G.

: Further electrification of aviation processes will help improve the air quality around the airport which will be beneficial to local residents.

: Emerging technology trends offer opportunities to meet the changing demands of consumers and improve their airport experience.

: Innovative technology trends will better support employees in the performance of their tasks, electrification provides a greener working environment.

Airports are becoming the testbeds for new technologies, including passenger identification systems, sensor and barcode reading devices, automated border control systems, biometric systems, mobile apps, sensors, and connected cameras. A major technology trend is also electrification of apron operations, with Electric Vehicles (EVs) vital to reducing the carbon footprint of airports. London's Heathrow Airport, for instance, has invested £5.6 million in EV charging infrastructure throughout the airport, and now operates 75 EVs in its fleet of ground vehicles and is on track to replace all of its small vans and cars by 2020.

In recent years, many airport operational stakeholders have engaged in the adoption of 4G in some areas to replace existing TETRA or P25 networks, allowing the use of instant messaging to communicate among staff. The trend and capability of applications is likely to accelerate with the widespread deployment of 5G networks in the coming years.

2.1.6.4. What does it mean for each stakeholder group?

2.1.6.4.1. Consumer

Conclusion 50 – How digitalisation benefits consumers

Digitalisation allows consumers to compare all transport-related information such as fares and schedules, creating transparency and increasing the level of competition between airlines. Automation reduces operational costs for airports and airlines. In general, digital implementation has a positive effect on passenger experience and satisfaction, partly due to reduced processing times at the airport.

 **: Digitalisation ensures better transparency for the consumer with regard to fares, which results in buyer power and flight tickets at the most optimal price.**

 **: Digital implementation at the airport ensures that the airport processes run more smoothly and creates a working environment in which employees are better supported in the performance of their duties.**

The benefits of information technology and automation for consumers are manifold, involving choice, affordability of travel and convenience.

Choice and affordability

Facilitated by access to the internet, flight search engines and the information available on a variety of websites, consumers are able to access and compare information concerning the available means of transport, flight schedules and routes, fares, service offerings, emissions data and other. This transparency gives consumers an unprecedented choice while leading to competition among airlines and airports and ultimately lowering travel costs. Arguably, information technology and the use of internet channels has been one of the key enablers of today's low-fares, unbundled services airline business models that are now prevalent among low cost and network airlines alike. Also, the now widespread use of self-service facilities and mobile applications have significantly contributed to a reduction in airport and airline operating cost per passenger and resulting lower air fares.

Convenience

In recent years, airlines and airports alike have made great progress in rolling out technologies to communicate with passengers in real time and at the right location to provide mobile services, travel information and commercial offers. Baggage tracking in particular is being mandated by IATA, whereas other solutions enable passenger flow management or more effective disruption resolution. Research by IATA has shown that as a result processing times at airports could be reduced and the passenger experience improved.

It can therefore be concluded that the impact that information technology and automation have on the consumer are generally positive.

2.1.6.4.2. Employment

Conclusion 51 – The double effect of digitalisation on employment

The impact of digitalisation and automation on employment is twofold: automation of airport processes leads to a reduction of personnel on the one hand, but creates new job positions that need to be filled on the other. The use of business intelligence and mobile technology results in the creation of opportunities for new services and more customer-oriented employment.

: Digitalisation and automation reduces the number of direct job opportunities in the airport for local inhabitants.

: Business intelligence and mobile technology provide the opportunity to offer new services and more customer focus.

: Automation of airport processes leads to the redundancy of certain jobs on the one hand and to the creation of new positions that need to be filled on the other hand.

The impact that information technology and automation on the employment at airline and airports is twofold, whereby on the one hand, digital technology and automation reduces the need for human workforces in customer facing activities such as check-in, transfer desks, information and baggage handling. As a result of the proliferation of self-service, many of these activities can be performed without the intervention of airport and ground handling staff. Likewise, airline and airport back-office and maintenance activities benefit from automation and the usage of information technology, enabling staff to become more productive and perform traditional back-office and maintenance tasks with less human involvement.

Focus

The airport ecosystem employs a multitude of staff from various stakeholders. Airline staff and ground handlers represent a large proportion of staff that may be affected by the implementation of self-service facilities and automation.

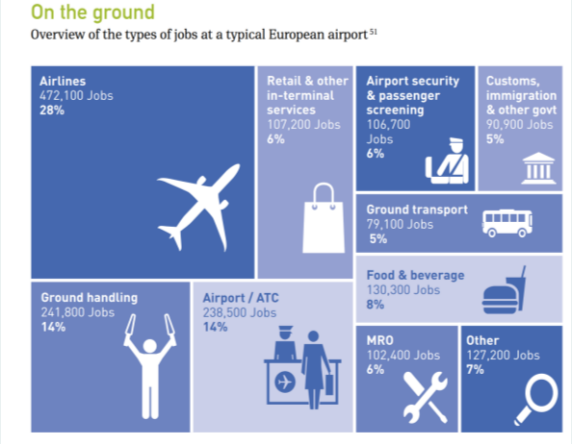

FIGURE 55. ACI EUROPE AND INTERVISTAS, ECONOMIC IMPACT OF EUROPEAN AIRPORTS, 2015

IATA[214] points out that most human resources professionals in the aviation industry expect that the greater use of customer self-service options on passenger mobile phones as well as in-airport self-service options will reduce demand for customer service workforces in particular. However, it also argues that as the industry keeps growing and the dependence on self-service and automation increases, the nature of employment evolves, leading to more customer-focussed or completely new job descriptions. As an example, it explains that Twitter and other social media have become the most prevalent channel of customer interaction used by airlines, whereby in this instance the job description has shifted from airport agent at the airline information desk towards moderating and managing social media channels.

Furthermore, thanks to mobile technology and the use of business intelligence, airlines and airports have become significantly more effective in identifying additional service opportunities and converting them into new revenue sources. As a result, information technology generates opportunities for new services and customer-facing employment in the airport environment, including in retail and hospitality.

2.1.6.4.3. Citizen

Conclusion 52 – Social impact of digitalisation from a broader perspective

Information technology allows a reduction of operational costs, especially in the airport sector. Innovative projects such as the use of biometrics make smaller airports more financially stable. Digitalisation in the aviation sector results in cyber security becoming the main area of investment in the future. Risk mitigation is essential both at government and airport level.

: Innovative technologies provide a safer travel environment for consumers, a better airport experience and higher customer satisfaction.

: Information technology ensures a reduction in operational costs at the airport, smoother airport processes and better support for employees in the performance of their duties.

Further to the benefits that technology provides to consumers and the shift it causes to the nature of employment at airports, the wider societal impact of information technology and automation in aviation needs to be understood.

Information technology and automation also facilitates the reduction of operating costs, especially in airport services, therefore helping to enable low-cost point-to-point connections at secondary and regional airport. As biometrics in security and immigration or remote towers are being rolled out at smaller airports, related costs could be reduced, possibly making peripheral airports operationally and financially more sustainable.

The roll-out of interconnected systems and devices amongst stakeholders in the airport environment however exposes aviation to cyber-security risks. As a result, cyber-security is the single most important IT investment priority among airports[215]. These risks need to be understood and mitigated, both, at government level by safeguarding strategic infrastructures and at the level of individual airport and aviation stakeholders.

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[214] *IATA Aviation Human Resources Report 2018: 68% of HR professionals expect that the greater use of customer self-service options on passenger mobile phones will reduce demand for customer service workforces. 59% say the same for in-airport self-service options*

[215] *SITA 2019 Air Transport IT Insights: 95% of airports plan major investment programs in the area of cybersecurity by 2022*

2.2. Developments up to 2025

This report draws on a several traffic forecasts produced by international and industry organisations. Each of these forecasts takes into consideration a combination of geopolitical, societal and macro-economic factors that influence industry-specific developments such as demand, operating costs, supply, fares, competition and business strategies. The forecasts present traffic developments from a different angles by considering passengers numbers, revenue passenger (or ton) kilometres (a measure of output), number of flights movements or ATM service units, number of aircraft units sold, etc. The following sections briefly present each of the published traffic forecasts which subsequently will be discussed in the context of this report.

2.2.1. Analysis of forecasts pre-COVID-19

2.2.1.1. ICAO long-term traffic forecast

The International Civil Aviation Organization (ICAO) is the United Nations entity responsible for air transport. As such, ICAO is one of the best-known providers of industry analysis, guidance and international regulation. ICAO publishes a long-term aviation forecast with a horizon of 30 years which considers the output of passenger and cargo airlines.

According to the latest ICAO Long-term Traffic Forecasts[216], global passenger traffic measured in Revenue Passenger-Kilometres (RPK) will grow at a compounded annual growth rate (CAGR) of 4.1 per cent annually from 2015 to 2025. Growth is expected to be strongest in parts of Asia, with more moderate rates in Europe. Intra-European and European domestic traffic is forecast to augment at 2.4 per cent per year in this period. Higher increases are foreseen for intercontinental traffic flows to Asia, the Americas, Middle-East and Africa, ranging between 3.6 and 4.1 per cent.

Summary of Passenger Traffic Forecasts by Route Group Passenger traffic results in terms of RPKs			
Region / Region-pair	CAGR 2015-2025	CAGR 2015-2035	CAGR 2015-2045
Europe - Middle East	3.8%	4.2%	4.0%
Europe - North Africa	3.9%	4.3%	4.1%
Europe - North America	2.5%	2.8%	2.6%
Europe - North Asia	2.1%	2.5%	2.4%
Europe - Pacific South East Asia	4.1%	4.5%	4.4%
Europe - South America	3.6%	4.2%	4.1%
Europe - Sub Saharan Africa	2.5%	2.9%	2.8%
Europe Domestic	2.4%	2.7%	2.6%
Intra Europe	2.4%	2.7%	2.6%

TABLE 31. ICAO PASSENGER TRAFFIC FORECASTS

[216] *ICAO Long-Term Traffic Forecasts, Passenger and Cargo (April 2018)*

ICAO are also taking a more long-term view on the time horizon until 2045 where air traffic in Europe is expected to grow at a marginally lower rate, as can be observed in Figure 53.

Growth in cargo traffic (measured in freight ton-kilometres) for airlines registered in Europe is forecast to increase at 2.9 per cent annually between 2015 and 2025. This compares to 4.1 per cent growth globally.

Summary of Total Cargo Traffic Forecast by Region of Airline Registration Passenger traffic results in terms of FTKs			
Region	CAGR 2015-2025	CAGR 2015-2035	CAGR 2015-2045
Europe	2.9%	2.7%	2.5%
World	4.1%	3.9%	3.6%

TABLE 32. ICAO CARGO TRAFFIC FORECASTS

2.2.1.2. IATA 20-year passenger traffic forecast

The International Air Transport Association (IATA) is the main trade association for airlines, representing about 290 airline members. It provides guidance and analysis to its members and other interested parties and is a key contributor to formulating industry policies and coordinating initiatives and common standards for the global airline and aviation industry. IATA is known to provide detailed analysis of airline economics and traffic monitoring on a monthly basis, as well as yearly economic outlooks and long-term traffic forecasts.

In the 2017 release of its 20-year passenger traffic forecast[217], IATA estimates passenger numbers to increase at an annual rate of 3.7 per cent CAGR globally, leading to a doubling of origin-destination passenger numbers between 2017 and 2037. The growth rate for passenger traffic to, from and within Europe is estimated to be 2.0% as a result of changing demographics, low GDP growth rates and an only moderate expected increase in living standards.

[217] *IATA 20-year passenger forecast (2017)*

2.2.1.3. Airbus global market forecast

Major airframe manufacturers are known to regularly publish long-term market forecasts which provide an estimate of future passenger and cargo traffic demand and corresponding fleet requirements. The latest edition available from Airbus is the Airbus Global Market Forecast 2019[218] whereby global passenger traffic in RPK is expected to increase by 4.4 per cent globally (CAGR) over the next twenty years, with a lower growth rate of 3.3 per cent for Europe.

More granular data are available for the period 2018 to 2028, shown in Figure 54. RPK within Western Europe are expected to grow by 2.4 per cent annually, 2.7 % between Central and Western Europe, and traffic between Western and Central Europe by 6.9 per cent annually.

Passenger traffic flow	2018-2028 CAGR	2018-2038 CAGR
ASEAN - Central Europe	3.0%	2.9%
ASEAN - Western Europe	2.4%	2.8%
Asia Developed - Western Europe	2.6%	2.8%
Asia Emerging (non-ASEAN) - Western Europe	4.2%	3.4%
Canada - Western Europe	2.4%	2.5%
Caribbean - Western Europe	3.4%	3.2%
Central America - Western Europe	3.1%	3.1%
Central Europe - Middle East	6.1%	5.3%
Central Europe - North Africa	3.3%	3.5%
Central Europe - PRC	5.0%	5.0%
Central Europe - Russia	4.8%	3.7%
Central Europe - Sub-Saharan Africa	0.0%	1.8%
Central Europe - USA	2.4%	2.8%
Central Europe - Central Europe	2.7%	2.4%
Central Europe - Western Europe	6.9%	5.5%
CIS - Central Europe	6.5%	4.2%
CIS - Western Europe	4.1%	3.4%
Indian Subcontinent - Western Europe	2.5%	3.1%
Middle East - Western Europe	5.7%	4.8%
North Africa - Western Europe	3.2%	3.5%
Russia - Western Europe	4.0%	3.4%
South Africa - Western Europe	1.7%	2.6%
South America - Western Europe	3.7%	3.5%
USA - Western Europe	2.5%	2.8%
Western Europe - Western Europe	2.4%	2.3%

TABLE 33. AIRBUS PASSENGER TRAFFIC FORECAST (EXCERPT)

[218] https://www.airbus.com/aircraft/market/global-market-forecast.html

Growth levels forecasted for freight for the period 2018 to 2028 range between 2.6 and 3.9 per cent for intra-European traffic.

Cargo traffic flow	2018-2028 CAGR	2018-2038 CAGR
ASEAN-Western Europe	3.0%	2.8%
Asia Developed-Central Europe	2.7%	2.5%
Asia Developed-Western Europe	1.9%	1.9%
Asia Emerging (non-ASEAN)-Western Europe	5.8%	2.7%
Canada-Central Europe	3.0%	2.7%
Canada-Western Europe	1.4%	1.5%
Caribbean-Western Europe	2.8%	2.7%
Central America-Western Europe	2.6%	2.5%
Central Europe-Central Europe	3.3%	3.0%
Central Europe-Western Europe	3.9%	3.7%
CIS-Western Europe	1.7%	1.9%
Indian Subcontinent-Western Europe	3.7%	3.9%
Middle East-Western Europe	4.4%	3.9%
North Africa-Western Europe	4.3%	4.2%
PRC-Western Europe	4.2%	3.8%
Russia-Western Europe	1.3%	1.2%
South Africa-Western Europe	4.1%	3.9%
South America-Western Europe	2.8%	2.9%
Sub-Saharan Africa-Western Europe	3.5%	3.1%
USA-Western Europe	3.3%	3.2%
Western Europe-Western Europe	2.6%	2.5%

TABLE 34. AIRBUS FREIGHT TRAFFIC FORECAST (EXCERPT)

2.2.1.4. Boeing commercial market outlook

Boeing publishes an annual 20-year Commercial Market Outlook[219], presenting anticipated fleet requirements, the market size for aircraft services, as well as passenger traffic forecasts. While the Boeing traffic forecast is largely presented in terms of absolute numbers, growth rates comparable to the ones in the Airbus forecast can be derived:

Passenger traffic flow	2018-2028 CAGR	2018-2038 CAGR
Africa--Europe	4.2%	4.1%
Central America--Europe	4.6%	3.9%
China--Europe	6.6%	5.2%
Europe--Europe	4.1%	3.6%
Europe--Middle East	4.5%	4.3%
Europe--North America	3.1%	2.9%
Europe--Northeast Asia	1.4%	1.6%
Europe--Russia & Central Asia	2.7%	2.7%
Europe--South America	4.3%	4.5%
Europe--South Asia	4.2%	4.7%
Europe--Southeast Asia	2.7%	2.8%

TABLE 35. BOEING PASSENGER TRAFFIC FORECAST (EXCERPT)

The US aircraft manufacturer expects growth rates of 4.1 per cent for intra-European traffic for the period 2018 to 2028. Intercontinental traffic flows for the North Atlantic are estimated to grow at 3.1 per cent and traffic flows into Middle east and Asia range from 1.4 per cent (North east Asia) to 6.6 per cent (China).

2.2.1.5. Embraer market outlook

The Brazilian aircraft manufacturer Embraer also releases annual market outlook, although with less detail being published. According to the report[220], the forecasted CAGR is 3.7% for Europe in the period 2019-2038.

2.2.1.6. Eurocontrol forecast

Eurocontrol, the European Organisation for the Safety of Air Navigation, monitors and forecasts for its members (41 members, including EU and non-EU States) and releases regular traffic forecasts expressed in number of flight movements and ATM service units. The latest long-term forecast available before 2020 was updated in October 2019 and considered three alternative traffic scenarios, low, baseline and high. The overall estimated grow in flight movements for Europe ranges between 0.7 and 3.1 per cent, depending on the economic growth scenario. Risks and uncertainties that were considered include economic growth in various European economies, the ramifications of Brexit, changing market dynamics and competition following the demise of several airlines in the recent past, risks from continuous trade tensions with the US, and political uncertainties.

The base scenario estimates the number of flight movements in European airspace to increase by 2% average annual growth rate (AAGR) between 2020 and 2024, with generally higher rates in Central and Eastern Europe and lower rates in the West, as shown in Figure 58.

Eurocontrol also releases traffic forecasts[221] in terms of en-route service units, a measure frequently used in the context of air traffic management and which factors in the maximum take-off weight and distance flown. The number of service units is expected to rise by 2.5 per cent AAGR, compared to the 2.0 per cent increase

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[219] https://www.boeing.com/commercial/market/commercial-market-outlook/

[220] *EMBRAER, 2018, Market Outlook 2018-2037, São José dos Campos, Embraer, Report, 48p.*

[221] *https://www.eurocontrol.int/ServiceUnits/Dashboard/EnRouteForecasts.html*

in flight movements, the reason for this being the use of larger and heavier aircraft mainly. Given that the measure of en-route service units factors in the weight (an approximation of aircraft size) and distance flown, growth trends in service units can be compared to RPK as employed by ICAO or airframers. However, unlike the other forecasts, Eurocontrol only measures service units flown in the European airspace; this means for example that strong intercontinental traffic growth would be reflected in Eurocontrol figures to a lesser extent than by the other forecasters. To the contrary, the measure of flight movements fully takes into account flights that have their origin or destination outside of Europe.

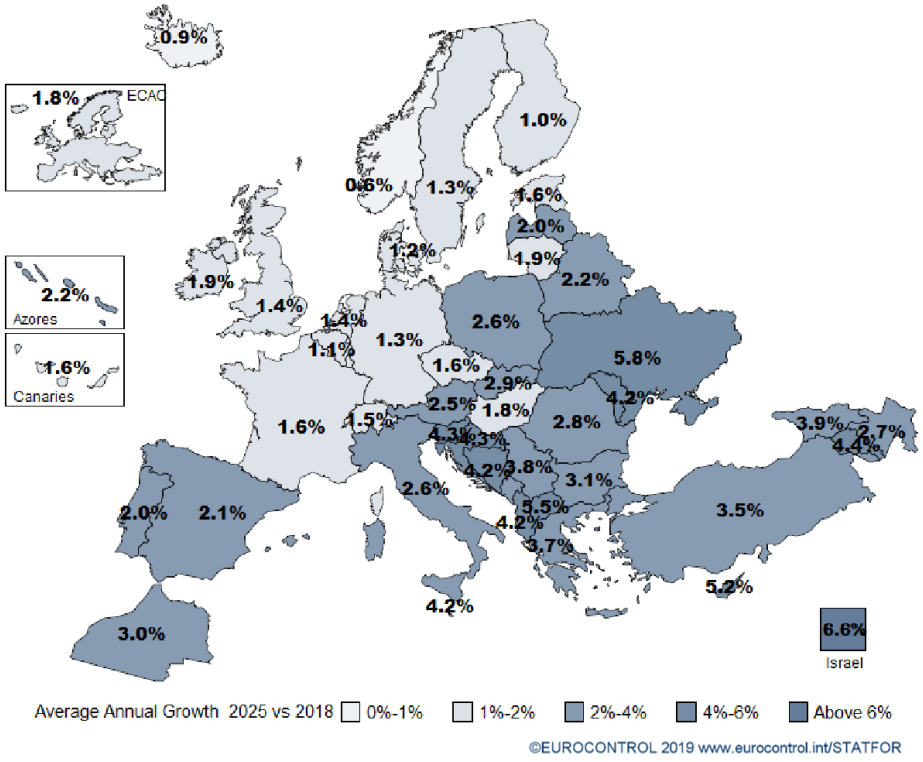


FIGURE 56. GROWTH IN FLIGHT MOVEMENTS PER STATE 2020-24

2.2.2. Pre-COVID-19 Summary

While the forecasts presented above vary in time horizon and the indicators used, a common tread is that all of the outlooks predict low traffic growth for Europe, at a rate that is markedly lower than for Asia, Middle east or much of the rest of the world.

Traffic flows inside Europe grow slowest (2 to 3 per cent RPK), particularly in Western Europe where the largest and most mature markets are located (see Figure 58). The forecasts consider that GDP growth is generally low in Europe, with economies being mature and living standards increasing slowly. Aviation is well developed and leaves only little unexploited opportunities for full service and low-cost carriers. Risks exist in terms of a slowing economic growth as a result of national political and macroeconomic conditions, Brexit and tensions in international trade.

The strongest increase in intercontinental traffic affecting Europe is forecasted on routes to Asia and the Middle east (about 4.0 per cent RPK for both markets). The North Atlantic which is by far the biggest single intercontinental traffic flow is forecasted to grow at a rate of approximately 2.5 to 3.1 per cent RPK, depending on the forecast. The forecasts for intercontinental traffic factor in the relatively good GDP performance of most emerging economies, especially in Asia. Risks exist in relation to tensions in international trade.

Considering the analysis presented in this report, the following developments should be highlighted as they may impact the development of air traffic in the next five years:

- European economies are mature and GDP growth in its biggest economies is naturally low. Risks to the long-term growth prospects exist in terms of demography, competitiveness and political and fiscal stability. As a result of an economic slowdown, air traffic could develop slower than forecasted by ICAO or aircraft manufacturers, more akin to the Eurocontrol low-case scenario.
- Commercial aviation in Europe is mature. The market penetration and additional demand created by low-cost carriers on intra-European routes is likely to have reached its peak, with low-cost carriers now moving to primary airports and withdrawing from non-profitable markets. Full-service carriers (network airlines and flag carriers) have responded and adjusted their business models in order to remain competitive. Therefore, low-cost travel is unlikely to create significant new demand and air traffic.
- The level of technology deployment and automation among airlines and airports in Europe is relatively high and unlikely to alter traffic dynamics significantly.
- Market consolidation can lead to reduced connectivity and less competition on specific routes or in individual countries. This could locally slow down or even reverse traffic growth.
- Strong growth rates into Asia, Africa and South America reflect economic growth in emerging countries, with traffic in some cases being channelled through hubs in the Middle east. The single biggest intercontinental traffic flow is from Europe to North America. Changing dynamics and risks in international trade translate into changes in these air traffic flows.
- Recently, environmental considerations have created a negative connotation associated with flying. This contrasts with a more positive view in the past, which was driven by consumer experience and lifestyle, especially for private travel. There is limited evidence so far that change in perception would have led to a significant decline in demand for air travel across Europe; however, the industry seems to take the potential risk serious and is taking marketing action and identifying options to address environmental concerns in the longer term.
- In the context of an increasing environmental awareness in society, governments are pledging to accelerate the development of rail transport and potentially being less likely to engage in large airport development projects. This may lead to a decline in domestic and short-haul travel in the longer term, i.e. post-2025. The trend may be reinforced by an increase in airport taxes or the introduction of carbon taxes, e.g. the CORSIA scheme.
- Changes in the use of digital and communication technologies can affect the demand for travel in the future, both by replacing the need for physical travel (negative impact on traffic) or by fostering international trade and social relations (positive impact on traffic).

2.2.3. Developments caused by COVID-19 pandemic

At the beginning of 2020, the emergence of a new strain of coronavirus, SARS-CoV-2, has led to the COVID-19 pandemic and affected countries around the world severely. The resulting travel restrictions and macro-economic shock is causing an unprecedented decline in air travel and affected the entire aviation industry. IATA estimates released at the beginning of May 2020, suggest that global air travel in 2020 is likely to decline by almost half, causing a revenue shortfall of over USD 300 Million to airlines. Assuming that domestic lock-downs in most European countries last about three months and international travel restrictions remain in place for a longer period during the summer, the output of European air traffic would be reduced by 55% in RPK, corresponding to a revenue loss of USD 89 Million. Figure 59 illustrates the sudden decline in traffic output caused by COVID-19, relatively to other geopolitical and economic shocks in the history of aviation.

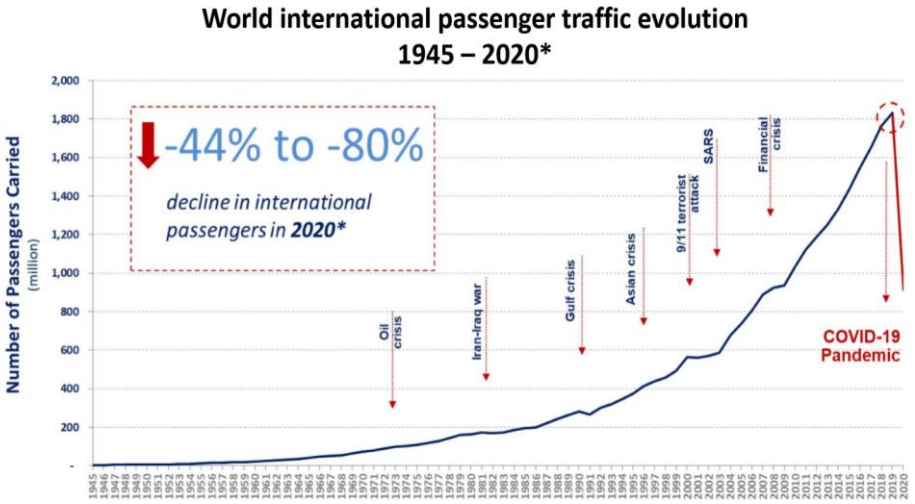


FIGURE 57. IMPACT OF COVID-19 ON AVIATION

Region of airline registration	RPKs 2020 (vs 2019 year-on-year change)	Passenger revenue $ billion 2020 vs. 2019 levels
Asia-Pacific	-50%	-113
North America	-36%	-64
Europe	-55%	-89
Middle East	-51%	-24
Africa	-51%	-6
Latin America	-49%	-18
Industry	**-48%**	**-314**

Note: This assumes, as in the previous impact assessment, that the domestic lock-down lasts 3 months, until the end of Q2. But international travel restrictions are assumed in this assessment to be reduced more slowly, with only 50% of pent-up international RPKs recovered by Q4 (after reduction due to recession impact).

Source: IATA Economics

FIGURE 58. IMPACT OF COVID-19 ON GLOBAL AIRLINE OUTPUT

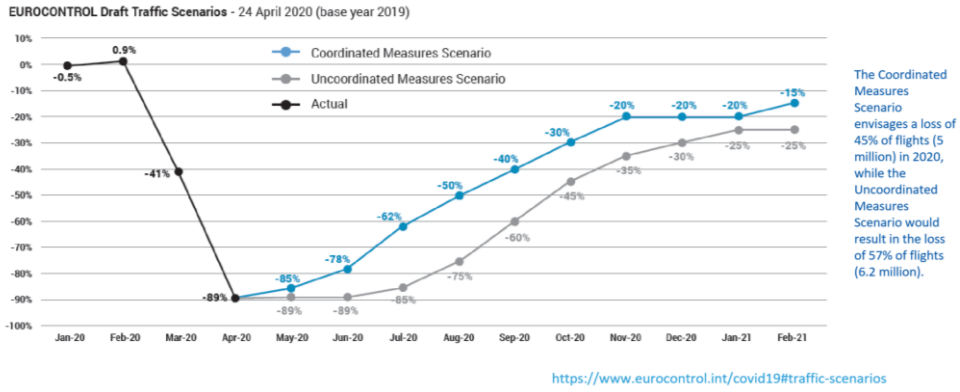
The IATA estimates for Europe are aligned with analysis released by ICAO at the end of April which quantify the impact in terms of international RPK in Europe with –40 to 74 per cent, for different scenarios. Airports in Europe would therefore be impacted by a decline in passenger numbers of almost -900 Million (-35 per cent), representing a revenue loss to airports of USD 24.6 Billion in 2020.

Region	**Passenger number** - both interntional and domestic for full year 2020		**Airport revenue** - both aeronautical and non-aeronautical for full year 2020	
	million and % change from 2020 "business as usual" baseline scenario		USD billion and % change from 2020 "business as usual" baseline scenario	
Africa	-77	-32.5%	-1.5	-35%
Asia/Pacific	-1,465	-42.1%	-23.9	-48%
Europe	-894	-35.0%	-24.6	-42%
Latin America/Caribbean	-244	-34.0%	-4.0	-38%
Middle East	-157	-36.5%	-5.7	-43%
North America	-790	-37.7%	-16.9	-49%
Total	**-3,627**	**-38.1%**	**-76.6**	**-45%**

https://aci.aero/wp-content/uploads/2020/03/200401-COVID19-Economic-Impact-Bulletin-FINAL-1.pdf

FIGURE 59. IMPACT OF COVID-19 ON AIRPORT TRAFFIC AND REVENUES

On 24 April 2020, Eurocontrol published a model of how flight volumes would be affected by the epidemic, depending on the re-opening scenario of international travel. The analysis suggests that following a decline of air traffic by -89 per cent of flight movements at the peak of the outbreak, recovery could be sped up the introduction of coordinated reopening measures between governments.



https://www.eurocontrol.int/covid19#traffic-scenarios

FIGURE 60. IMPACT OF COVID-19 ON FLIGHT MOVEMENTS AND RECOVERY SCENARIOS

The consequences of COVID-19 will become clearer over the course of 2020 and will ultimately depend on the length of travel restrictions, the depth of the recession caused and the time for recovery of the national economies of Europe and worldwide. By May 2020, many airlines have engaged in talks with shareholders, governments and creditors about additional cash injections in the face of a near-total loss of income. Many thousand professionals at airlines, airports and in the wider aviation industry have lost their employment as a result of the immediate financial duress on the industry and in anticipation of the recession to come. In this context, the expectation among industry observers is that many airlines will face bankruptcy in the foreseeable future.

As of May 2020, airlines, airports, industry bodies and governments are only starting to draw out the roadmap towards normalisation. This may include guidelines to ensure "social distancing" on board aircraft and at airports, loss of demand, a changed competitive landscape and lower fuel prices. Fares, demand and supply may change significantly in the future from what has been known over the recent past. As a result, the world of aviation is likely to become very different in the future and the traffic forecasts developed before the year 2020 may be of little meaning.

3. STRATEGIC OVERVIEW

The following paragraphs summarise into simple models and matrixes the outcomes of parts 1 and 2 of the report. These syntheses were elaborated through several collective brainstorming sessions of the report writing team. They make it possible to identify the key factors which have an impact on the structure of the European aviation market (airlines and airports).

To synthesise these key factors, we used two models commonly deployed in the field of organizational strategy (public or private):

- **Analysis of the external environment of the sector based on the PESTEL (or PESTLE) model;**
- **Analysis of the internal environment of the sector base on Porter's 5(+1) forces model.**

3.1. Macro-Environment Analysis

3.1.1. About the PESTEL Model

Political, Economic, Social, and Technological (PEST) analysis is a management method that examines the effect that events or influences from outside may have on the performance of a company or organisation[222].

The basic PEST analysis includes four factors:

- **Political factors** relate to how the government intervenes in the economy. Specifically, political factors have areas including tax policy, labour law, environmental law, trade restrictions, tariffs, and political stability. Political factors may also include goods and services which the government aims to provide or be provided (merit goods) and those that the government does not want to be provided (demerit goods or merit bads). Furthermore, governments have a high impact on the health, education, and infrastructure of a nation.
- **Economic factors** include economic growth, exchange rates, inflation rate, and interest rates. These factors greatly affect how businesses operate and make decisions. For example, interest rates affect a firm's cost of capital and therefore to what extent a business grows and expands. Exchange rates can affect the costs of exporting goods and the supply and price of imported goods in an economy.
- **Social factors** include the cultural aspects and health consciousness, population growth rate, age distribution, career attitudes and emphasis on safety. High trends in social factors affect the demand for a company's products and how that company operates. For example, the ageing population may imply a smaller and less-willing workforce (thus increasing the cost of labour). Furthermore, companies may change various management strategies to adapt to social trends caused from this (such as recruiting older workers).
- **Technological factors** include technological aspects like R&D activity, automation, technology incentives and the rate of technological change. These can determine barriers to entry, minimum efficient production level and influence the outsourcing decisions. Furthermore, technological shifts would affect costs, quality, and lead to innovation.

The environmental (E) and legal (L) factors were then added to form the acronym 'PESTEL'.

- **Environmental factors** include ecological and environmental aspects such as weather, climate, and climate change, which may especially affect industries such as tourism, farming, and insurance. Furthermore, growing awareness of the potential impacts of climate change is affecting how companies operate and the products they offer, both creating new markets and diminishing or destroying existing ones.
- **Legal factors** include discrimination law, consumer law, antitrust law, employment law, and health and safety law. These factors can affect how a company operates, its costs, and the demand for its products.

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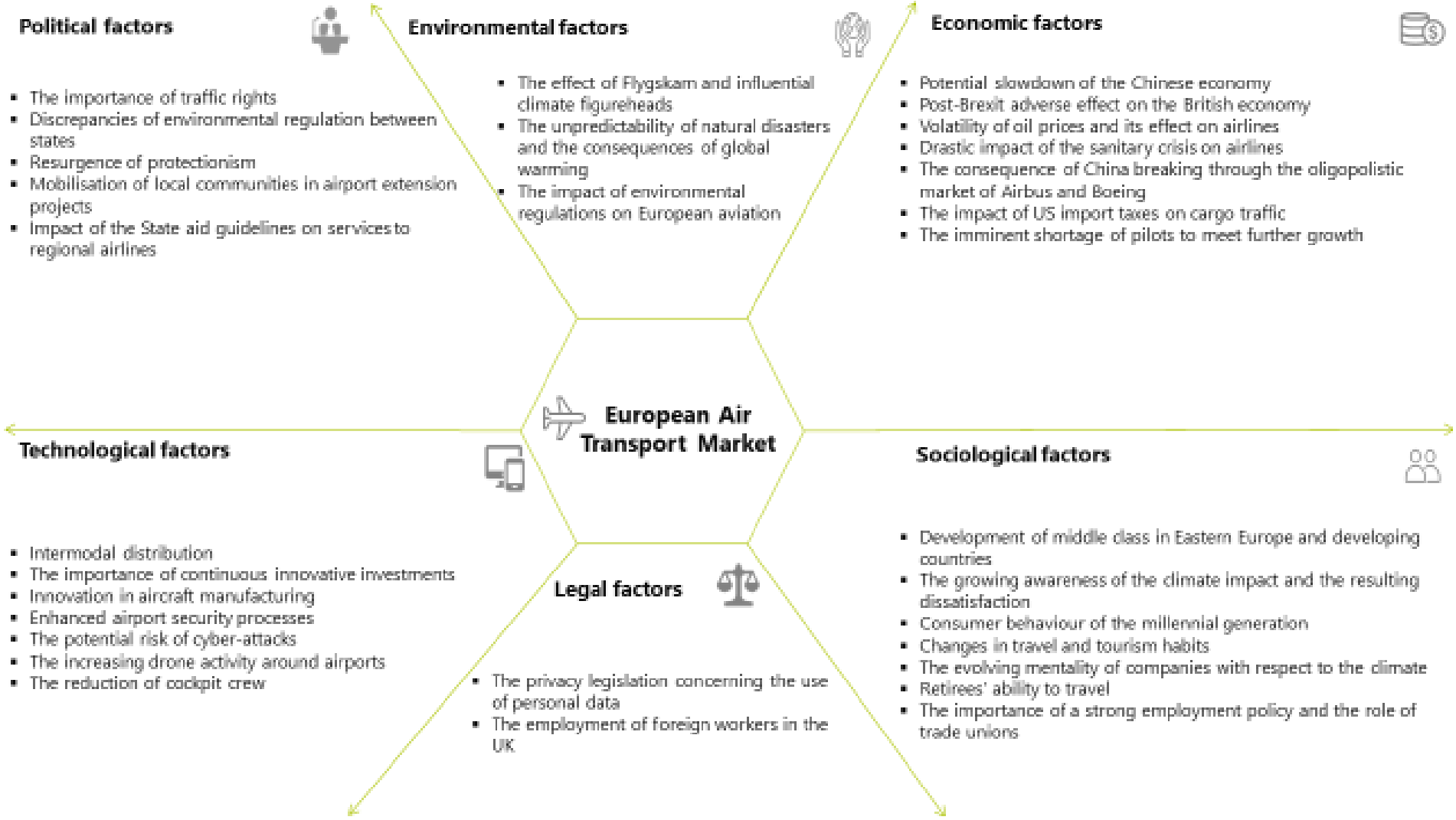
[222] *Cambridge dictionary*


Political factors
The importance of traffic rights
Discrepancies of environmental regulation between states
Resurgence of protectionism
Mobilisation of local communities in airport extension projects
Impact of the State aid guidelines on services to regional airlines
Environmental factors
The effect of Flygskam and influential climate figureheads
The unpredictability of natural disasters and the consequences of global warming
The impact of environmental regulations on European aviation
Economic factors
Potential slowdown of the Chinese economy
Post-Brexit adverse effect on the British economy
Volatility of oil prices and its effect on airlines
Drastic impact of the sanitary crisis on airlines
The consequence of China breaking through the oligopolistic market of Airbus and Boeing
The impact of US import taxes on cargo traffic
The imminent shortage of pilots to meet further growth
European Air Transport Market
Technological factors
Intermodal distribution
The importance of continuous innovative investments
Innovation in aircraft manufacturing
Enhanced airport security processes
The potential risk of cyber-attacks
The increasing drone activity around airports
The reduction of cockpit crew
Legal factors
The privacy legislation concerning the use of personal data
The employment of foreign workers in the UK
Sociological factors
Development of middle class in Eastern Europe and developing countries
The growing awareness of the climate impact and the resulting dissatisfaction
Consumer behaviour of the millennial generation
Changes in travel and tourism habits
The evolving mentality of companies with respect to the climate
Retirees' ability to travel
The importance of a strong employment policy and the role of trade unions

3.1.2. Analysis

3.1.2.1. Political factors

- **Importance of traffic rights:** The further negotiation and granting of traffic rights to non-European carriers will lead to an increase of market liberalisation and the level of competition in the European Air Transport Industry. However, attaching further importance to traffic rights is beneficial for European airlines as it allows them to further expand their network. The establishment of comprehensive agreements with third countries (see 2.1.1.3 Aviation agreements) can stimulate the air transport market between the European Union and the countries in question (traffic volume, diversity of routes and airlines, connectivity, affordability).
- **Discrepancies of environmental regulation between states:** EU deployed common environmental regulations and standards for its member states, including aviation (see 2.1.1.1 Environmental policy). On the other hand, each Member State can do more with additional regulations and standards. Compared to third countries, the European Union can be considered as a pioneer in many public policies and environmental standards. While ambitious environmental standards help to achieve the objectives of reducing greenhouse gas emissions and other forms of pollution (local pollution, noise, etc.), they can create an asymmetry of standards with competing airlines and airports located in less environmentally constraining States or even between member states (e.g. environmental taxation). The fact that ICAO sets many environmental standards for international aviation largely limits this risk with non-EU states. Implementing further EU common environmental rules could also limit discrepancies between member states.
- **Resurgence of protectionism:** European Central Bank (ECB) identified resurgence of protectionism as a potential factor of destabilisation for the economy (i.e. trade tensions, financial stability, etc.). The aviation sector widely benefited from the opening up of national economies (e.g. deregulation of European air transport in the 1990s, signature of numerous EU level agreements with third countries). However, if this feeling further spreads in the future, the comprehensive agreements may be jeopardised and traffic rights can be limited.
- **Mobilisation of local communities in airport extension projects:** The increasing involvement of local communities in infrastructure projects has largely challenged traditional approaches of transport planning and design. Beyond the 'NIMBY syndrome[223]', better involvement of local communities had an impact on timelines and contents of infrastructure projects. Aviation has been greatly impacted by the involvement of local communities, particularly in Europe. Protests against the environmental nuisance of airports (particularly noise pollution) are delaying or even cancelling some airport extension projects. Therefore European airports could suffer more than other regions' airports from congestion issues.
- **Impact of the State aid guidelines on services to regional airports:** Guidelines on State aid to airports and airlines[224] intend to avoid distortions of competition between modes of transport and between airports. In particular, airports must demonstrate that they are developing their activity in order gradually to reduce the State aid they receive for investment and operation, but also to support airlines in launching new routes (see 2.1.2.3 Regional airports: from regional connectivity to European hyper-competition to attract low-cost airlines). The more or less strict limitation of State aid may have an impact on the volume of air traffic (some airlines might give up serving thin routes) and regional airports in particular. Some of these airports only rely one airline (*low-cost*) which requires important amounts of support to operate routes.

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[223] *NIMBY is the abbreviation for not in my back yard; a person who does not want something unpleasant to be built or done near where they live: The spokeswoman said that nimby attitudes were delaying development of the site. (source: Cambridge Dictionary)*

[224] *Communication of the Commission, "Guidelines on State aid to airports and airlines", 2014/C 99/03 (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014XC0404(01))*

3.1.2.2. Economic factors

- **Potential slowdown of the Chinese economy:** Asia, particularly China, has been the largest contributor to global air traffic growth in recent years. IATA predicted (forecast made before the COVID crisis) that China would be the leading growth market with one billion new passengers by 2037. China's GDP growth in 2019 was the lowest since 1990 and is expected to fall below 6% in 2020. The country is combining cyclical difficulties with structural challenges linked to the transformation of its economy. The slowdown of the Chinese economy has direct (e.g. demand for transport from/to China) and indirect (e.g. lower investment in Europe) effects that could impact the European air transport market.
- **Post-Brexit adverse effect on the British economy:** GDP growth in the UK was 1.4% in 2018, a sharp slowdown compared to the average of the last five years (2.2%), mainly due to the weight of Brexit's uncertainties on business investment and the international slowdown. Economic effects of Brexit are still uncertain. While the announcement of the UK's exit has had transitory effects on sterling and UK growth, the different exit scenarios will not have the same effect on the UK economy. The United Kingdom is a major driver of air transport demand in Europe (e.g. tourism to the rest of Europe, second homes, foreign workers, etc.). Several low-cost airlines (i.e. Easyjet, Jet2.com, Ryanair, Wizz Air) have largely taken advantage of the British market to develop. The slowdown in the UK economy could therefore have a severe impact
- **Volatility of oil prices and its effect on airlines:** The price of oil is a key element of airline profitability. Excessive price volatility destabilises airlines and their ability to hedge the risks associated with an excessively high barrel price (e.g. financial hedging). In 2019, the Brent crude oil prices totalled an average of 64.36 U.S. dollars per barrel, down significantly from the 2014 average price of 99 U.S. dollars per barrel. To put the 2019 figure in context, however, it was a considerable increase from the 2001 average, at 24.45 U.S. dollars per barrel. International trade relations and events happening in the world such as sanctions on Iranian oil transports, the US-China trade war or the increase of geopolitical instability in petroleum exporting countries that are crucial for the rest of the world affect the volatility of these market prices. Recently with the COVID-19 fuel prices have remained close to 30 USD per barrel, more than 50% below the level witnessed at the beginning of 2020.
- **Drastic impact of the sanitary crisis on airlines:** The impact of the past sanitary crisis called COVID-19 on aviation is enormous. Among other things, the crisis has had a major impact on airports. For example, passenger traffic at European airports has dropped by 88% on 22 March 2020[225]. Furthermore, all European airlines have had to temporarily stop their commercial flights and the majority of the operations still carried out today consist of cargo for the medical sector. As a result, some major airlines, such as Lufthansa in Germany or Air France, are requesting state aid to overcome these losses. In the end, state aid of around 10 billion[226] was granted to the Air France-KLM group. However, the granting of this sum of money was seen by other airlines, such as Ryanair, as unfair competition. Moreover, given the fact that this crisis will mean the end of many airlines, it is likely that the European airline industry will continue to consolidate over the next few years. Furthermore, the impact of this crisis will continue to be felt for a number of years, according to Air France's CEO, who expects to have an activity of more than 80% by the end of 2021[227]. In the future, it may be important for the European authorities to tighten up the regulatory framework for the provision of state aid in order to anticipate the consequences of major crises and to bring all airlines into line in terms of obtaining fair competition.
- **The consequence of China breaking through the oligopolistic market of Airbus and Boeing:** China is likely to become the world's largest aviation market and it can already be seen that aviation in Asia is in full expansion. This growth is nowadays likely to be absorbed by Boeing and Airbus.

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[225] *https://www.aci-europe.org/airport-traffic-covid-19*

[226] *https://www.cnbc.com/2020/04/27/coronavirus-air-france-klm-to-receive-up-to-12-billion-in-state-aid.html*

[227] *https://www.bloomberg.com/news/articles/2020-04-26/air-france-klm-sees-traffic-at-70-by-year-end-if-all-feel-safe*

However, the introduction of the COMAC C919 might be a game changer. Increasing the supply and breaking through the oligopolistic market could result in a lowering of the list price of airplanes. If China promotes their aircraft at a lower price, Boeing and Airbus will have to respond to this. Furthermore, cheaper aircraft will reduce fixed costs for airlines, which may lead to an increase in the number of aircraft in the market. This is something that needs to be anticipated as capacity constraints both in the air and on the ground become more and more apparent.

- **The impact of US import taxes on cargo traffic:** Aviation is subject to specific charges and taxes. In the case of cargo traffic, this mainly concerns customs, handling costs and imports. Taxes not only reduce demand, but also have an impact on the environment. For example, a reduction in the taxes levied will lead to an increase in demand and at the same time have an adverse effect on the climate through an increase in both CO2 and noise emissions. In recent years, global freight traffic has experienced a further reduction, partly due to political uncertainties in the world, but mainly due to the US-China trade war[228]. This phenomenon had its impact on developing markets as they are more sensitive to such tensions. For European freight traffic a reduction of 3.3%[229] was observed in August 2019 and this decline is expected to continue. Indeed, political instability between countries does not stimulate air freight. If the US announces a further increase in cargo taxes in the future, this will result in a reduction of European cargo traffic. One reason for this is that freight revenue will fall at the expense of rising transport costs. In any case, the issue of import taxes on freight transport is something to take into account as it may hinder the further development and growth of air cargo.
- **The imminent shortage of pilots to meet further growth:** Several studies have shown that there is an imminent shortage of pilots all over the world. For example, it is predicted that 95,000[230] [231]commercial pilots will be needed by the year 2034 to meet the growth in the European aviation sector. These shortages are even more pronounced in other markets such as Asia-Pacific, where the largest growth in aviation is predicted and 226,000[232] commercial pilots will be needed. One of the main reasons for these shortfalls is the cost of training. This cost is seen by many future pilots as too much of an investment, making it impossible to start training. In view of this problem, several European airlines such as Air France and KLM have set up their own flying school where, after a strict selection, the required number of future pilots are trained at the expense of the airline. However, places are limited. Furthermore, there is a migration trend, with some pilots moving from Europe to Asia to get better working conditions. Both the shortage of pilots and the migration trend could be detrimental to the further growth of the European aviation market as it might lead to problems in meeting the future demand. However, the ongoing COVID crisis could reduce the demand for air travel and reduce the demand for pilots.

3.1.2.3. Social factors

- **Development of middle class in Eastern Europe and developing countries:** "*Due primarily to increased wealth in emerging economies, the world is experiencing a significant and rapid expansion of the global middle class*". OECD[233] identified that the strong development of middle-class in the World has a direct impact on tourism. While until recently the middle class in those regions did not have the opportunity to afford air travel, now they can. As a result, the aviation sector will see a further boost in the future, partly thanks to this fact.
- **The growing awareness of the climate impact and the resulting dissatisfaction:** As the many climate protests in recent years have shown, the population is increasingly aware that aviation plays a major role in global warming. This has led to a change in travel behaviour, especially in the countries of northern Europe, with the population increasingly opting for alternative means of travel for shorter

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[228] https://www.piie.com/research/piie-charts/us-china-trade-war-tariffs-date-chart
[229] https://www.iata.org/en/pressroom/pr/2019-10-09-01/
[230] https://www.airport-technology.com/news/study-reveals-eu-face-major-pilot-shortage/
[231] https://www.aerobuzz.fr/breves-transport-aerien/boeing-revise-a-la-hausse-ses/
[232] *ibid*
[233] *OECD, 2018, p.67*

distances. This could have a particular impact on short haul traffic in Europe, which is facing increasing competition from the high-speed train network. It is very likely that this trend will continue in the coming years with consequences for intra-European air traffic.

- **Consumer behaviour of the millennial generation:** The millennial generation adopts a new consumption behaviour that has largely modified the range of products and services on offer, distribution channels and sales methods[234]. This generation was notably marked by strong digitalisation and increased use of social networks. However, it does not consume exclusively through these channels. Physical selling and loyalty to a brand remain applicable to this generation. Emergence of this generation of consumers accelerated the need to digitalise the airlines (distribution, passenger experience, etc.).
- **Changes in travel and tourism habits:** recent studies on tourism trends[235] showed that the following trends directly impacted travel habits. Recent COVID impact could deeply question these habits:
  - *Off-Peak travel*: Depending on the composition of households, off-peak travel is increasing (seasonal shoulders in particular), but the strong summer seasonality of tourist demand remains.
  - *More trips per year*: younger generations of travellers (millennials in particular) take more trips annually compared to other generations (four or more per year)
  - *Shorter durations of stays*: The corollary of more frequent travel per year has been a reduction in the duration of each trip. This also favoured strong development of urban tourism and city breaks.
  - *Environmental Awareness*: This more recent trend may contradict the others. Awareness of the environmental impact of tourism (especially mass tourism) could significantly change travellers' tourism behaviour. The choice of mode of transport and type of tourism product could evolve to have less impact on the environment. The emergence of "*Flygskam*" in Northern Europe could directly impact the demand for tourist air transport. The aim would be to travel less far, less often and as little as possible by air. Airlines and airports benefited greatly from the strong development of frequent but short trips in Europe. A paradigm shift in travel behaviour could therefore significantly reduce demand.
- **The evolving mentality of companies with respect to the climate:** In general, companies in the European Union are encouraged to make their policies more climate-friendly; for example, the European Commission is awarding companies for their initiatives and invested projects with a view to a more climate-friendly future[236]. This trend continues in the aviation sector, where European airlines are increasingly reducing their impact on the climate by complying with climate regulations. However, airlines are also increasingly taking initiatives themselves to make their flights greener. For example, Air France's target was to eliminate 210 million single-use plastic items on board by the end of 2019[237]. It is possible that in the future, this phenomenon will spread across the various European airlines, and will even develop into a marketing strategy. This is because the climate policy of airlines does play a role in the passenger booking process[238], keeping global warming in mind.
- **Retirees' ability to travel:** Longer life expectancy allows a greater level of autonomy for the older generations of the population. "Younger" retirees therefore enjoy more independent free time, which is particularly favourable to travel. With the ageing of the population, a "silver economy" is developing in Europe. This generation represents an important market segment for airlines with specific travel habits for both touristic and VFR purposes. This specific demand is already reflected in the offer of airlines with the development of low fares to meet "VFR" travel needs (especially on the domestic market) or off-season services to destinations in southern Europe where there may be a large number of second homes for retirees.

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[234] *Accenture, 2013.*
[235] *OECD, 2018.*
[236] https://ec.europa.eu/commission/presscorner/detail/en/IP_16_3538
[237] https://corporate.airfrance.com/en/press-release/air-france-committed-eliminating-210-million-single-use-plastic-items-end-2019
[238] https://www.sciencedirect.com/science/article/abs/pii/S0969699715000046

- **Profound changes in employment schemes (pre-COVID impact):** The emergence of new labour contracts could profoundly redefine social relations within companies. Digital labour platforms already strongly developed on the mobility market (intra-metropolitan mobility) and self-employed contract schemes also emerged as a new way to hire additional human resources[239]. In the aviation, especially within low-cost airlines, temporary employment agencies have been widely solicited to provide pilots at reduced costs. Most of these pilots have a self-employed status. This could be a major trend in the labour market, the regulation of which is still complex. Some companies have made extensive (or even exclusive) use of this form of contractualisation. Some member states' courts have convicted some of them for undeclared work and have reclassified self-employed entrepreneurs as employees of the company. American aviation was the pioneer for this new approach of pilot employment. European low-cost airlines developed self-employment schemes in Europe but Employee protection is more important in Europe than in the United States. Therefore, the trend could be mitigated.

3.1.2.4. Technological factors

- **Intermodal distribution:** development of end to end multimodal distribution solutions (one ticket for the entire journey including several modes and access to airports/train stations) could disrupt the market. EU declared this a priority on its agenda (2018 was considered as the year of multimodality)[240]. Creation of 'multimodal ticketing and payment systems' is a key to enable true multimodal journeys. Rebooking of passengers, smooth modal change and clear information are essential to favour intermodal journeys. Development of such solution, including air transport could change the way passengers chose modes of transportation and organise their journeys.
- **The importance of continuous innovative investments:** Digitalisation is becoming more and more embedded in our modern society. By automating various processes in the aviation sector and more specifically at airports, costs can be reduced and better safety can be achieved. The further automation and digitisation of airport processes will be necessary in the future in order to meet the predicted growth and to process the large passenger flow as efficiently as possible. However, account must always be taken of the fact that passengers should not be penalised for this. Three major segments in terms of innovation will be at the heart of European aviation in the future:
- *Individual initiatives of airlines* : In the near future, European airlines will continue to work on innovation and digitalisation in order to optimise all the different departments of the company and to improve customer satisfaction. For example, Lufthansa launched the "Mildred" concept[241], a chat box in the messenger app that helps passengers to find the most suitable and cheapest flight for their search. For this, Lufthansa followed the example of other airlines such as Icelandair and Austrian Airlines. Outside of Europe, American Airlines changed their standard approach to a smarter system in which a large amount of data is collected, analysed and consequently used to generate an offer that is tailor-made to the customer's expectations. To achieve this result, no less than 150 variables of the customer profile are collected and researched. This strategy led to a 15% increase in revenues of the US airline[242].
- *The introduction of the 5G network and its contribution on connected vehicles* : In the coming years, the 5G network will be further introduced in the airline industry and thus also in the European aviation sector. Brussels airport was one of the first European airports to introduce the network in order to stimulate technological innovation and speed up airport processes[243]. Furthermore, the 5G network will also have an impact on the automotive industry. It is therefore highly probable that it will contribute to the development of the process concerning the connected vehicles[244]. Cars will be able

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[239] *European Commission 2018b, p.58*
[240] *Finger, et al., 2019*
[241] https://www.prologis.aero/wp-content/uploads/2017/05/Digitalization-and-its-impact-on-aviation.pdf
[242] https://www.prologis.aero/wp-content/uploads/2017/05/Digitalization-and-its-impact-on-aviation.pdf
[243] https://www.brusselsairport.be/pressroom/brussels-airport-innovates-with-private-5g/
[244] https://www.forbes.com/sites/danielnewman/2019/07/14/top-10-digital-transformation-trends-for-2020/#7aea96f576be

to drive fully autonomously and will, for example, drive back home independently after the passengers have reached the airport. This can have a major impact on the revenues of an airport, since the parking revenues, depending on the size of the airport, account for 30% of the total non-aeronautical revenues[245].

- *The shift from market segmentation to individual customisation* : There is a trend among European airlines where their strategy to achieve the best possible customer satisfaction is no longer based on market segmentation but on individual customisation. For example, in 2017 Air France set up the subsidiary Joon, with the airline focusing on the millennials segment. Joon wanted to focus on young people in the airline but suspended its operations in 2019. Now airlines are going to focus much more on the customer as an individual. For example, by collecting and analysing data, they are going to make an offer that is as close as possible to the expectations of each individual passenger. Therefore, Singapore Airlines introduced the "personalised dining experience concept", where passengers can put together their menu before the flight, thereby improving customer satisfaction[246]. Innovation and digitalisation will further contribute to optimising individual customisation in the future.

- **Innovation in aircraft manufacturing:** Technological innovation is becoming more and more important amongst aircraft and engine manufacturers, who increasingly feel the need to invest in, for example, research into the construction and design of greener aircraft: aircraft that are quieter and more environmentally friendly, but still meet all comfort requirements. In the coming years, various innovative projects will be further developed and influence the European aviation sector:

- *Electrically-powered aircraft*: The pressure on airlines to reduce their CO2 emissions is increasing. Manufacturers such as Airbus and Boeing are also aware of this and have therefore started projects over the years to meet this demand. One of those projects was the electrically powered aircraft. In collaboration with Rolls-Royce, Airbus launched the E-fan X project[247]. This electrically powered fan is the successor to the E-fan with which several test flights, including crossing the canal, were completed in 2015. The E-fan X is 30 times more powerful than its predecessor and was scheduled to enter the market in 2021[248]. Nevertheless, the project was recently stopped by COVID-19[249], as the sanitary crisis is strongly affecting manufacturers in a negative way. Apart from that, Airbus is convinced to make continued progress in research into electrically powered aircraft, with the main goal of a passenger aircraft for 100 people, powered on an electric and hybrid-electric basis. This might be the basis for a new era of regional electrically-powered aircraft in European air transport.

- *The introduction of long-haul narrow body aircraft*: During the past years some new types of aircraft have entered the aviation industry. The future will mainly be influenced by the arrival of the long-haul narrow body type aircraft, including the A321XLR. This single aisle aircraft is expected to perform its first commercial flights in 2023 and could impact the European aviation market due to its increased seating capacity, its more fuel efficient engines and increased range of 4700NM[250]. The latter will allow this type of aircraft to connect continents that previously required larger aircraft. This could have a major impact on the on the hub-and-spoke transport system used by many flag carriers today, or on the further development of low-cost carriers, since for they could open high-frequency routes between cities such as London and New York.

- *Ultra-long-haul aircraft*: The trend of operating ultra-long-haul flights is becoming increasingly prominent in the aviation sector. For example, Qantas flying directly from New York to Sydney without a stopover. Airlines are willing to invest a lot in these projects as it is what their passengers want: customer satisfaction is the highest on the London-Perth leg in Qantas' entire network and the airline also achieves a load factor of 94%[251]. Furthermore, the success of these ultra-long-haul flights

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[245] https://www.adlittle.com/en/insights/viewpoints/airport-parking
[246] https://www.connectedtoindia.com/sia-to-offer-personalised-in-flight-meals-and-enhance-child-meals-for-travellers-5291.html
[247] https://www.airbus.com/innovation/future-technology/electric-flight.html
[248] Ibid.
[249] https://paxex.aero/2020/04/airbus-rolls-royce-halt-development-on-e-fan-x-electric-aircraft/
[250] https://www.airbus.com/newsroom/stories/a321xlr-programme-update.html
[251] https://centreforaviation.com/analysis/video/new-route-opportunities-ultra-long-haul-markets-opened-up-by-next-gen-aircraft-1129

has an impact on the aircraft manufacturers. Airbus and Boeing need to optimise their type of aircraft so as to be capable of bridging these long distances. Hence the development of the A350-1000 and the 787-900. The manufacturers focus on the efficiency of the engines, but also on the cabin design. A lower effective cabin pressure, for instance, results in less muscle fatigue. The further development of ultra-long-haul aircraft can strongly influence the network system of airlines as new continents can be connected and more direct routes will be created.

- **Enhanced airport security processes:** The security process is often experienced by passengers as the most stressful part of their journey. In spite of this, efforts are made on a daily basis to further improve the system and make it run more smoothly. In the future, the efficiency of security processes will definitely be a working point on the agenda, since airports will have to handle ever-increasing passenger flows in a shorter period of time, while maintaining safety as the highest priority. For example, the number of passengers of US carriers increased by 10.9% between 2016 and 2019[252]. In addition, one in seven passengers missed their flight in 2018 due to long queues at security[253]. Furthermore, European airports set a new record of handling 2.43 billion passengers in 2019, representing a continuous increase in passenger numbers since 2014[254]. In order to process the growing passenger flows, security processes are becoming increasingly automated, using the latest technologies. This automation leads to a reduction of costs for the airport and to a more reliable security system, taking human factors into account. For example, fatigue or repetitive work can lead to reduced concentration, which might cause gaps in the process.
- **The potential risk of cyber-attacks:** There is no denying that further digitalisation and automation of the aviation sector will have many advantages. But there are also risks associated with it, such as the increased probability of cyber-attacks. When certain processes are automated, as in airports, it is also necessary to ensure that they are adequately protected against hackers. To this end, IATA, in collaboration with the Security Advisory Council, is developing an Aviation Cyber Security Strategy[255]. In this way, the organisation can support the aviation sector and provide guidelines. In addition, there is the Aviation Cyber Security Roundtable, an annual event in which various people from the industry come together and share their experiences related to cyber security. In this way, the current problems in the aviation sector can be identified and corresponding solutions can be found. Furthermore, stakeholders want to have developed an unambiguous approach to cyber security in aviation by 2030[256].
- **The increasing drone activity around airports:** Drones recently gained popularity and are no longer only used for professional purposes but also for recreational ones. The advantages of drones accumulated, as they are flexible, extremely manoeuvrable and perfectly suited for carrying out more delicate tasks for which aircraft are not suitable. Unfortunately, the UAVs have also caused major problems in recent years. People used them in the vicinity of airports, for example, to boycott airport activities. This had enormous consequences for London Gatwick airport in 2018 for example, where drones were used as part of a protest action. It is extremely important that this is further monitored in the future and a strict criminal regulation regarding the drones is elaborated since the safety of not only pilots and passengers, but also the people passing by on the ground is endangered.
- **The reduction of cockpit crew:** Airbus and Boeing are currently working on technologies to remove one pilot from the cockpit in passenger jets. This major change would both address foreseen shortage of pilots and decrease the airlines' payrolls. Boeing considers a single-pilot aircraft could allow a completely fresh design: by changing the shape of the aircraft and reducing the space dedicated to the nose, some fuel consumption economies could be made. Furthermore, aviation analysts claim that Boeing's new type of aircraft, the 797, expected to enter service in 2028, could

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[252] https://www.axios.com/how-automation-could-make-airports-more-efficient-a76b7e39-27c0-41ca-956d-17d035edb22d.html
[253] Idem.
[254] https://www.aci-europe.org/media-room/235-european-airports-report-slower-passenger-growth-declining-freight-in-2019.html
[255] https://www.iata.org/en/programs/security/cyber-security/
[256] idem

enter the market designed for one pilot only[257]. Airbus is also working on single-pilot operations, and the Head of Research and Technology at Airbus, Daniela Lohwasser, outlined in 2019 that the eventual target of their research were fully-autonomous aircraft requiring no pilot at all. But according to a 2014 study made by Embry Riddle Aeronautical University, 60% of the passengers are not ready yet for such a change[258]. However, this would be mostly due to a lack of knowledge about automation, and a better understanding of its benefits could convince more and more of them. In a closer future, single-pilot operation of freighter aircraft would be a stepping stone before being arranged on passenger aircraft.

3.1.2.5. Environmental factors

- **The effect of Flygskam and influential climate figureheads:** In recent years, the climate protests led by figureheads such as Anuna de Wever and Greta Thunberg have been an inescapable part of the news. These actions have made themselves felt in certain segments of the aviation market. For example, the number of passengers SAS welcomed on board fell by 2% in 2019[259] and the number of domestic flights in Sweden by no less than 9% in 2019 according to Swedavia, the operator of most Swedish airports[260], both of which are claimed to be caused by flight shaming. On the other hand, train traffic in many countries experienced a sudden increase. For example, the number of rail passengers increased in EU from 105.856 billion passenger-kilometres at the beginning of 2016 to 121.505 billion passenger-kilometres at the end of 2018[261]. An increase of 1.5% was observed in rail traffic in Europe in 2018 compared to the previous year. As the effects of climate change become more evident, an increasing number of travellers will consider the environmental impact of their choice of transport and destination.
- **The unpredictability of natural disasters and the consequences of global warming:** Nature is unpredictable and can bring aviation to a standstill at the most unexpected moments. For example, sandstorms in the Canary Islands have recently disrupted European air traffic[262]. Natural disasters such as floods or hurricanes are likely to become more frequent in the future. In addition, climate change also affects the travel and tourism sector more broadly. Excessive summer temperatures are making some destinations in the south unattractive to travellers at certain times of the year. It is therefore possible that in the near future there will be a shift in tourism patterns as northern holiday destinations become more attractive. Moreover, global warming is leading to periods of insufficient snowfall at ski resorts. The snowfall period in the Swiss Alps, for example, has been shortened by nine days every ten years since 1970[263]. In addition, the maximum snow depth has also been constantly reduced. The coming years will be critical for ski resorts and further global warming could lead to millions of losses for the European tourism sector during the winter season.
- **The impact of environmental regulations on European aviation:** The environmental regulations drawn up by the authorities cover several important segments that will continue to play an even greater role for European aviation in the future:
  - *Emissions trading:* CO2 emissions from aviation have been included in the EU emissions trading system (EU ETS) since 2012. Under the EU ETS, all airlines operating in Europe, European and non-European alike, are required to monitor, report and verify their emissions, and to surrender allowances against those emissions. They receive tradeable allowances covering a certain level of emissions from their flights per year. As the total emissions "cap" is decreasing each year, this will imply higher allowance prices and hence higher compliance costs.
  - *Ecological taxation*: European aviation is subject to various forms of taxation and charges, including departure charges. However, since aviation has a small but significant impact on global warming, the

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[257] *https://www.cnbc.com/2019/05/20/boeings-new-797-could-be-built-to-fly-with-just-one-pilot-on-board.html*

[258] *https://www.discovermagazine.com/technology/despite-passenger-fears-automation-is-the-future-of-aviation*

[259] *https://www.reuters.com/article/us-travel-flying-climate/flight-shaming-hits-air-travel-as-greta-effect-takes-off-idUSKBN1WH23G*

[260] *Ibid.*

[261] https://ec.europa.eu/eurostat/statistics-explained/index.php/Railway_passenger_transport_statistics_-_quarterly_and_annual_data

[262] https://www.euronews.com/2020/02/24/massive-saharan-sandstorm-grounds-flights-in-canary-islands

[263] https://www.climatechangepost.com/news/2017/1/6/snow-cover-duration-swiss-alps-has-shortened-9-day/

willingness to subject the aviation sector to carbon pricing measures is increasing. (See 2.1.1.1 Environmental policy).

- *Carbon offsetting (Incl. CORSIA)*: The emissions produced by aviation were growing very rapidly until 2019. For 2020, for example, the annual gas emissions from international aviation were forecasted to be 70% higher than in 2005[264] (pre-COVID). ICAO also predicted that if no additional counteracting measures are taken to reduce the climate impact of aviation, this percentage could grow by more than 300% by 2050[265]. The effectiveness of offsetting programmes will depend to a large degree on the adoption of ambitious targets, the successful collaboration with third countries and the environmental integrity of eligible offsets. (See 2.1.1.2 Analysis of aviation market-based measures in Europe and selected regions).
- *Curfews*: Setting a curfew at an airport prevents aircraft from landing or taking off during certain periods of the night. This restriction is necessary for some airports as they are increasingly surrounded by more or less densely populated residential areas. In some cases, this may lead airlines to operate quieter aircraft into the airport in order to meet the curfew requirements. For example, the A320neo and 737max are being promoted, not only because of their reduced fuel emissions, but also because of their quieter engines. On average, aircraft entering service today are 20 dB quieter than thirty years ago[266]. Airport noise and related curfews have a negative economic impact, not only on the airlines but also on the economy in general, including the housing market. Residential areas are moving ever closer to the airport, leading to dissatisfaction and negatively affecting the value of the surrounding land[267]. Furthermore, there is also an economic impact on airlines from having to adjust their scheduling, as well as the reduced number of passengers or cargo transported in 24 hours. In addition, the airport itself is also impacted as it is forced to adjust its operational hours, which can lead to congestion just before or just after the entry into force of the restriction, resulting in reduced airport activity.

3.1.2.6. Legal factors

- **The privacy legislation concerning the use of personal data:** The personal data of passengers travelling by plane is collected during the different stages of their trip, from the booking to the completion of the flight. This data is mainly used for security purposes. Meanwhile, several legislations have already been drawn up concerning the privacy policy for the collection and use of this personal data. The purpose of this e-privacy regulation is to improve the security and reliability of all technologies that process this data. In the next few years, new innovative technologies will be launched at European airports, introducing for example the use of biometrics technology. This technology uses physiological character traits such as fingerprints or facial recognition whereby the face is linked to the passenger's boarding pass. Due to the expected increasing use of biometrics in the future, it will be necessary to have an unambiguous European privacy policy in this respect and to clearly inform passengers about this new technology.
- **The employment of foreign workers in the UK:** Currently residents of the UK, EEA and Switzerland can work in Great Britain without a work permit. In the end, however, this fact will become much more complex as the transitional period for the completion of the Brexit will be over. As a result, it will be necessary for the British state to develop clear regulations regarding the employment of foreign workers in the UK. This will also have an impact on Europe, since today many Europeans can work without any problems at, for example, British airports. This will be more difficult in the future and a special work permit will be required.

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[264] https://ec.europa.eu/clima/policies/transport/aviation_en
[265] idem
[266] https://www.academia.edu/33664198/Analysis_of_the_Economic_Impacts_of_Night_Curfews_on_Airport_Operations
[267] https://simpleflying.com/airport-curfews/

3.2. Micro-Environment Analysis

3.2.1. About the Porter's 5(+1) Forces Model

Porter's 5(+1) model is an analysis method derived from Michael E. Porter's five forces analysis developed in 1979[268]. It is a very simple analytical grid that allows a synthetic assessment of the microenvironment of a given sector, industry or market.

Hence, the Porter framework consists of identifying the structure and attractivity of the industry subsequently the positioning of the company within it. The five so-called forces impacting the profitability and attractivity of the market are:

1. **Threat of new entrants.** Can new competitors enter the market?
2. **Threat of substitutes.** Can my product/service be replaced by substitutes (e.g. the car replaced horse and partly train)
3. **Bargaining power of customers.** Are the customers in position to negotiate or influence the business (e.g. limited number of customers and high competition could give strong power to customers).
4. **Bargaining power of suppliers.** Is any supplier in a critical position to deliver the product/service (e.g. Engine manufacturers in the aircraft manufacturing industry).
5. **Competitive rivalry.** How intense is the competition within the sector/business (e.g. Real estate in metropolitan areas)?

By determining the importance of each of these forces, the attractiveness of the European aviation market can be defined. The higher every power is, the less attractive the industry is for the different market players of aviation. Furthermore it is important to keep in mind that that the Porter model should be used at the level of a strategic field of activities and not only at the level of the organisation as a whole. An airline that is offering several services such as long-haul flights and domestic flights target different customers for each segment, hence the impact of the forces may be different for each domain.

This simple model of analysis has been a great success since its publication. However, one key element was missing from the analysis; the influence of the public sector on an industry/sector. The influence of the authorities was thus the sixth force of the model, added later.

6. **Influence of authorities.** Is the public sector influencing my business (i.e. regulation, etc.)?

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[268] *Porter's Five Forces Framework is a method for analysing competition of a business. It draws from industrial organization (IO) economics to derive five forces that determine the competitive intensity and, therefore, the attractiveness (or lack of it) of an industry in terms of its profitability. An "unattractive" industry is one in which the effect of these five forces reduces overall profitability. The most unattractive industry would be one approaching "pure competition", in which available profits for all firms are driven to normal profit levels. The five-forces perspective is associated with its originator, Michael E. Porter of Harvard University. This framework was first published in Harvard Business Review in 1979.*

Competitive rivalry	Threat of new entry	Power of substitutes	Supplier power	Buyer power	Authorities
• Increasing competitive pressure coming from Middle-East major carriers (Emirates, Etihad, Qatar Airways) • Intense hub competition between airports, where, as far as Europe is concerned, Western Europe in particular faces a very high level of competition • Increasing trend of LCC operating from primary hubs • Emergence of high volume city pairs • Increased consolidation of airlines resulting in a decrease of competition and a more oligopolistic aviation market	• Significant barriers of entry protect the incumbents of new market players (high fixed costs, regulatory compliance, technical capabilities of management and staff) • The closure of regional airports will reduce competitive pressure but could have major economic consequences • European airline market is more competitive than in other comparable regions such as North-America, China and Japan	• Europe's advanced high-speed rail network offers alternative mean of transport on some city-pairs • Increasing popularity of bus companies (Flixbus) and carpooling affects air travel and European regional airports • Revival of local tourism could substitute the need for air travel • Re-emergence of tourism in North-Africa might have a negative effect on local tourism in Europe but is beneficial for the aviation industry	• Changing supplier power between airlines and aircraft manufacturers, with aircraft manufacturers taking slightly the upper hand • Supplier power of airports vis-à-vis airlines, in which regional airports lose out over hub airports	• Evolving buyer power between airlines and passengers, that is gradually moving to the benefit of consumers • Developing company policies with greater emphasis on online meetings • Fluctuating buyer power between airlines and travel agencies, where the latter's strength is on a downward trend • Different levels of buyer power at European airports, where regional airports have the least power • Evolving trends in the airport retail stores policy to gain purchasing power	• Involvement of stakeholders in the regulatory process • Power of Member States and European institution to regulate the sector • EASA influence on certification processes • Power of bilateral agreements between Member States • The role of regulatory authorities with regards to tax regulation • The effect of environmental regulation on the sector (e.g. ETS, slots, taxes, etc.) • Involvement of local authorities to subsidise regional routes and/or airports (subject to compliance with EC Guidelines)

3.2.1.1 Threat of new entrants

The threat of new entrants implies that the positioning of a company is subject to the extent to which new start-ups can enter the market. Consequently, it is important for companies to ask the question of how this can be done easily. For example: "Do significant investments need to be made?", or "Does a strict legislation prevent new companies from entering the market?". If there are high barriers of entry in the industry in question, this is to the advantage of the incumbent airlines and it can be taken advantage of. An example is the presence of economies of scale in the market, referring to the cost advantage of a firm when increasing their level of output.

- **Barriers of entry protecting the incumbents from new entrants:** When a new airline wants to enter the airline industry, there are some barriers that need to be overcome. First of all, there must be significant start-up capital available, as starting up an airline involves high costs. In addition, the operator must be in possession of all the necessary certificates and documents for the aircraft in the fleet so that all operations can be carried out safely. For example, it is important for maintenance staff that they have obtained the necessary licences (EASA PART 66) to carry out maintenance on the aircraft legally. This also applies to the pilots, cabin crew, etc.

  However, studies have shown that none of these entry barriers are considered to be the main barriers of entry for European aviation[269]. After questioning the airline managers of 58 different European airlines, it was found that the availability of slots at airports and the presence of the high-speed rail network are regarded as the main barriers. From this it can be seen that the barriers of entry vary according to the continent. For example, in the US, the train network is not considered as a barrier of entry by the airlines since the absence of a well-thought-out train network gives them an advantage. In the future, both barriers will continue to be the main reason preventing new operators from starting an airline, because an increasing shortage of slots will be present at European airports and the growing climate awareness will feed the market share of rail traffic.

- **The breakthrough of the oligopolistic market of aircraft manufacturers:** The current world of aircraft manufacturers is mainly dominated by Airbus and Boeing. However, this could change in the future with the arrival of the Chinese aircraft manufacturer COMAC. The arrival of this new player on the market could lead to additional pressure and competition on the other manufacturers. For example, the C919 was designed to compete with the B737MAX and the A320 family[270], as the features of both aircraft are comparable. However, COMAC will need to overcome some barriers before it can compete with Boeing and Airbus. For example, the US-China trade war could throw a spanner in the work, if US suppliers are banned from working with COMAC. Honeywell, for example, supplies the company with electronic systems and the landing gear[271]. Furthermore, the C919 has to obtain approval from the FAA and EASA to fly over the American and European continent respectively, certification processes that take time. Although COMAC may not pose a threat to Boeing and Airbus in the next few years, it can certainly grow exponentially by responding to the Asian market, which is expected to see the largest growth in aviation.

  What is certain, is that the threat of new entrants for aircraft manufacturers in general is very low as the market is dominated by a few aircraft manufacturers that have created an enormously strong image over the years, making it difficult for new entrants to compete.

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[269] https://www.sciencedirect.com/science/article/pii/S1366554513000161
[270] https://simpleflying.com/comac-c919-737-max-competition/
[271] https://www.engineering.com/AdvancedManufacturing/ArticleID/19642/Comac-Has-a-Plan-to-Challenge-Boeing-and-Airbus.aspx

- **Can closure of regional airports reduce competitive pressure?** Not only airlines are in competition with each other, but also airports. When different airports have an overlapping catchment area, they are in competition with each other as travellers can choose from which airport they want to start their journey. Because of this, more and more airports try to improve their services in order to distinguish themselves from the others. It is not always easy for secondary airports to outperform the large, primary hubs, especially now that LCC are operating more and more frequently from the primary airports, causing them to lose part of their aeronautical revenues (See 2.1.2.2 Metropolitan airport systems: what is the trend for low-cost peripheral airports?).

  As a result, certain regional airports may face difficulties in the future and will have to close down, which will reduce the competitive rivalry as far as airports are concerned. For example, a report by T&E states that European airports that do not make a profit within five years are no longer allowed to receive State aid and must close[272]. This statement, however, gets headwinds from, among others, ACI Europe. Today, 71% of regional airports in Europe are loss-making[273]. The report states that their closure would be beneficial for the environment. Even though regional airports account for only 3% of total European air traffic, which means that their closure has at first sight only a negligible impact on the environment, it can still lead to major economic consequences. This, since the state aid received by many of them can be used to further focus on the climate impact of aviation. However, it should be taken into account that the closure of regional airports may lead to an increase in road traffic emissions, as passengers will have to bridge a further distance to their departure airport.

Considering the airline industry, the threat of new entrants is concluded to be considered as low. Since the opening of a new airline implies a significant investment, several licenses and certificates and qualified staff, existing players have a competitive advantage compared to the new opponents.

Moreover the experienced airlines have built up an extensive network, including well-thought-out loyalty programmes that lead towards a strong positioning in the market and a significant barrier of entry for newcomers. However, emergence and consolidation of low-cost airlines over the last two decades showed that the market could be disrupted by new players with innovative business models.

European airlines market presents a tougher competitive environment than in other comparable regions in the World (Northern America, China, Japan, etc.). Even if consolidation occurred over the last ten years, competition remains intense.

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[272] https://www.internationalairportreview.com/news/98666/aci-dismisses-call-close-regional-airports/
[273] *Ibid.*

3.2.1.2 Threat of substitutes

The threat of substitution segment identifies products or services allowing consumers to switch from one product or service to another one, giving them the same level of utility or satisfaction. If customers can easily substitute, the company's position in the market will be weakened, which might be detrimental to its profitability. In the airline industry, the threat of substitutes implies the several modes of transportation offered on the market. When looking at the short-haul market for example, high-speed rail is a considerable substitute for travellers with a low-sensitivity to travel time but a high price sensitivity.

- **Europe's advanced high-speed rail network:** Europe has developed a very extensive and advanced train network over the past decades (see 2.1.5.1 Trends on modal competition). This network brings many benefits but also poses a threat to air traffic when it comes to domestic and intra-European flights. Travellers often prefer the train to cover these relatively shorter distances as the time lost at the airport before the flight compensates for the extra time spent travelling. Furthermore, the climate protests of recent years have made many travellers aware of the environmental impact of their flights. As a result, rail traffic in Europe has grown steadily in recent years, for example by 1.5% between 2017 and 2018[274] and is therefore seen as a major transport mode for substitution of European air traffic. Nevertheless, the high-speed rail network, and consequently intra-European traffic, has in turn been facing strong competition in Europe in recent years from bus companies such as Flixbus (this point will be developed in more detail in the next bullet point). Furthermore, the rail network does not offer substitute to all aviation sectors in the world. For example, there is only one high-speed rail company operating in the US, Acela Express, which connects Washington and Boston[275]. This "shortcoming" is considered an advantage by many US airlines.
- **The increasing popularity of bus companies and carpooling:** Not only trains, but also buses and cars pose a threat to the growth of intra-European air traffic. In recent years, the well-known bus company "Flixbus" has gained tremendous popularity. For example, in 2018 the company controlled 94% of the long-haul bus business on its home market.[276] Moreover, just like the LCC, it offers low fare tickets that are often even cheaper than what airlines offer. High frequency and an extensive network also contribute to their success story. Moreover, carpooling is increasingly appreciated by the population too, the concept of "BlaBlaCar", for example, is very popular in France, where 40% of the population aged between 18 and 35 make use of it[277]. All these forms of substitution ensure that airlines are not only in competition with each other but also with other modes of transport. In addition, this phenomenon affects the regional airports, as the increasing number of travellers who prefer the bus or train as a means of transport is making it increasingly difficult for them to cope with the intensely competitive aviation sector.

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[274] https://ec.europa.eu/eurostat/statistics-explained/index.php/Railway_passenger_transport_statistics_-_quarterly_and_annual_data
[275] https://www.hindawi.com/journals/jat/2017/8426926/
[276] https://www.dw.com/en/flixbus-europes-hottest-bus-operator-turns-5/a-42562177
[277] https://techcrunch.com/2018/09/24/blablacar-is-on-the-path-to-profitability/

- **Digital travel: A distant dream or soon to be a reality?** In recent years, new features and technologies have facilitated various processes at the airport and in the cockpit. In the future, innovative ideas will continue to make their way into the aviation sector and maybe also into the tourism industry. For example, will people soon be travelling, not in real life but virtually? Dr. Ian Pearson predicted that, by 2050, the way people live would be changed by virtual reality[278]. It may become possible that putting on a pair of glasses will be able to get people to their favourite holiday destination faster than any other flight. Therefore, digitalisation can partly substitute travel. Furthermore, the introduction of virtual reality goggles is already ensuring optimal empathy in a virtual world and this trend could perhaps continue in the tourism sector. In addition, the number of mobile virtual reality users rose from 18 to 110 million between 2016 and 2019[279]. Nevertheless, this phenomenon is certainly not yet for the next few years and it is highly likely that many travellers will still want to travel in "the good old way". Nonetheless, this form of digital travel could replace short stays, or offer a solution for that part of the population that cannot afford a real journey.

- **Climate awareness leading to the revival of local tourism:** In recent years, the many climate protests have often been a major focus of the news. Global warming is becoming a known fact and it is necessary to take action. The aviation sector was often seen as one of the main culprits in terms of global warming and the protest groups called on travellers to travel more consciously and to opt for the train. Especially in Northern Europe, this phenomenon had a major impact. For example, domestic travel in Sweden decreased by 9% in 2019[280] and general air traffic passing through their airport by 4%[281]. In the future, this phenomenon may spread further and travellers may prefer holidays closer to home. This has already been the case in recent years, with almost 80% of the population travelling within their own regions[282]. Furthermore, when studying popular European holiday destinations such as France and Spain, it was found that in 2017, 70 million out of 87 million tourists in France came from Europe. For Spain, this figure was even higher: 75 million out of a total of 82 million tourists. This is good news for the local tourism sector, as it is booming again.

  However, this trend can be detrimental to intra-European air traffic, since travellers can travel by train, bus or simply the car. In this way, local travel can also be seen as a threat of substitution for the European aviation market.

- **The re-emergence of tourism in North-Africa:** Sunny destinations such as Tunisia and Egypt have always been very popular among European tourists. Unfortunately, the effects of terrorist attacks in these countries have affected local tourism in recent years. For example, the terrorist attack in Egypt on a Russian plane in 2016 caused the Russian population to avoid the country. As a result, revenues fell by half from $7.4 billion in 2015 to $3.8 billion in 2016[283]. This testifies to the fact that tourists associate certain North-African destinations with a feeling of insecurity. Nevertheless, the local tourism sector is recovering rapidly. For example, the number of international tourists in Tunisia rose again from 5.7 million in 2016 to 9.5 million in 2019[284]. In the future, this recovery and upward trend will most likely continue, as peace has returned to several countries and their image has been restored. Consequently, more travellers will once again find their way to these touristic destinations. This may, on the one hand, have a negative impact on the local tourism sector in Europe but, on the other hand, it may also be to the advantage of the European airline industry, as tourists will have to travel there by plane.

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[278] *Ternès, 2018, p.74*
[279] *Ibid., p.74*
[280] *https://www.reuters.com/article/us-airlines-sweden/swedens-air-travel-drops-in-year-when-flight-shaming-took-off-idUSKBN1Z90UI*
[281] *https://www.bbc.com/news/world-europe-51067440*
[282] *https://www.theguardian.com/news/2019/jul/01/global-tourism-hits-record-highs-but-who-goes-where-on-holiday*
[283] *Neagu, 2018*
[284] https://thearabweekly.com/tunisias-tourism-sector-shows-signs-recovery

3.2.1.3 Bargaining power of customers

This force determines to what extent customers are able to put the organisation under pressure. If the company has a large amount of customers, the bargaining power of them will be low. On the other hand, however, the bargaining power will be high in case of having a small and selected group of buyers. Another factor having an impact on the bargaining power is for example the switching cost. If the cost of switching from one product to another is low, the bargaining power of the buyers increases and vice versa.

- **The evolving buyer power between airlines and their passengers:** The purchasing power of passengers in relation to the airlines was variable over the years. While passengers did not have the possibility to compare different offers, before the emergence of online price comparison, they can now find the cheapest offer for their search with just one click. As a result, today's passengers get buyer power. Partly due to transparency and the extremely competitive market in which the aviation sector finds itself, it is difficult for airlines to regain this power. Moreover, the arrival of low-cost carriers has meant that legacy carriers have had to bend over backwards to take part in the price war, as travellers are becoming increasingly price sensitive and want to travel as economically as possible. But not only comparing prices between different airlines is very easy today, passengers can also easily compare the price of their airline ticket with that of, for example, the bus, train or car. In conclusion, the purchasing power between passengers and airlines today is to the advantage of passengers and will probably remain so in the future as passengers will travel more and more price-conscious.

- **The evolving business travel policy of companies:** The purchasing power of the airlines towards companies is in transition since companies have changed their travel policy in general: not only in terms of price but also in terms of climate. These days, for example, many institutions are replacing meetings that do not necessarily require a specialist on site with online meetings where the negotiations can be discussed by means of a Skype call. Moreover, a study in which more than 1300 professionals were interviewed showed that 55% of them felt that a video conference resulted in more innovative and collaborative work[285]. Nevertheless, another study in which more than 2,000 professionals were interviewed worldwide found that 81% thought face-to-face meetings were better for building a long-term business relationship[286]. In any case, due in part to the increasing number of employees who work from home during one or more days, video conferencing is gaining in popularity. In addition, it also leads to cost and time savings for the company. As a result, the proportion of business travellers in European aviation may decrease in the future.

- **The fluctuating balance of buyer power between airlines and travel agencies:** The travel agencies have given up a lot during the last decades due to the arrival of internet and especially due to the increasing popularity of the online booking system. Whereas travellers used to have to book their trip through a professional travel agent who searched for the best offer, nowadays they do this themselves from home. For example, only 43% of current travellers still use a travel agency[287].

  Due to this fact, the purchasing power of travel management companies has decreased significantly over the years as they have become superfluous for many travellers. However, travel agencies still have a certain amount of purchasing power in niche markets that are mainly operated by charter airlines. Moreover, the older generation of the population, who are nowadays travelling more and more, prefers to use a travel agency. In general, the purchasing power of travel agencies can be described as a downward trend due in part to the innovative IT technologies available on the market.

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[285] https://www.techrepublic.com/article/how-video-conferencing-is-reducing-business-travel-and-increasing-productivity/
[286] https://www.gdg.travel/blog/are-virtual-meetings-impacting-business-travel/
[287] https://www.travelagentcentral.com/running-your-business/stats-43-travelers-prefer-travel-agents-for-air-bookings

- **The market power of European airports:** Do European airports have market power? While some airports are considered as true monopolies, the market power of others is negligible. A study on market power carried out by Copenhagen Economics and sponsored by ACI Europe[288] states that the liberalisation of aviation has resulted in a reduction of airport power. Another study published in 2010 revealed "*high degrees of market power and low countervailing power for most of the largest airports, such as Paris, Frankfurt, Madrid, Rome or Amsterdam.* […]. *The only element of countervailing power appears in cases when the respective hub carrier can threaten to switch a larger number of transfer passengers to alternative hubs it might operate, such as AMS versus CDG for Air France/KLM or MUC/VIE/ZRH versus FRA for Lufthansa.*"[289]

  Namely, airline liberalisation has brought about changes in the demand side of airports, leading to increased airline switching and inter-airport substitutability. Today, it is concluded that a European airport has market power if it can impose higher than average tax charges. For example, when looking at London's various airports, it can be noted that London Heathrow, almost exceptionally served by FSNC, applies the highest tax rate. London Stansted, on the other hand, charges much lower costs, but that is precisely what makes the airport attractive to LCC. In France, the difference between Paris Charles de Gaulle and Paris Orly is negligible. In conclusion, there can be no uniform decision on the possible monopoly positioning of European airports. What is clear from the study is that the market power is linked to the type of ownership of the airport. For example, all London airports are under private or public-private ownership, while airports in Germany are mainly public.

  Smaller regional airports have a very limited market power, especially if these airports are served by one or two airlines. The latter have much more influence to negotiate reduced fares and marketing support.

- **The evolving trends of airport retail stores**: Digitalisation does not only have an impact on airline and airport processes, but also on the daily shopping behaviour of consumers. If one projects this on the airport retail sector, it can be seen that many travellers today are frequent users of digital shopping tools. This implies that people are increasingly buying and comparing products online. Furthermore, consumers also expect the shopping areas to become more digital, which will improve their shopping experience. In the future, it will be important for retailers to adapt to the changing needs of customers if they are to meet their ever-evolving requirements. In recent years there has been a trend in consumer behaviour at airports, with the share of food and beverages increasing. For example, it turned out that more than 50% of passengers eat or drink during their visit to the airport and that retail is increasingly responding to putting local products on the map[290]. According to Walter Seib, CEO of HMSHost International, is "eating the new shopping". Luxury brand shopping also gained popularity, with the average spending on luxury brands at Rome Fiumicino airport amounting to 500 euros in 2017[291]. In the next five-year period, new technologies will enter the retail industry. For example, IATA's NDC and ONE order will strengthen airline retail[292]. This concept implies that additional, passenger-specific requirements, which may consist of airport facilities, can be added to the flight booking. Furthermore, products will be promoted to passengers even before they reach the airport, making the shift from impulse decision-making to planned decision-making[293].

For this segment too, it is not possible to form a general conclusion about buyer power in the European aviation market, as it has to be evaluated from market player to market player.

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[288] https://centreforaviation.com/analysis/reports/european-airports-monopolies-or-exploiting-market-power-512724
[289] Reichmuth, et al., 2010, p.37
[290] https://www.internationalairportreview.com/article/34899/airport-retail-non-aviation-business/
[291] Ibid.
[292] Ibid.
[293] https://www.airport-technology.com/features/airport-retail-trends-2019/

3.2.1.4 Bargaining power of suppliers

This force determines the capability of the organisation's supplier(s) to raise the price of the input. In this segment, the total number of suppliers and available substitutes are crucial if one wants to determine the bargaining power. A high number of suppliers will increase the power of the organisation whereas a low amount of substitutes is an advantage for them. Furthermore, switching costs and the level of differentiation also have an impact, positive or negative, depending on the point of view it is approached from.

- **The supplier power between aircraft manufacturers and airlines:** Given that the aircraft manufacturers' market is mainly dominated by Airbus and Boeing, the supplier power of the aircraft manufacturers vis-à-vis the airlines is high[294]. Due to the fact that the airlines do not have a wide range of manufacturers at their disposal and the availability of production lines, the manufacturers have relatively high supplier power over them. This means that Boeing and Airbus have a certain freedom to negotiate the price since the airlines do not have the possibility to easily switch to another manufacturer offering them a better proposal. On the other hand, supplier power may also lie more with the airlines when they order a large number of aircraft at once, as LCC such as Ryanair often do. For example, the Irish budget airline placed an order for 210 737MAX aircraft[295]. Furthermore, ANA provided in 2014 to order 70 aircraft from Boeing and Airbus spread over the years from 2016 to 2027[296]. This in order to get a bigger discount than the average of 40% on the list price[297]. In this case, the airline is more free to negotiate the price given the size of the order. In conclusion, supplier power cannot be placed unequivocally on either party, but depends on the situation.
- **The supplier power of airports vis-à-vis airlines:** Both airlines and airports find themselves in a market where the competitive level between the various players is very high. This makes it interesting to discuss the supplier strength between both parties. Depending on the type of airport, the power lies with one of the two parties. When looking at the primary hubs, the airport has the supplier power. The availability of slots is in fact scarce at these airports as many of them are already fully saturated, which means that airlines have little freedom to negotiate, for example, taxes. This is completely different at the secondary, more regional airports. These airports have to make sure that they retain the few airlines that operate their flights to and from their airport. Therefore, airlines have more opportunity to obtain lower taxes as these airports are, as it were, dependent on the airlines.

  This is particularly the case for airports handling up to 1 million passengers per year[298]. An example of this is the airport of Carcassonne in the South of France, where the total number of passengers in 2016 and 2017 was respectively 392,038 and 291,209[299]. This low passenger number is the result of the fact that only Ryanair offers commercial flights from the airport. As a result, Ryanair has enormous supplier power over Carcassonne airport, as it is partially dependent on the aeronautical and non-aeronautical revenues it obtains from Ryanair. If their only commercial airline is dissatisfied with the taxes it has to pay to the airport, it is likely that Ryanair will decide to operate only flights from nearby Toulouse airport, which could mean the end of Carcassonne Airport. It can therefore be concluded that the supplier power between airports and airlines varies greatly from one airport to another.

  Smaller regional airports largely rely on LCC to develop their traffic sometimes only one. If a LCC focuses on small airports to develop its traffic, it can therefore develop a very strong supplier power against these airports and generate a strong competition between them.

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[294] https://fr.scribd.com/doc/58246013/Bargaining-Power-of-Suppliers-and-Airline-Industry
[295] https://www.rte.ie/news/business/2020/0203/1112728-ryanair-quarterly-results/
[296] https://asia.nikkei.com/Business/ANA-places-bulk-plane-orders-with-Boeing-Airbus
[297] *Ibid.*
[298] https://www.sciencedirect.com/science/article/pii/S2352146517310888
[299] https://www.carcassonneairport.net/passenger-statistics.shtml

It is difficult to form a general conclusion about the supplier power in the European aviation market, as this aspect has to be seen from market player to market player. Nevertheless, supplier power is an evolving item, where power can often shift slightly, given the economic situation in which aviation finds itself or the market players considered.

3.2.1.5 Competitive rivalry

At the heart of the Porter five forces scheme, the competitive rivalry is represented. This force studies the intensity of the current competition in the industry by identifying the number of competitors, their size and power on the market. Besides the number of competitors is the concentration ratio a good indicator of the competitive rivalry. A low concentration ratio means that the level of competition between airlines is high and vice versa.

- **The increasing competitive pressure coming from the MEB3 carriers:** Qatar Airways, Etihad Airways and Emirates, often referred to as the MEB3 carriers, have built up an extensive route network in recent years and are considered to be strong competitors for European airlines. Adding more destinations to their network strengthens their market position. For example, Qatar Airways added as many as fifteen new destinations to its network between 2017 and 2018 and additional capacity to their weekly flights[300]. Looking at the top fifteen countries where the three airlines have the biggest ASK growth, five of them are in the European Union (UK, Germany, Spain, Italy and France)[301]. Moreover, their activities have resulted in an expansion of +360% presence in Europe since 2005[302]. All this data testifies to having a high frequency of direct routes from Europe to the Middle East and consequently a high level of competition between the MEB3 airlines and the European carriers. This for both passenger transport and cargo. Furthermore, the favourable positioning of the hub of Emirates in Dubai and Turkish airlines at Istanbul airport also ensures significant market power. The location of their hub allows them to make optimal use of the Sixth Freedom Right, where a carrier can transport traffic between two third States via the home state of the airliner.

- **Intense hub competition between the different airports in the world:** The hub-and-spoke system is one of the most widely used transport systems in the aviation sector. Competition between the different hubs is increasing but also depends on the positioning of the airport in Europe. For example, airports in Eastern Europe face hardly any competition, whereas for Western Europe it is much higher (see 1.3.3 Airport competition). Competition between European airports has remained stable in recent years and is expected to remain so in the future, given the already highly competitive market and barriers of entry for new operators. However, international hub competition will increase. For example, Dubai airport, which handled 86.4 million passengers in 2019 and was the world's busiest hub for the sixth year in a row[303], believes that by 2021 it could surpass airports such as Beijing as the busiest in the world[304]. This growth of airports in the Middle East leads to increased competitive pressure on European airports, especially on the spokes of their hub-and-spoke system. This may lead to an adjustment of the business models of European airlines in order to alleviate this pressure.

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300 https://www.anna.aero/2019/01/09/meb3-network-review-2018-qatar-airways-dominates-new-route-race-us-is-biggest-market-by-asks-india-and-uk-top-capacity-table/

301 *Ibid.*

302 https://www.anna.aero/2015/11/18/emirates-etihad-airways-and-qatar-airways-in-europe-analysed/

303 https://www.thenational.ae/business/aviation/dubai-international-retains-number-one-rank-as-world-s-busiest-hub-for-international-passengers-1.974319

304 https://www.reuters.com/article/us-dubai-airport/dubai-airport-handles-89-1-million-passengers-in-2018-misses-target-idUSKCN1PM0D8

- **The shift of low-cost carriers to primary airports:** Initially, the low-cost airlines focused mainly on secondary airports, as these are often subsidised to add these destinations to their network, thus boosting tourism and, consequently, the local economy in that region. In addition, the airlines benefit from reduced taxation than if they were flying to a hub. Recently, however, this trend has been changing and more and more low-cost carriers are also adding primary airports to their network. This is done using a trade-off: revenue per passenger is higher than at secondary airports, even though it is more difficult to obtain an optimal turnaround time and the costs of loading are higher. European airports with increasing LCC penetration are London Gatwick and London Stansted with 62.2% and 96.7% respectively, Copenhagen with 32.9%, Amsterdam with 22.2% and Madrid with 20.6%[305]. Nevertheless, the share of LCC carriers at primary hubs varies widely across Europe. A further increase in the number of LCC carriers adding primary airports to their network is expected in the future. This is partly due to the greater potential for attracting business travellers, the increased use of self-connection and, above all, the growing demand from passengers for the availability of LCCs at an airport, resulting in increased demand from the airport operators themselves. As a result, the level of competition on the hub's FSNC will increase.
- **The increased consolidation of airlines**: In recent years, the European aviation market has been consolidated. Studies have shown that by 2018, two thirds of total passenger transport in Europe was handled by only five operators (see 2.1.3 Airlines Developments). Furthermore, the four largest European airlines (Ryanair Air France-KLM, Lufthansa and IAG) control 40% of the market[306]. In addition, IAG hopes to carry out 80% of domestic travel in Spain by the end of 2020[307]. In any case, consolidation in the US is even greater, with 74% of total traffic being handled by four US airlines (American Airlines, Delta Airlines, United Airlines and Southwest Airlines)[308]. As the number of operators decreases, the market becomes oligopolistic and competition between airlines further decreases. In the future, further consolidation of European air traffic is a real possibility. The consolidation of European airlines could be advantageous, inter alia, since it has become increasingly difficult to obtain slots, which could hamper a company's rapid growth and, more importantly, since it would ensure more sustainable growth in the sector.
- **The saturation of high volume city pairs:** Some routes between European cities or between a European and non-European airport are operated by several airlines, which saturates these routes and makes the competitive level very high. For example, the highest volume city pair within Europe in 2017 was London-Dublin[309]. Furthermore, nine of the top ten most competitive intra-European routes started or ended in London and five routes included airports in Spain[310]. All city pairs in the top ten were served by four to eight different airlines. When it comes to air traffic to and from Europe, the most competitive route in 2019 was from Stockholm to Antalya. This leg was operated by eight airlines, two of which were LCC. Further saturated routes include Stockholm-Chania, Stuttgart-Antalya and Dusseldorf-Antalya with seven airlines each[311]. A clear trend is therefore visible. Different scenarios are possible in the future: for example, the entry of long-haul narrow body aircraft could increase pressure from LCC on specific high volume city pairs or a further consolidation of European air traffic could reduce competitive pressure on some routes.

In conclusion it can be said that the competitive rivalry in the air transport industry is very high, especially with the entry of low-cost carriers, the barriers of entry, low switching costs and customers that can compare prices at any time and any place.

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[305] https://centreforaviation.com/analysis/reports/lccs-increasingly-attracted-to-primary-airports-459531
[306] https://qz.com/1742580/european-airlines-are-beginning-the-long-process-of-consolidation/
[307] *Ibid.*
[308] https://www.aerotime.aero/rytis.beresnevicius/24527-consolidation-in-europe-worrying-times
[309] https://centreforaviation.com/analysis/reports/europes-top-10-airline-routes-analysis-reveals-market-characteristics-and-developments-354183
[310] *Ibid.*
[311] https://www.routesonline.com/news/29/breaking-news/284362/europes-most-competitive-airport-and-city-pairs-/

3.2.1.6 Influence of authorities

Even though Porter's strategy includes five forces, more and more organisations include a sixth force, i.e. the power of the authorities. Despite the fact that this segment is not included in the original scheme, it is very important to take into account since all regulating authorities, whether they are at national or international level, have the power of modifying the profit made by companies. The several aspects that have to be questioned are the taxes or presence of environmental regulation in a country, whether the authority is a client or supplier for the firm, the level of protectionism in the country or the financing role of the state.

Influence of authorities in the European aviation market takes place at various levels:

- **At the European level:**
  - *Stakeholder involvement in the regulatory process*: The regulatory process for European aviation is strict and binding. It has been drawn up by experts with the greatest care and in as fair a manner as possible. Nevertheless, there is often shareholder interference during the drafting of the legislation. As a result, the legislation is no longer completely impartial and can therefore be considered unfair by certain parties in the sector. Moreover, lobbying practices often take place. For example, the trade association "Airlines for Europe" was created in 2016[312]. This group consists of both legacy carriers and LCC and was created in response to the perceived ineffectiveness of the previous major European airline association. Comprising 16 airlines, the group represents more than 70% of European air traffic. According to sources, the lobby group currently has six active lobby representatives in the European Parliament who are committed to defending the rights of these European airlines and ensure a fair competitive European aviation market.
  - *The strong power of Member States and European Institutions on the sector:* There is considerable intervention on the part of the authorities when it comes to granting State aid to a given country. For example, the European Commission controls the process of granting State aid and can therefore reclaim it if it is convinced that it has been granted unduly. By monitoring and coordinating the regulatory process, the European Commission wants to ensure that there is fair competition in the aviation sector throughout Europe and that there are no practices that disrupt it. Furthermore, in order to be as transparent as possible in the decision-making process, a "State aid scoreboard" is published every year in which a clear and complete overview of the various expenditures is represented.
  - *The influence of the EASA certification process on airports and airlines*: Since both airlines and aerodromes have to comply with the strict guidelines drawn up by the overarching European legislative organisation EASA before they can start operations or operate an aerodrome, it can be said that EASA has a major influence on the various players in the aviation market. Non-compliance with the established rules can have serious consequences for operators, such as airport closures. Furthermore, it is important that airlines are always in regulation with all the necessary documents to fly over European territory, as a serious infringement of the regulations can lead to the inclusion of the airline on the list of banned operators[313]. In the future, EASA's influence will remain strong, as safety will always remain the main value of the aviation sector. Beyond EU borders, EASA standards can also be prerequisites through the negotiation of bilateral aviation safety agreements with third countries.

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[312] https://a4e.eu/

[313] https://ec.europa.eu/transport/modes/air/safety/air-ban/search_en

- **At Member State level:**
  - *The power of bilateral agreements between Member States*: Despite the fact that, in recent years, the European Commission has tried to harmonise the various agreements that exist between the Member States of the European Union and third parties, the strength of bilateral agreements directly concluded between different Member States and third countries remains high. Moreover, in order to counter the legal restrictions that prevent the further sustainable growth of international air traffic, the European Commission has drawn up several comprehensive agreements between EU and non-EU countries that have allowed further liberalisation of the aviation sector (see 2.1.1.3 Aviation agreements).

    Nevertheless, the EU will in the future continue to focus on the further unification of agreements in order to achieve a harmonisation of conventions.
  - *The impact of a prolific flag carrier on the state*: Having a thriving and profitable flag carrier is a very important issue for many countries due to the fact that owning their own airline provides a lot of job opportunities and thus influences their economy. Consequently, a country will often attach great importance to its flag carrier and will therefore try to protect it in the event of an exceptional crisis. Nevertheless, the question arises as to whether having your own flag carrier is really advantageous in recent years. This is because, if a bankruptcy is imminent, the government will have to assist them financially to counter a major economic blow, as is the case today due to the sanitary crisis[314]. Many airlines, including flag carriers, are struggling to survive and will receive State aid to overcome this situation and thereby contribute back to the recovery of the country's economic empowerment. Therefore, it can be concluded that having a flag carrier can be very beneficial for the country's economy and employment, but only in times of economic prosperity.
  - *The role of the regulatory authorities in the process of tax regulation*: There are different types of taxes associated with the operation of flights to and from a given airport. The total amount depends on the type of airport to which the airline flies: for example, it costs the airline more to fly to Paris Charles de Gaulle than to Carcassonne airport. Currently, airport taxes are subject to the national authorities of the Member States. Nevertheless, the debate concerning the levying of taxes at European airports has recently been reopened. In 2009, the Airport Charges Directive (ACD) was drawn up by the European Commission; this document was considered to be a guide to the preparation of airport taxes in a country and was applicable to hubs handling more than five million passengers a year or the country's largest airport. The document has recently met with considerable opposition from IATA, in part due to the fact that the international organisation states that 60% of passengers in Europe travel through only 25 airports[315], giving them more power than other hubs. Furthermore, IATA concluded inter alia that, in the period between 2009 and 2017, the number of passengers travelling through airports that were included in the ACD increased by 55.2% while the passenger number in Europe increased by 38.5%[316]. Finally, IATA's report stated that the ACD did not prevent European airports from levying taxes above the regular competition level. Therefore, it may be important for the future of the European aviation market that this regulatory document is further elaborated and refined, whether or not in cooperation with the international authorities.

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[314] https://www.economist.com/gulliver/2019/03/22/flag-carriers-increasingly-pose-a-too-big-to-fail-problem-for-some-finance-ministries

[315] https://www.airport-technology.com/features/airport-taxes-in-europe/

[316] *Ibid.*

- **At local government level:**
  - *The effect of environmental regulation on the sector (e.g. ETS, slots, taxes, etc.)*: Airports, regardless of their size and extent, have an impact on the local and ultimately the global climate. This is partly caused by emissions from aircraft and ground vehicles, noise pollution for local residents or, for example, the disturbance of the fauna and flora around the airport grounds. As a result, the number of climate protests at airports has risen by 25% in recent years[317]. In order to compensate for all these forms of pollution, climate regulations have been drawn up by the local authorities.

    To date, 203 European airports in 42 countries have signed the agreement, accounting for 64.3% of European passenger transport[318]. In the future, more and more airports are expected to join this commitment, which will enable the European aviation market to take continuous steps to become more climate-neutral in the coming years. Nevertheless, the initiatives to be taken to achieve this will have a major impact on airports as they will be encouraged to invest in, for example, energy efficient buildings or to install renewable energy systems, both of which are major investments.
  - *The local authority's decision to subsidise regional airports*: In order to stimulate tourism in certain regions, it is often decided by local authorities to subsidise regional airports. In this way, airlines can be attracted to add the regional airport to their network, as they will have to pay lower airport taxes than when flying to a primary hub. Attracting airlines will improve local tourism and thus the economy. Over the past few years, regulations governing the local authorities' right of decision on investing in facilities at regional airports have been amended. This change states that local governments will no longer have to obtain approval from the European Commission for investment in the infrastructure of airports handling less than three million passengers a year[319]. This had an impact on 420 European airports, representing 80% of the total number of airports in Europe, but accounting for only 13% of total air traffic[320]. This adjustment is seen as a positive aspect, giving more freedom to local governments. Nevertheless, since the debate concerning the granting of State aid to regional airports has recently been reopened (see 3.2.1.1. Threat of new entrants), the future of some European regional airports might be uncertain.

In conclusion, it can be said that the authorities play a very important role in the aviation sector. They have a great deal of decision-making power when it comes to granting for example licences, certifications or state aid. Furthermore, the authorities can decide on the continuation or temporary suspension of an airport or airline. It can therefore be concluded that the authorities' interference in the European aviation market is considerable and that both airlines and airports are strongly influenced by their decisions.

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[317] https://www.internationalairportreview.com/article/77656/effects-climate-change-airports/
[318] https://www.forbes.com/sites/marisagarcia/2019/09/23/europes-airports-step-up-to-climate-change-challenge/#8657b8a7d526
[319] https://www.ft.com/content/a4087e26-3aef-11e7-ac89-b01cc67cfeec
[320] https://www.reuters.com/article/us-eu-airports-stateaid-ports-idUSKCN18D1AJ

APPENDIXES

Appendix A. List of LCCs

Airline code	Airline name
0B	Blue Air
2B	Albawings
3O	Air Arabia Maroc
3Z	Smartwings Poland
4U	Germanwings
5F	FlyOne
6D	Smartwings Slovakia
7O	Smartwings Hungary
8Q	Onur Air
8Z	Wizz Air Bulgaria
AD	Azul Airlines
BF	French Bee
BLX	TUIfly Nordic
BV	Blue Panorama Airlines
CAI	Corendon Airlines
CND	Corendon Dutch Airlines
CO	Cobalt Air
D8	Norwegian Air International
DE	Condor Flugdienst
DI	Norwegian Air UK
DK	Thomas Cook Airlines Scandinavia
DP	Pobeda Airlines LCC
DP	Pobeda
DS	Easyjet Switzerland
DU	Norwegian Long Haul
DW	Great Dane Airlines
DY	Norwegian Air Shuttle
E2	Eurowings Europe
EC	Easyjet Europe
EG	Ernest Airlines
EW	Eurowings Luftverkehrs
FR	Ryanair
FZ	flydubai
G9	Air Arabia
HG	NIKI
HQ	Thomas Cook Airlines Belgium
HV	Transavia.com
JON	Jonair
LS	Jet2.com
LV	LEVEL (operated by OpenSkies)
MON	Monarch Charter
MT	Thomas Cook Airlines
OE	Laudamotion
OR	TUI fly Netherlands
PC	Pegasus Airlines
PF	Primera Air
PQ	SkyUp
QS	Smartwings
RK	Ryanair UK
SE	XL Airways France
SS	Corsair Intl
TB	TUI fly Belgium
TO	Transavia.com (France)
TOM	Thomson Airways
TZ	Scoot
U2	Easyjet
V7	Volotea
VK	LEVEL (operated by Anisec Luftfahrt)
VY	Vueling Airlines
W6	Wizz Air
W9	Wizz Air UK
WAU	Wizz Air Ukraine
WK	Edelweiss Air
WS	WestJet
WU	Wizz Air Ukraine
WW	WOW air
X3	TUIfly
XG	SunExpress Deutschland
XQ	SunExpress
XY	National Air Services-NAS
ZB	Monarch Airlines

Appendix B. Measuring airline and airport competition

Airline competition

The Herfindahl-Hirschman Index (HHI) to measure airline competition

The HHI is a measure for market concentration. Since an increase in market concentration is generally accompanied by a decrease in the degree of competition the HHI can also be used as a measure for competition. One can calculate the HHI of a market by adding up the squared market shares of the firms that operate in that market. The resulting HHI ranges from 0 till 1. A HHI of 0 indicates perfect competition, whereas a HHI of 1 indicates a monopoly. So, an increase in the index indicates a decrease in the degree of competition.

To measure airline competition using the HHI indicator, we use airline market shares per origin-destination market.[321] In the calculation of the HHI we take into account airline alliances. When an alliance is active on a market we calculate the HHI on the basis of the market share of the alliance (instead of the market shares of the individual airlines member of that alliance). The HHI on a specific origin-destination market is calculated by summing the squared market shares in terms of passengers for every airline that operates on that market. This is best explained using an example:

Consider, as an illustration, the market Amsterdam (AMS)-Hong Kong (HKG), with three active airlines and 10,000 passengers per year. The market shares are distributed as follows:

Airline	Route	Passengers	Market share
Cathay Pacific	AMS-HKG (direct)	6000	60%
Lufthansa	AMS-FRA-HKG (1 stop)	2500	25%
Aeroflot	AMS-SVO-HKG (1 stop)	1500	15%

Note: Figures for illustrational purposes

The HHI on this market is now defined by the sum of the squared market share per airline, i.e.:

$$HHI_{BRU-HKG} = 0.6^2 + 0.25^2 + 0.15^2 = 0.36 + 0.0625 + 0.0225 = 0.445$$

Consequently, the HHI of a member state is obtained by determining the average HHI on the markets departing from that member state, weighting each market by the total number of passengers on that market.

Number of competitors per route

Whereas the HHI focuses on market concentration per origin-destination market, the number of competitors per route focuses on the number of active airlines per flight segment.

The number of competitors per route is determined using monthly flight OAG schedule data. An airline is considered to be active on a route if it operates at least once a week on that route. At member state level, the average number of competitors per route is then calculated over all routes from that member state, weighting for the total number of passengers per month on that flight segment.

Airport competition

The first step in the assessment of airport competition is to determine which airports are competitors. Airports are considered to be competitors if they serve the same catchment area. Based on discussion with the European Commission, an airport is considered to compete with another airport if it is located within 2 hours driving time. The Google Maps distance matrix API is used to calculate the travel time between all EU airports, in order to determine all competing airports.

Once the competitors for each airport are defined, for each route the market share per competing airport is determined. This is best explained by an example:

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[321] An origin-destination market is defined as a city to city market, to control for multiple airports in the same region. Appendix E provides a list of multi-airport systems used for this analysis

The competing airports from Brussels Airport are Brussels South-Charleroi, Eindhoven, Liège, Lille, Maastricht, Ostend and Rotterdam-The Hague. Suppose the destination Malaga (AGP) in Spain is served from Brussels Airport and three of the competing airports, with the following traffic figures:

Airline	Total passengers (all airlines)	Airport market share
Brussels Airport (BRU)	6000	40%
Brussels South (CRL)	2500	17%
Eindhoven (EIN)	5000	33%
Rotterdam-The Hague (RTM)	1500	10%

Note: Figures for illustrational purposes

Then the level of airport competition in terms of HHI is determined by:

$$HHI_{BRU-AGP} = 0.4^2 + 0.17^2 + 0.33^2 + 0.10^2 = 0.2 + 0.029 + 0.109 + 0.01 = 0.348$$

The average HHI per member state is determined by calculating the average route level HHI, weighted for the number of passengers per route. The HHI on the member state level (that is reported in Table 18) provides insight into the degree of competition that airports in this member state encounter. A low HHI indicates that the airports in the member state have to compete with other airports in the neighbourhood (both in the member state itself and in other countries) that offer flights to the same destination. A high HHI, on the other hand, indicates that the airports do not have to compete with other airports.

In line with the assessment on airline competition, we also determine the number of competing airports. Similarly to the airline analysis, an airport is said to compete if it serves the same route with at least one weekly flight. In the example above, the number of number of competing airports would be 4. The average number of competitors is computed by taking the average number of airport competitors per route from the respective member state, weighing for the total number of passenger per route.

Appendix C. Statistics

Financial performance

The tables below present traffic and financial performance data for a selection of EU+ and non-EU+ airlines and airports, as assessed in sections 1.1.6 and 1.1.7. Two tables are presented for either airports and airlines: the first containing traffic data, ranked by total passenger numbers, and the second containing financial data, ranked by total revenue. Data is sourced from the annual reports of the respective company. For comparability, all monetary values are converted to Euros, using the average annual exchange rates as reported by Eurostat. Some companies use financial years differing from calendar years – in these cases the reported figures refer to the year the financial year starts in. Empty fields indicate the respective data point is not reported in the annual report.

Ranking by airline (group)

TABLE 36 AIRLINES RANKED BY TRAFFIC

				Passengers (x mln)				RPKs (billion)				
Rank	Airport name	Region	Currency	2015	2016	2017	2018	2015	2016	2017	2018	Rank RPK
1	American Airlines	non-EU+	USD	201	199	200	204	359	360	364	372	1
2	Southwest Airlines	non-EU+	USD	145	152	158	164	189	201	208	215	9
3	Lufthansa Group	EU+	EUR	108	110	129	142	220	227	261	285	4
4	Ryanair	EU+	EUR	106	120	130	142		92	101	110	14
5	China Southern Airlines	non-EU+	CNY	109	115	126	140	190	206	231	259	7
6	China Eastern Airlines	non-EU+	CNY	94	102	111	121	146	168	183	201	10
7	IAG	EU+	EUR	88	101	105	113	222	243	253	271	6
8	Air China Group	non-EU+	CNY	90	97	102	110	172	188	201	221	8
9	Air France-KLM	EU+	EUR	90	93	99	101	256	261	274	284	5
10	easyJet	EU+	GBP	69	73	80	89	78	81	90	99	15
11	Turkish Airlines	non-EU+	USD	61	63	69	75	119	127	137	149	12
12	LATAM	non-EU+	USD	68	67	67	69	112	114	116	119	13
13	Emirates	non-EU+	AED	52	56	59	59	255	277	292	300	3
14	British Airways	EU+	GBP	43	44	45	47	142	144	147	152	11
15	Air Asia Group	non-EU+	MYR	24	26	39	44	30	25	51	56	23
16	Norwegian Air Shuttle	EU+	NOK	26	29	33	37	42	51	63	85	16
17	Wizz Air	EU+	EUR	20	24	30	35	31	38	47	56	18
18	Vueling	EU+	EUR	25	28	30	33					28
19	SAS Group	EU+	SEK	29	29	30	30	34	37	40	40	19
20	TAP	EU+	EUR	11	12	14	16			35	38	20
21	Aegean Airlines	EU+	EUR	12	13	13	14	11	13	14	14	25
22	Finnair	EU+	EUR	10	11	12	13	26	27	31	35	22
23	Aer Lingus	EU+	EUR	10	10	11	11	18	19	21	23	24
24	Virgin Atlantic	EU+	GBP	5	5	5	5	37	37	36	38	21
25	Flybe	EU+	GBP	8	9	9	5					28
26	Icelandair	EU+	USD	3	4	4	4	9	11	13	13	26
27	Croatia Airlines	EU+	EUR	2	2	2	2	1	1	2	2	27
28	Iberia	EU+	EUR					49	51	55	61	17
29	Delta Airlines	non-EU+	USD					337	343	350	362	2
30	Air Malta	EU+	EUR									28

TABLE 37 AIRLINES RANKED BY FINANCIAL PERFORMANCED

				Revenue (x mln EUR)				Net result (x mln EUR)				
Rank	Airport name	Region	Currency	2015	2016	2017	2018	2015	2016	2017	2018	Rank
1	American Airlines	non-EU+	USD	36945	36265	37729	37715	7	2	1	1	6
2	Delta Airlines	non-EU+	USD	36687	35640	36415	37627	4079	3790	2837	3332	1
3	Lufthansa Group	EU+	EUR	32056	31660	35579	35844	1698	1776	2340	2163	4
4	Air France-KLM	EU+	EUR	25691	24846	25867	26515	101	522	171	411	11
5	IAG	EU+	EUR	22858	22567	22880	24406	1516	1952	2009	2897	2
6	Emirates	non-EU+	AED	19909	19913	21613	22920	1713	339	697	241	18
7	Southwest Airlines	non-EU+	USD	17864	18330	18718	18599	1966	1972	2972	2087	5
8	China Southern Airlines	non-EU+	CNY	16011	15639	16753	18394	691	802	904	431	10
9	Air China Group	non-EU+	CNY	15783	15661	16257	18043	1077	1055	1133	1052	7
10	China Eastern Airlines	non-EU+	CNY	14232	14196	14413	15608	723	674	893	375	13
11	British Airways	EU+	GBP	15614	13964	13997	14718	3455	1641	1578	2363	3
12	Turkish Airlines	non-EU+	USD	9484	8846	9700	10885	963	-70	197	638	9
13	LATAM	non-EU+	USD	8779	8120	8510	8379	-161	100	178	181	19
14	Ryanair	EU+	EUR	6536	6648	7151	7697	1242	1316	1450	885	8
15	easyJet	EU+	GBP	6456	5698	5757	6667	755	521	348	405	12
16	Iberia	EU+	EUR	4590	4491	4802	5157	472	153	137	245	17

17	SAS Group	EU+	SEK	4239	4167	4427	4359	102	140	119	155	20
18	Norwegian Air Shuttle	EU+	NOK	2513	2804	3318	4195	28	122	-192	-152	30
19	TAP	EU+	EUR	2409	2290	2979	3251	-160	-32	12	-117	29
20	Virgin Atlantic	EU+	GBP	3833	3282	2999	3143	110	229	-75	-43	27
21	Finnair	EU+	EUR	2340	2392	2645	2908	90	85	169	151	21
22	Air Asia Group	non-EU+	MYR	1511	1571	2166	2484	125	447	324	356	14
23	Vueling	EU+	EUR	1934	2028	2088	2340	95	49	117	150	22
24	Wizz Air	EU+	EUR	1429	1571	1939	2319	193	246	276	295	15
25	Aer Lingus	EU+	EUR	1719	1766	1858	2020	118	206	234	258	16
26	Icelandair	EU+	USD	1027	1161	1255	1279	100	80	33	-47	28
27	Aegean Airlines	EU+	EUR	1002	1035	1142	1205	68	32	60	68	23
28	Flybe	EU+	GBP	859	863	858	463	9	-33	-9	8	24
29	Croatia Airlines	EU+	EUR	205	209	238	231	2	2	1	-10	26
30	Air Malta	EU+	EUR		192	198			-15	16		25

Ranking by airport (group)

TABLE 38 AIRPORTS RANKED BY TRAFFIC

				Passengers (x mln)				Aircraft movements (x 1000)				
Rank	**Airport name**	**Region**	**Currency**	**2015**	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**	**Rank (movements)**
1	AENA	EU+	EUR	207	230	249	264	1,902	2,045	2,174	2,300	1
2	TAV	mixed	EUR	102	104	115	152					27
3	AOT	non-EU+	THB	107	120	129	140	707	777	824	875	4
4	CGK+	non-EU+	IDR	84	95	105	111	632	724	821	857	5
5	ADP	EU+	EUR	95	97	102	105	700	707	705	710	6
6	ATL	non-EU+	USD	98	104	104	105	870	897	889	885	3
7	LAX	non-EU+	USD	76	82	83	87	624	642	633	639	9
8	ORD	non-EU+	USD	77	78	80	83	864	856	856	893	2
9	LHR	EU+	GBP	75	76	78	80	470	471	471	473	12
10	AMS	EU+	EUR	64	70	76	79	499	527	548	554	10
11	HKG	non-EU+	HKD	70	71	74	75	410	410	423	429	13
12	FRA	EU+	EUR	61	61	65	70	468	463	476	512	11
13	DFW	non-EU+	USD	65	66	66	69	682	675	654	662	8
14	SIN	non-EU+	SGD	57	59	63	66	351	362	377	386	16
15	MAG	EU+	GBP	52	56	59	62					
16	ANA	EU+	EUR	39	44	52	55	320	359	398	419	14
17	AVINOR	EU+	NOK	50	51	53	54	724	704	697	690	7
18	ADR	EU+	EUR	46	47	47	49	368	362	352	360	17
19	LGW	EU+	GBP	41	44	46	46	266	279	281	282	19
20	MUC	EU+	EUR	41	42	45	46	380	394	405	413	15
21	SWEDAVIA	EU+	SEK	38	40	42	42					
22	DAA	EU+	EUR	27	30	32	34	209	228	236	247	22
23	SEA	EU+	EUR	28	29	32	34	253	261	271	284	18
24	ZRH	EU+	CHF	26	28	29	31	265	269	270	278	20
25	CPH	EU+	DKK	27	29	29	30	255	266	259	266	21
26	VIE	EU+	EUR	23	23	24	27	227	226	225	241	23
27	BRU	EU+	EUR	23	22	25	26	239	224	238	235	24
28	FINAVIA	EU+	EUR	20	21	23	25					
29	DUS	EU+	EUR	23	24	25	24	210	218	222	219	25
30	ATH	EU+	EUR	18	20	22	24	176	189	196	217	26
31	ICN	non-EU+	KRW	49	58	62		305	340	360		

TABLE 39 AIRPORTS RANKED BY FINANCIAL PERFORMANCE

				Revenue (x mln EUR)				Net result (x mln EUR)				
Rank	**Airport name**	**Region**	**Currency**	**2015**	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**	**Rank**
1	ADP	EU+	EUR	2935	2947	3617	4478	433	438	614	695	3
2	AENA	EU+	EUR	3463	3722	3976	4217	834	1164	1232	1328	1
3	FRA	EU+	EUR	2679	2954	3010	3603	297	400	360	506	5
4	LHR	EU+	GBP	3812	3428	3290	3357	967	-145	589	461	6
5	HKG	non-EU+	HKD	2114	2168	2498	2104	974	967	1305	908	2
6	SIN	non-EU+	SGD	1419	1509	1669	1909	514	430	536	360	7
7	AOT	non-EU+	THB	1197	1352	1480	1628	493	502	542	661	4
8	AMS	EU+	EUR	1540	1506	1538	1616	378	311	286	285	9
9	MUC	EU+	EUR	1310	1431	1513	1554	135	152	159	149	18
10	LAX	non-EU+	USD	1011	1162	1215	1225	241	366	152	334	8
11	AVINOR	EU+	NOK	1340	1161	1236	1222	274	111	54	122	22
12	TAV	Mixed	EUR	1079	1104	1139	1169	200	120	185	266	11
13	ADR	EU+	EUR	957	1186	1011	1045	137	220	245	246	13
14	MAG	EU+	GBP	1073	1025	933	1005	161	145	140	167	16
15	ZRH	EU+	CHF	926	929	922	930	168	227	279	259	12
16	LGW	EU+	GBP	927	891	872	916	196	152	231	235	14
17	ORD	non-EU+	USD	762	856	864	899	-213	-83	30	113	24
18	DAA	EU+	EUR	680	793	855	897	88	85	136	142	20
19	ANA	EU+	EUR	589	695	784	846	101	168	248	284	10
20	VIE	EU+	EUR	728	752	764	812	112	113	127	152	17
21	DFW	non-EU+	USD	612	674	744	787	-293	-80	6	39	30
22	SEA	EU+	EUR	695	700	677	713	81	94	82	136	21
23	SWEDAVIA	EU+	SEK	692	629	615	604	151	76	42	50	28
24	CPH	EU+	DKK	545	594	597	596	146	169	173	148	19
25	BRU	EU+	EUR	520	536	552	595	70	65	89	111	25
26	CGK+	non-EU+	IDR	380	451	536	565	113	132	133	114	23
27	ATH	EU+	EUR	371	405	434	479	121	132	140	171	15
28	DUS	EU+	EUR	449	465	483	475	54	60	60	59	27
29	ATL	non-EU+	USD	435	440	441	445	104	113	57	100	26
30	FINAVIA	EU+	EUR	369	385	382	391	40	28	38	45	29
31	ICN	non-EU+	KRW	1544	1745	1957		614	751	875		31

Indirect connectivity

TABLE 40. INDIRECT CONNECTIVITY BY STATE (IN CONNECTIVITY UNITS (CNU))

Country	2016	2017	2018	2019	Percentage
Austria	7,811	7,946	8,666	9,074	16%
Belgium	6,083	5,914	6,323	6,495	7%
Bulgaria	1,759	1,731	1,855	2,067	18%
Croatia	2,698	2,946	3,576	3,915	45%
Cyprus	1,173	1,364	1,727	1,761	50%
Czech Republic	3,436	3,588	4,098	4,335	26%
Denmark	7,800	8,178	8,659	8,705	12%
Estonia	1,192	1,276	1,448	1,388	16%
Finland	5,263	5,631	6,188	6,385	21%
France	28,689	29,365	30,742	32,472	13%
Germany	50,646	51,862	55,945	57,368	13%
Greece	7,067	7,188	8,239	8,910	26%
Hungary	2,698	2,923	3,195	3,368	25%
Iceland	928	951	1,398	1,336	44%
Ireland	6,575	7,221	7,300	7,617	16%
Italy	28,301	29,049	33,481	35,146	24%
Latvia	1,148	1,282	1,342	1,454	27%
Lithuania	717	1,014	1,122	1,149	60%
Luxembourg	1,550	1,667	1,970	1,945	25%
Malta	1,033	1,350	1,514	1,628	58%
Netherlands	10,966	11,564	11,541	12,085	10%
Norway	8,019	7,910	8,601	8,594	7%
Poland	6,444	6,909	8,513	9,051	40%
Portugal	7,209	7,955	10,221	10,397	44%
Romania	3,014	3,043	3,464	3,268	8%
Slovakia	48	41	215	211	337%
Slovenia	914	944	1,101	1,136	24%
Spain	26,664	28,122	31,064	33,093	24%
Sweden	9,179	9,981	10,365	10,009	9%
Switzerland	14,003	14,161	15,166	15,461	10%
United Kingdom	41,083	42,913	43,681	43,921	7%
EU+	294,110	305,989	332,720	343,744	17%

Source: Analysis SEO with NetScan based on OAG schedules analyser

TABLE 41. INDIRECT CONNECTIVITY PER STATE - INTRA EU+ FLIGHTS

Country	2016	2017	2018	2019	Percentage change 2016-2019
Austria	1,752	1,755	1,867	1,754	0%
Belgium	1,143	1,092	1,125	1,104	-3%
Bulgaria	756	744	812	818	8%
Croatia	809	905	1,187	1,242	54%
Cyprus	617	710	994	970	57%
Czech Republic	645	724	726	688	7%
Denmark	2,063	2,166	2,317	2,359	14%
Estonia	665	743	890	784	18%
Finland	2,711	2,864	3,031	2,978	10%
France	4,069	4,166	4,537	4,594	13%
Germany	8,363	8,518	9,522	9,185	10%
Greece	3,711	3,668	4,332	4,454	20%
Hungary	775	876	867	875	13%
Iceland	454	440	464	495	9%
Ireland	1,085	1,266	1,380	1,426	32%
Italy	5,762	5,596	7,112	7,113	23%
Latvia	439	542	565	571	30%
Lithuania	416	552	613	586	41%
Luxembourg	272	300	402	396	46%
Malta	460	612	720	699	52%
Netherlands	1,083	1,245	1,269	1,267	17%
Norway	3,315	3,118	3,544	3,513	6%
Poland	2,451	2,496	2,929	2,971	21%
Portugal	3,040	3,489	4,434	4,295	41%
Romania	1,551	1,568	1,700	1,544	0%
Slovakia	33	30	119	117	254%
Slovenia	227	192	237	227	0%
Spain	7,679	8,283	9,111	9,075	18%
Sweden	3,330	3,683	3,849	3,627	9%
Switzerland	2,072	2,028	2,215	2,137	3%
United Kingdom	6,072	6,577	6,739	6,479	7%
EU+	67,820	70,948	79,609	78,343	16%

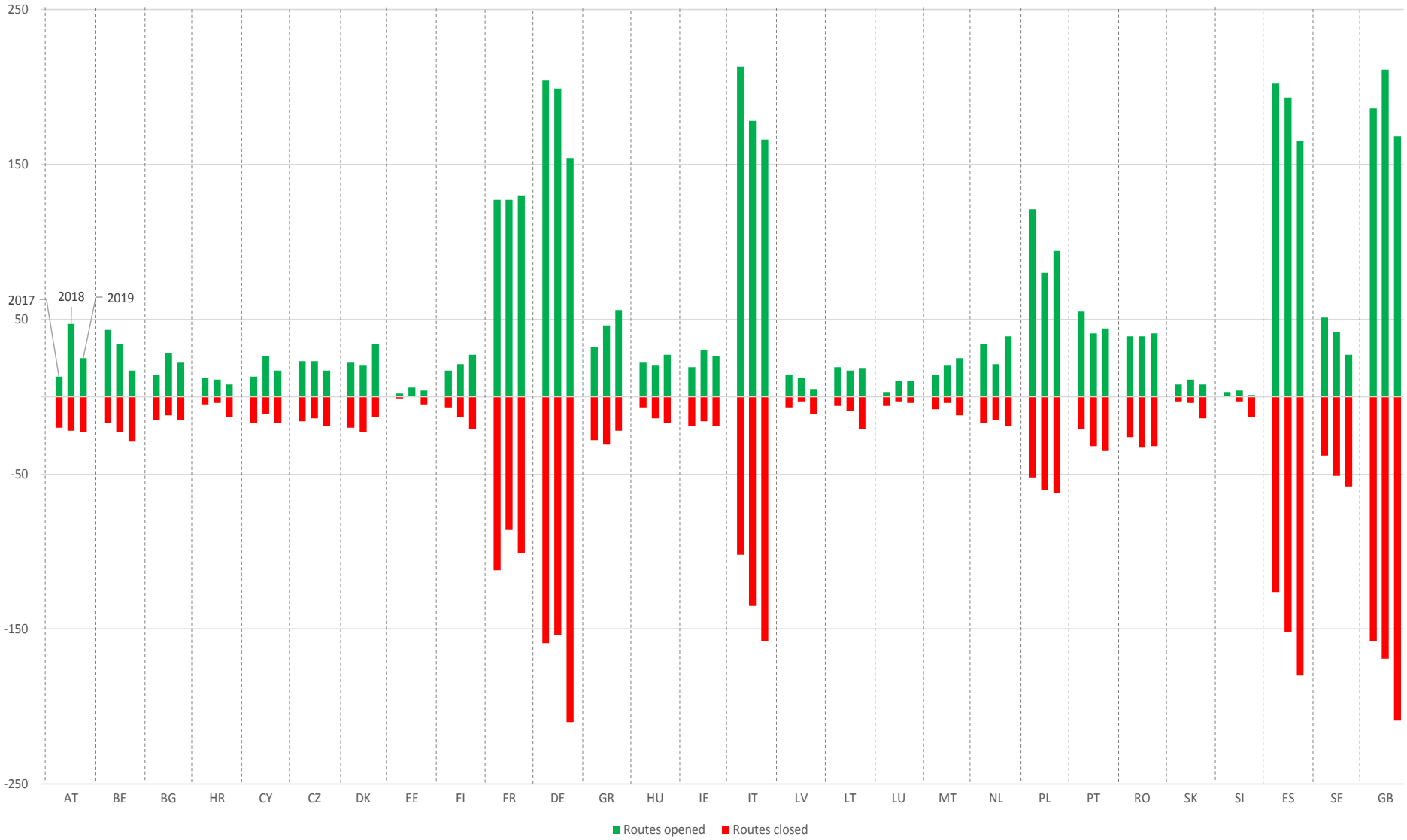
Source: Analysis SEO with NetScan based on OAG schedules analyser

TABLE 42. INDIRECT CONNECTIVITY PER STATE - EXTRA EU+ FLIGHTS

Country	2016	2017	2018	2019	Percentage change
Austria	6,059	6,191	6,799	7,319	21%
Belgium	4,939	4,822	5,198	5,392	9%
Bulgaria	1,003	987	1,042	1,249	25%
Croatia	1,889	2,041	2,389	2,673	42%
Cyprus	557	654	733	791	42%
Czech Republic	2,790	2,864	3,372	3,647	31%
Denmark	5,710	5,918	6,266	6,270	10%
Estonia	528	534	558	604	14%
Finland	2,534	2,747	3,134	3,382	33%
France	24,432	24,899	25,936	27,624	13%
Germany	42,258	43,307	46,366	48,137	14%
Greece	3,329	3,501	3,883	4,419	33%
Hungary	1,923	2,047	2,328	2,493	30%
Iceland	475	512	934	841	77%
Ireland	5,490	5,955	5,920	6,190	13%
Italy	22,278	23,185	25,961	27,608	24%
Latvia	709	740	777	882	24%
Lithuania	301	462	509	563	87%
Luxembourg	1,278	1,367	1,568	1,549	21%
Malta	573	738	794	928	62%
Netherlands	9,883	10,319	10,271	10,819	9%
Norway	4,097	4,092	4,376	4,439	8%
Poland	3,981	4,402	5,574	6,070	52%
Portugal	4,129	4,422	5,733	6,056	47%
Romania	1,463	1,475	1,764	1,724	18%
Slovakia	15	11	96	94	514%
Slovenia	687	753	864	908	32%
Spain	18,350	19,203	21,134	23,150	26%
Sweden	5,270	5,780	6,073	6,032	14%
Switzerland	11,931	12,133	12,951	13,324	12%
United Kingdom	34,923	36,233	36,864	37,389	7%
EU+	223,784	232,294	250,167	262,566	17%

Source: Analysis SEO with NetScan based on OAG schedules analyser

FIGURE 61. NUMBER OF ROUTE OPENINGS AND CLOSURES PER MEMBER STATE



Source: Analysis SEO based on OAG schedules analyser

TABLE 43. NUMBER OF ROUTES OPENED AND CLOSED – WINTER SEASON

	2017			2018			2019		
Country	Openings	Closings	Difference	Openings	Closings	Difference	Openings	Closings	Difference
Austria	13	20	-7	47	22	25	25	23	2
Belgium	43	17	26	34	23	11	17	29	-12
Bulgaria	14	15	-1	28	12	16	22	15	7
Croatia	12	5	7	11	4	7	8	13	-5
Cyprus	13	17	-4	26	11	15	17	17	0
Czech Republic	23	16	7	23	14	9	17	19	-2
Denmark	22	20	2	20	23	-3	34	13	21
Estonia	2	1	1	6	0	6	4	5	-1
Finland	17	7	10	21	13	8	27	21	6
France	127	112	15	127	86	41	130	101	29
Germany	204	159	45	199	154	45	154	210	-56
Greece	32	28	4	46	31	15	56	22	34
Hungary	22	7	15	20	14	6	27	17	10
Iceland	22	7	15	7	20	-13	14	15	-1
Ireland	19	19	0	30	16	14	26	19	7
Italy	213	102	111	178	135	43	166	158	8
Latvia	14	7	7	12	3	9	5	11	-6
Lithuania	19	6	13	17	9	8	18	21	-3
Luxembourg	3	6	-3	10	3	7	10	4	6
Malta	14	8	6	20	4	16	25	12	13
Netherlands	34	17	17	21	15	6	39	19	20
Norway	70	69	1	47	52	-5	39	57	-18
Poland	121	52	69	80	60	20	94	62	32
Portugal	55	21	34	41	32	9	44	35	9
Romania	39	26	13	39	33	6	41	32	9
Slovakia	8	3	5	11	4	7	8	14	-6
Slovenia	3	0	3	4	3	1	1	13	-12
Spain	202	126	76	193	152	41	165	180	-15
Sweden	51	38	13	42	51	-9	27	58	-31
Switzerland	32	24	8	34	19	15	12	29	-17
United Kingdom	186	158	28	211	169	42	168	209	-41
EU+	1,649	1,113	536	1,605	1,187	418	1,440	1,453	-13

Source: Analysis SEO based on OAG schedules analyser

TABLE 44. HHI PER STATE – AIRLINE COMPETITION

Country	2016	2017	2018	2019[322]	Percentage change 2016-
Austria	0.606	0.650	0.669	0.617	2%
Belgium	0.546	0.545	0.543	0.546	0%
Bulgaria	0.591	0.578	0.577	0.578	-2%
Croatia	0.669	0.663	0.686	0.676	1%
Cyprus	0.506	0.524	0.521	0.522	3%
Czech Republic	0.515	0.512	0.528	0.527	2%
Denmark	0.515	0.507	0.524	0.538	4%
Estonia	0.627	0.610	0.597	0.546	-13%
Finland	0.611	0.604	0.592	0.601	-2%
France	0.534	0.531	0.519	0.530	-1%
Germany	0.544	0.561	0.611	0.619	14%
Greece	0.558	0.535	0.525	0.535	-4%
Hungary	0.550	0.544	0.547	0.543	-1%
Iceland	0.607	0.601	0.596	0.658	8%
Ireland	0.566	0.552	0.541	0.545	-4%
Italy	0.527	0.526	0.525	0.520	-1%
Latvia	0.573	0.562	0.560	0.550	-4%
Lithuania	0.634	0.633	0.636	0.620	-2%
Luxembourg	0.597	0.540	0.541	0.541	-9%
Malta	0.559	0.558	0.562	0.576	3%
Netherlands	0.553	0.538	0.539	0.549	-1%
Norway	0.576	0.552	0.552	0.547	-5%
Poland	0.753	0.735	0.734	0.720	-4%
Portugal	0.515	0.509	0.515	0.503	-2%
Romania	0.594	0.589	0.596	0.620	5%
Slovakia	0.948	0.940	0.888	0.860	-9%
Slovenia	0.730	0.734	0.739	0.726	-1%
Spain	0.465	0.461	0.475	0.483	4%
Sweden	0.515	0.510	0.516	0.528	3%
Switzerland	0.623	0.624	0.646	0.663	6%
United Kingdom	0.482	0.477	0.482	0.483	0%
EU+	0.532	0.530	0.540	0.543	2%

Source: Analysis SEO based on OAG schedules analyser

TABLE 45. HHI PER STATE – DOMESTIC – AIRLINE COMPETITION

Country	2016	2017	2018	2019	Percentage change	Number of domestic
Austria	0.958	1	1	0.999	4%	1.7
Bulgaria	0.959	0.626	0.631	0.990	3%	0.6
Croatia	0.983	0.997	0.988	0.985	0%	1.1
Denmark	0.727	0.616	0.627	0.643	-12%	4.6
Finland	0.731	0.724	0.717	0.717	-2%	7.0
France	0.633	0.628	0.585	0.611	-4%	56.0
Germany	0.582	0.630	0.780	0.785	35%	62.2
Greece	0.569	0.481	0.455	0.498	-12%	19.3
Iceland	0.999	0.995	0.999	1.000	0%	0.5
Ireland	0.779	0.782	0.760	0.748	-4%	0.2
Italy	0.584	0.567	0.547	0.533	-9%	63.3
Norway	0.575	0.568	0.569	0.565	-2%	34.0
Poland	0.895	0.774	0.818	0.912	2%	5.0
Portugal	0.589	0.569	0.577	0.566	-4%	11.6
Romania	0.658	0.535	0.520	0.582	-11%	2.6
Spain	0.497	0.491	0.507	0.521	5%	95.0
Sweden	0.519	0.513	0.514	0.542	4%	15.6
Switzerland	0.661	0.822	0.982	0.961	45%	2.0
United Kingdom	0.631	0.650	0.648	0.659	4%	44.0
EU+	0.586	0.582	0.598	0.608	4%	390.0

Source: Analysis SEO based on OAG schedules analyser

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[322] *The calculations for 2019 are based on the first eleven months of 2019. The same applies to Table Table 45. HHI per state – domestic – airline competition,Table 46. HHI per state – intra-EU+ traffic – airline competition and Table 47. HHI per state – extra EU+-traffic – airline competition*

TABLE 46. HHI PER STATE – INTRA-EU+ TRAFFIC – AIRLINE COMPETITION

Country	2016	2017	2018	2019	Percentage change 2016-
Austria	0.613	0.674	0.702	0.629	3%
Belgium	0.555	0.557	0.554	0.555	0%
Bulgaria	0.572	0.572	0.579	0.565	-1%
Croatia	0.651	0.645	0.676	0.663	2%
Cyprus	0.557	0.558	0.531	0.549	-1%
Czech Republic	0.510	0.512	0.525	0.517	1%
Denmark	0.484	0.490	0.513	0.527	9%
Estonia	0.617	0.603	0.585	0.531	-14%
Finland	0.564	0.556	0.540	0.556	-1%
France	0.510	0.513	0.518	0.526	3%
Germany	0.541	0.548	0.589	0.598	11%
Greece	0.554	0.562	0.554	0.552	0%
Hungary	0.566	0.554	0.553	0.549	-3%
Iceland	0.506	0.515	0.520	0.614	21%
Ireland	0.595	0.582	0.567	0.569	-4%
Italy	0.498	0.511	0.527	0.527	6%
Latvia	0.586	0.578	0.576	0.575	-2%
Lithuania	0.643	0.630	0.627	0.618	-4%
Luxembourg	0.592	0.522	0.523	0.521	-12%
Malta	0.554	0.554	0.554	0.567	2%
Netherlands	0.582	0.563	0.563	0.571	-2%
Norway	0.584	0.532	0.532	0.526	-10%
Poland	0.757	0.747	0.744	0.722	-5%
Portugal	0.487	0.486	0.493	0.484	-1%
Romania	0.598	0.610	0.623	0.644	8%
Slovakia	0.953	0.942	0.879	0.852	-11%
Slovenia	0.703	0.709	0.716	0.701	0%
Spain	0.446	0.442	0.456	0.462	3%
Sweden	0.511	0.504	0.513	0.517	1%
Switzerland	0.646	0.646	0.676	0.703	9%
United Kingdom	0.470	0.462	0.470	0.469	0%
EU+	0.527	0.526	0.540	0.542	3%

Source: Analysis SEO based on OAG schedules analyser

TABLE 47. HHI PER STATE – EXTRA EU+-TRAFFIC – AIRLINE COMPETITION

Country	2016	2017	2018	2019	Percentage change 2016-
Austria	0.567	0.568	0.569	0.568	0%
Belgium	0.514	0.508	0.513	0.523	2%
Bulgaria	0.591	0.590	0.560	0.547	-7%
Croatia	0.619	0.628	0.633	0.637	3%
Cyprus	0.446	0.484	0.508	0.493	11%
Czech Republic	0.527	0.513	0.533	0.548	4%
Denmark	0.508	0.500	0.504	0.520	2%
Estonia	0.652	0.633	0.613	0.605	-7%
Finland	0.631	0.636	0.633	0.633	0%
France	0.473	0.466	0.459	0.466	-1%
Germany	0.522	0.541	0.540	0.550	6%
Greece	0.550	0.520	0.528	0.519	-6%
Hungary	0.488	0.508	0.529	0.525	8%
Iceland	0.693	0.678	0.641	0.654	-6%
Ireland	0.419	0.411	0.421	0.433	3%
Italy	0.499	0.487	0.482	0.483	-3%
Latvia	0.527	0.499	0.500	0.463	-12%
Lithuania	0.582	0.645	0.675	0.630	8%
Luxembourg	0.619	0.640	0.637	0.649	5%
Malta	0.613	0.601	0.636	0.653	7%
Netherlands	0.478	0.471	0.476	0.494	3%
Norway	0.536	0.531	0.527	0.531	-1%
Poland	0.633	0.632	0.655	0.667	5%
Portugal	0.584	0.570	0.561	0.535	-8%
Romania	0.524	0.517	0.522	0.523	0%
Slovakia	0.908	0.928	0.926	0.886	-2%
Slovenia	0.776	0.776	0.781	0.767	-1%
Spain	0.490	0.481	0.489	0.488	0%
Sweden	0.522	0.523	0.532	0.536	3%
Switzerland	0.556	0.554	0.554	0.553	-1%
United Kingdom	0.418	0.416	0.422	0.429	3%
EU+	0.489	0.489	0.493	0.498	2%

Source: Analysis SEO based on OAG schedules analyser

TABLE 48. AVERAGE NUMBER OF EFFECTIVE AIRLINE COMPETITORS PER ROUTE PER STATE

Country	2016	2017	2018	2019[323]	Change 2016-2019
Austria	2.4	2.3	2.4	2.5	0.1
Belgium	2.7	2.7	2.7	2.6	-0.1
Bulgaria	2.2	2.3	2.5	2.6	0.4
Croatia	2.1	2.3	2.3	2.3	0.2
Cyprus	3.5	3.7	3.7	3.4	-0.1
Czech Republic	2.5	2.6	2.6	2.6	0.1
Denmark	2.7	2.6	2.7	2.6	-0.1
Estonia	1.6	1.6	1.8	2.1	0.5
Finland	2.0	2.1	2.1	2.0	0.0
France	3.1	3.1	3.2	3.1	0.0
Germany	2.5	2.5	2.4	2.4	-0.1
Greece	2.6	2.7	2.9	2.8	0.2
Hungary	2.2	2.3	2.3	2.4	0.2
Iceland	2.4	2.7	2.9	2.4	0.0
Ireland	2.8	2.9	3.0	3.1	0.3
Italy	3.0	2.9	2.9	3.0	0.0
Latvia	1.9	1.9	2.0	2.0	0.1
Lithuania	1.9	1.8	1.8	1.9	0.0
Luxembourg	1.8	2.3	2.4	2.4	0.6
Malta	2.7	2.6	2.8	2.8	0.1
Netherlands	2.9	3.0	3.0	3.0	0.1
Norway	2.4	2.6	2.6	2.6	0.2
Poland	1.5	1.6	1.6	1.7	0.2
Portugal	3.2	3.3	3.1	3.2	0.0
Romania	2.5	2.4	2.4	2.4	-0.1
Slovakia	1.2	1.1	1.2	1.3	0.1
Slovenia	1.6	1.8	1.7	1.7	0.1
Spain	3.5	3.6	3.4	3.3	-0.2
Sweden	2.6	2.7	2.7	2.7	0.1
Switzerland	2.6	2.6	2.5	2.3	-0.3
United Kingdom	4.4	4.5	4.4	4.5	0.1
EU+	3.1	3.1	3.1	2.9	-0.2

Source: Analysis SEO based on OAG schedules analyser

[323] *The calculations for 2019 are based on the first eleven months of 2019.*

TABLE 49. HHI PER STATE – AIRPORT COMPETITION

Country	2016	2017	2018	2019[324]	Percentage change 2016-
Austria	0.883	0.883	0.886	0.894	1%
Belgium	0.604	0.609	0.599	0.588	-3%
Bulgaria	0.983	0.982	0.975	0.987	0%
Croatia	0.803	0.795	0.807	0.804	0%
Cyprus	0.794	0.789	0.782	0.778	-2%
Czech Republic	0.859	0.865	0.860	0.881	3%
Denmark	0.905	0.903	0.898	0.904	0%
Estonia	1	1	1	1	0%
Finland	0.879	0.875	0.883	0.880	0%
France	0.683	0.687	0.689	0.692	1%
Germany	0.621	0.618	0.626	0.636	2%
Greece	0.994	0.993	0.992	0.992	0%
Hungary	0.999	0.995	0.995	0.997	0%
Iceland	0.999	0.998	0.999	0.999	0%
Ireland	0.714	0.716	0.723	0.730	2%
Italy	0.647	0.654	0.660	0.673	4%
Latvia	1	1	1	1	0%
Lithuania	0.889	0.853	0.883	0.864	-3%
Luxembourg	0.673	0.678	0.656	0.710	5%
Malta	1	1	1	1	0%
Netherlands	0.738	0.746	0.746	0.740	0%
Norway	0.958	0.959	0.960	0.960	0%
Poland	0.813	0.821	0.818	0.818	1%
Portugal	0.975	0.975	0.974	0.975	0%
Romania	0.980	0.997	0.993	0.990	1%
Slovakia	0.677	0.707	0.678	0.687	1%
Slovenia	0.458	0.468	0.474	0.479	5%
Spain	0.914	0.909	0.906	0.909	0%
Sweden	0.785	0.793	0.792	0.799	2%
Switzerland	0.647	0.643	0.642	0.642	-1%
United Kingdom	0.512	0.503	0.502	0.498	-3%
EU+	0.732	0.735	0.738	0.742	1%

Source: Analysis SEO based on OAG schedules analyser

TABLE 50. HHI PER STATE – DOMESTIC – AIRPORT COMPETITION

Country	2016	2017	2018	2019	Percentage change	Number of domestic
Austria	0.918	0.923	0.921	0.925	1%	1.8
Bulgaria	1	1	1	1	0%	0.6
Croatia	0.975	0.982	0.957	0.967	-1%	1.1
Denmark	0.833	0.831	0.829	0.838	1%	4.6
Finland	0.837	0.823	0.836	0.839	0%	7.1
France	0.670	0.662	0.655	0.657	-2%	53.6
Germany	0.631	0.631	0.676	0.683	8%	63.0
Greece	0.985	0.980	0.974	0.972	-1%	19.3
Iceland	1.000	0.995	0.999	0.999	0%	0.5
Ireland	0.997	0.998	0.996	0.999	0%	0.2
Italy	0.646	0.654	0.659	0.667	3%	63.4
Norway	0.932	0.934	0.934	0.933	0%	34.0
Poland	0.861	0.943	0.891	0.884	3%	4.9
Portugal	0.974	0.974	0.973	0.975	0%	11.6
Romania	1	1	1	0.999	0%	2.7
Spain	0.890	0.889	0.887	0.883	-1%	95.5
Sweden	0.636	0.631	0.625	0.640	1%	15.7
Switzerland	0.877	0.857	0.839	0.861	-2%	2.1
United Kingdom	0.498	0.505	0.502	0.504	1%	42.7
EU+	0.739	0.745	0.752	0.756	2%	387.8

Source: Analysis SEO based on OAG schedules analyser

[324] The calculations for 2019 are based on the first eleven months of 2019. The same applies to Table Table 50. HHI per state – Domestic – airport competition, Table 51. hhi per state – intra-eu+ – airport competition and

TABLE 51. HHI PER STATE – INTRA-EU+ – AIRPORT COMPETITION

Country	2016	2017	2018	2019	Percentage change 2016-
Austria	0.861	0.863	0.865	0.881	2%
Belgium	0.537	0.537	0.520	0.517	-4%
Bulgaria	0.981	0.979	0.969	0.985	0%
Croatia	0.795	0.785	0.799	0.793	0%
Cyprus	0.662	0.684	0.677	0.679	2%
Czech Republic	0.853	0.861	0.858	0.880	3%
Denmark	0.900	0.898	0.889	0.895	-1%
Estonia	1	1	1	1	0%
Finland	0.877	0.876	0.882	0.874	0%
France	0.624	0.642	0.655	0.656	5%
Germany	0.566	0.561	0.563	0.576	2%
Greece	0.998	0.998	0.998	0.998	0%
Hungary	0.999	0.993	0.994	0.996	0%
Iceland	0.999	0.999	1	1	0%
Ireland	0.682	0.679	0.683	0.688	1%
Italy	0.611	0.618	0.622	0.637	4%
Latvia	1	1	1	1	0%
Lithuania	0.869	0.839	0.859	0.843	-3%
Luxembourg	0.629	0.638	0.616	0.680	8%
Malta	1	1	1	1	0%
Netherlands	0.653	0.666	0.668	0.670	3%
Norway	0.990	0.990	0.990	0.989	0%
Poland	0.791	0.790	0.795	0.799	1%
Portugal	0.976	0.975	0.973	0.975	0%
Romania	0.975	0.997	0.991	0.987	1%
Slovakia	0.663	0.685	0.661	0.689	4%
Slovenia	0.426	0.431	0.434	0.433	2%
Spain	0.918	0.911	0.906	0.914	0%
Sweden	0.840	0.856	0.853	0.853	2%
Switzerland	0.613	0.610	0.610	0.614	0%
United Kingdom	0.432	0.421	0.421	0.416	-4%
EU+	0.701	0.703	0.707	0.712	2%

Source: Analysis SEO based on OAG schedules analyser

TABLE 52. HHI PER STATE – EXTRA-EU+ – AIRPORT COMPETITION

Country	2016	2017	2018	2019	Percentage change 2016-
Austria	0.940	0.935	0.940	0.924	-2%
Belgium	0.827	0.828	0.818	0.780	-6%
Bulgaria	0.989	0.991	0.992	0.994	0%
Croatia	0.769	0.776	0.792	0.802	4%
Cyprus	0.943	0.910	0.906	0.886	-6%
Czech Republic	0.872	0.875	0.864	0.883	1%
Denmark	0.967	0.968	0.969	0.969	0%
Estonia	1	1	1	1	0%
Finland	0.950	0.946	0.952	0.955	0%
France	0.776	0.768	0.763	0.765	-1%
Germany	0.724	0.725	0.717	0.719	-1%
Greece	0.999	0.999	0.999	0.999	0%
Hungary	1	0.999	1	1	0%
Iceland	0.997	0.997	0.997	0.995	0%
Ireland	0.870	0.882	0.888	0.905	4%
Italy	0.750	0.751	0.758	0.774	3%
Latvia	1	1	1	1	0%
Lithuania	1	0.923	0.991	0.957	-4%
Luxembourg	0.885	0.893	0.875	0.873	-1%
Malta	1	1	1	1	0%
Netherlands	0.955	0.961	0.949	0.916	-4%
Norway	0.997	0.998	0.998	0.997	0%
Poland	0.928	0.932	0.918	0.886	-5%
Portugal	0.975	0.975	0.978	0.979	0%
Romania	1	1	1	1	0%
Slovakia	0.782	0.804	0.754	0.680	-13%
Slovenia	0.511	0.527	0.549	0.553	8%
Spain	0.952	0.951	0.950	0.954	0%
Sweden	0.968	0.966	0.961	0.954	-1%
Switzerland	0.726	0.725	0.722	0.708	-3%
United Kingdom	0.723	0.716	0.700	0.697	-4%
EU+	0.806	0.805	0.803	0.801	-1%

Source: Analysis SEO based on OAG schedules analyser

TABLE 53. AVAILABLE COMPETING AIRPORTS PER DESTINATION PER STATE

Country	2016	2017	2018	2019[325]	Change 2016-2019
Austria	1.4	1.5	1.5	1.5	0.1
Belgium	3.1	3.1	3.2	3.2	0.1
Bulgaria	1.1	1.1	1.2	1.1	0.0
Croatia	1.5	1.5	1.5	1.5	0.0
Cyprus	1.5	1.5	1.5	1.5	0.0
Czech Republic	1.4	1.4	1.5	1.3	-0.1
Denmark	1.5	1.5	1.4	1.4	-0.1
Estonia	1.0	1.0	1.0	1.0	0.0
Finland	1.4	1.4	1.4	1.4	0.0
France	2.2	2.2	2.2	2.2	0.0
Germany	2.6	2.6	2.6	2.6	0.0
Greece	1.0	1.0	1.0	1.0	0.0
Hungary	1.0	1.0	1.0	1.0	0.0
Iceland	1.0	1.0	1.0	1.0	0.0
Ireland	2.0	2.0	2.0	1.9	-0.1
Italy	2.4	2.3	2.3	2.2	-0.2
Latvia	1.0	1.0	1.0	1.0	0.0
Lithuania	1.3	1.3	1.3	1.3	0.0
Luxembourg	2.2	2.1	2.2	2.0	-0.2
Malta	1.0	1.0	1.0	1.0	0.0
Netherlands	2.9	2.8	2.9	2.9	0.0
Norway	1.1	1.1	1.1	1.1	0.0
Poland	1.5	1.4	1.5	1.5	0.0
Portugal	1.1	1.1	1.1	1.1	0.0
Romania	1.1	1.0	1.0	1.0	-0.1
Slovakia	2.0	1.9	2.1	2.1	0.1
Slovenia	2.2	2.3	2.2	2.2	0.0
Spain	1.3	1.3	1.3	1.3	0.0
Sweden	2.0	1.9	1.9	1.9	-0.1
Switzerland	2.3	2.4	2.3	2.1	-0.2
United Kingdom	3.5	3.6	3.6	3.6	0.1
EU+	2.2	2.2	2.2	2.1	-0.1

Source: Analysis SEO based on OAG schedules analyser

[325] *The calculations for 2019 are based on the first eleven months of 2019.*

TABLE 54. GREENHOUSE GAS EMISSIONS FROM INTERNATIONAL AND DOMESTIC AVIATION (IN KT CO_2 EQUIVALENTS)

Country	International aviation				Domestic aviation			
	2015	2016	2017	Percentage change 2015-2017	2015	2016	2017	Percentage change 2015-2017
Austria	2,149	2,344	2,265	5%	51	48	43	-15%
Belgium	4,434	4,428	4,843	9%	17	13	14	-18%
Bulgaria	533	642	718	35%	40	61	62	54%
Croatia	357	379	453	27%	31	31	32	2%
Cyprus	757	885	1,007	33%	1	1	1	-9%
Czech Republic	895	956	1,083	21%	10	10	10	-4%
Denmark	2,650	2,851	2,936	11%	174	182	189	9%
Estonia	152	139	181	19%	4	3	4	-14%
Finland	1,979	1,984	2,115	7%	185	188	196	6%
France	17,637	17,361	17,604	0%	4,751	4,873	5,046	6%
Germany	24,649	26,625	29,392	19%	2,137	2,175	2,078	-3%
Greece	2,894	3,106	3,464	20%	393	414	407	4%
Hungary	548	604	701	28%	4	4	4	-14%
Iceland	680	925	1,156	70%	21	23	23	12%
Ireland	2,538	2,603	3,062	21%	16	17	17	12%
Italy	9,651	10,384	11,251	17%	2,179	2,174	2,240	3%
Latvia	331	376	431	30%	2	2	5	160%
Lithuania	247	289	320	30%	2	1	2	-5%
Luxembourg	1,353	1,501	1,697	25%	1	1	1	-4%
Malta	352	377	431	22%	1	1	0	-19%
Netherlands	11,477	11,775	12,116	6%	31	30	32	5%
Norway	1,683	1,599	1,685	0%	1,177	1,105	1,114	-5%
Poland	1,891	2,019	2,517	33%	124	117	134	8%
Portugal	3,169	3,397	3,870	22%	369	451	506	37%
Romania	723	878	1,015	40%	99	85	149	51%
Slovakia	146	155	166	14%	4	4	3	-6%
Slovenia	75	61	74	-1%	2	2	2	-13%
Spain	14,219	15,839	17,066	20%	2,500	2,698	2,829	13%
Sweden	2,199	2,563	2,791	27%	512	554	553	8%
Switzerland	4,943	5,182	5,345	8%	139	142	121	-13%
United Kingdom	33,493	33,981	—	—	1,948	1,874	1,918	-2%
EU	**141,218**	**148,008**	**158,268**	**12%**	**15,184**	**15,616**	**16,067**	**6%**
Australia	11,839	12,460	13,626	15%	8,553	8,754	8,757	2%
Canada	11,878	12,471	13,002	9%	7,060	6,986	7,015	-1%
Japan	19,299	20,220	21,235	10%	10,157	10,278	10,492	3%
Russian Federation	9,286	8,386	9,929	7%	11,476	11,331	12,089	5%
Turkey	11,180	10,720	11,109	-1%	4,205	4,281	3,838	-9%
Ukraine	865	998	1,239	43%	83	131	172	107%
United States of America	72,633	74,770	78,442	8%	145,861	155,582	161,514	11%

Source: UNFCCC GHG Data Interface (*https://di.unfccc.int/time_series*)

Appendix D. NetScan methodology

This Appendix provides detailed information about the NetScan connectivity model. As already mentioned in section 1.2.2 this model measures the connectivity offered by an airport. The quality of the routes offered by an airport is taken into account in the measurement of the connectivity. In this appendix we explain how the quality of a connection is determined in the model.

The quality of each connection is calculated as follows:

1. First the maximum allowable perceived travel time is calculated. The maximum allowable perceived travel time $t_{x(h)y}^{perceived,\max}$ between airports X and Y depends upon the non-stop flight time between both airports $t_{xy}^{flight,non-stop}$ and a factor which decreases with distance. The non-stop flight time is determined by the geographical coordinates of origin and destination airport and the flight speed of an average jet aircraft taking into account the time needed for take-off and landing. Over longer distances passengers are willing to accept longer transfer and circuity times. Therefore the maximum allowable travel time also depends on a factor which decreases with distance: the further apart two airports are, the longer the maximum perceived travel time will be. For example, when the direct flight time between two airports is one hour, the maximum allowable perceived travel time will be about three hours, whereas this will be 24 hours for airports which are 12 hours apart by direct flight.

$$t_{xy}^{perceived,\max} = t_{xy}^{flight,non-stop} + 5 * \log(t_{xy}^{flight,non-stop} + 0.5) \quad (1)$$

2. Second the actual perceived travel time is determined. For direct connections, the actual perceived travel time between airports X and Y $t_{x(h)y}^{perceived,actual}$ equals the actual flight time $t_{xy}^{flight,actual}$. For indirect flights the perceived travel time equals the flight times on both flight legs and the transfer time at hub H $t_h^{transfer}$. As transfer time is considered more uncomfortable than flight time, the transfer time is penalized by a factor which decreases with distance p_{xy}:

$$t_{x(h)y}^{perceived,actual} = \begin{cases} t_{xy}^{flight,actual} & for\ direct\ flights \\ (t_{xh}^{flight,actual} + t_{hy}^{flight,actual}) + p_{xy} * t_h^{transfer} & for\ indirect\ flights \end{cases} \quad (2)$$

3. If the actual flight time is smaller than or equal to the average non-stop flight time, then the weight of the connection $q_{x(h)ya}$ equals one. In practice, this is only the case on direct flights operated by aircraft that are at least equally fast as the average jet aircraft on which the non-stop flight time is based. When the perceived travel time becomes larger than the maximum allowable perceived travel time, then the weight of the connection is zero and the connection will be considered unviable. In any other case, the perceived travel time lies between the non-stop flight time and the maximum allowable perceived flight time. In these cases, the weight of the connection depends on the relative difference between the perceived and maximum allowable travel time.

$$q_{x(h)y} = \begin{cases} 1 & if\ t_{x(h)y}^{perceived,\,actual} <= t_{xy}^{flight,\,non-stop} \\ 1 - \dfrac{t_{x(h)y}^{perceived,\,actual} - t_{xy}^{flight,\,non-stop}}{t_{xy}^{perceived,\,\max} - t_{xy}^{flight,\,non-stop}} & if\ t_{xy}^{flight,\,non-stop} < t_{x(h)y}^{perceived,\,actual} < t_{xy}^{perceived,\,\max} \\ 0 & if\ t_{x(h)y}^{perceived,\,actual} => t_{xy}^{perceived,\,\max} \end{cases} \quad (3)$$

When the perceived travel time is relatively small compared to the maximum allowable travel time, then the weight of the connection will be high and vice versa. The connectivity $CNU_{x(h)ya}$ of an individual direct or indirect connection equals its quality $q_{x(h)ya}$.

$$CNU_{x(h)ya} = q_{x(h)ya} \quad (4)$$

The CNU is calculated for each individual direct and indirect connection. This means that when a flight is offered with a daily frequency, the CNU's for each of these seven flights as well as for each possible connection have been calculated. The reason for distinguishing between individual flights is twofold. First, the flights might be carried out by different airplane types during the week leading to different flight times and therefore differing CNU's. Second, the same flight might connect to different flights on for example a Monday than on a Friday.

Appendix E. Multi Airport Cities

World region	Country	City	Airport Code	Airport Name
Europe	Belgium	Brussels	BRU	Brussels Airport
			CRL	Brussels S. Charleroi Airport
	Switzerland	Basel/Mulhouse	BSL	Basel
			MLH	Mulhouse
	Germany	Berlin (DE)	BER	Berlin Brandenburg Apt
			SXF	Berlin Schoenefeld Apt
			TXL	Berlin Tegel Apt
		Duesseldorf	DUS	Duesseldorf International Airport
			NRN	Duesseldorf Weeze Airport
		Frankfurt	FRA	Frankfurt International Apt
			HHN	Frankfurt Hahn Airport
		Hamburg	HAM	Hamburg Airport
			XFW	Hamburg Finkenwerder
		Munich	AGB	Munich Augsburg Airport
			MUC	Munich International Airport
	Denmark	Copenhagen	CPH	Copenhagen Kastrup Apt
			RKE	Copenhagen Roskilde Apt
	Spain	Tenerife	TFN	Tenerife Norte
			TFS	Tenerife Sur Apt
	France	Lyon	GNB	Lyon Grenoble-St Geoirs Apt
			LYS	Lyon St-exupery Apt
		Paris	BVA	Paris Beauvais-Tille Airport
			CDG	Paris Charles de Gaulle Apt
			LBG	Paris Le Bourget Apt
			ORY	Paris Orly Apt
			XCR	Paris Chalons-Vatry Airport
	United Kingdom	Belfast	BFS	Belfast International Apt
			BHD	Belfast George Best City Apt
		Glasgow (GB)	GLA	Glasgow International Airport
			PIK	Glasgow Prestwick Apt
		London (GB)	LCY	London City Apt
			LGW	London Gatwick Apt
			LHR	London Heathrow Apt
			LTN	London Luton Apt
			SEN	London Southend Apt
			STN	London Stansted Apt
		Shetland Islands	LSI	Shetland Islands Sumburgh Apt
			LWK	Shetland Islands Lerwick/Tingwall Apt
	Iceland	Reykjavik	KEF	Reykjavik Keflavik International Apt
			RKV	Reykjavik Apt
	Italy	Milan	BGY	Milan Bergamo/orio al Serio Apt
			LIN	Milan Linate Apt
			MXP	Milan Malpensa Apt
			PMF	Milan Parma Apt
		Rome (IT)	CIA	Rome Ciampino Apt
			FCO	Rome Fiumicino Apt
		Venice	TSF	Venice Treviso/Sant'Angelo Apt
			VCE	Venice Marco Polo Apt
		Verona	VBS	Verona Brescia/Montichiari Airport
			VRN	Verona Villafranca Airport
	Norway	Oslo	OSL	Oslo Gardermoen Airport
			TRF	Oslo Sandefjord-Torp Arpt
	Sweden	Stockholm	ARN	Stockholm Arlanda Apt
			BMA	Stockholm Bromma Apt
			NYO	Stockholm Skavsta Airport
			VST	Stockholm Vasteras Apt
	Turkey	Istanbul	ISL	Istanbul Ataturk Airport
			IST	Istanbul Airport
			SAW	Istanbul Sabiha Gokcen Apt
	Romania	Bucharest	BBU	Bucharest Baneasa - Aurel Vlaicu Apt
			OTP	Bucharest Henri Coanda Apt
	Russian Federation	Moscow	DME	Moscow Domodedovo Apt
			SVO	Moscow Sheremetyevo International Apt
			VKO	Moscow Vnukovo International Apt

	Ukraine	Kiev	IEV	Kiev Zhuliany Intl Apt
			KBP	Kiev Borispol Intl Apt
Africa	Senegal	Dakar	DKR	Dakar Leopold Sedar Senghor
			DSS	Dakar Blaise Diagne International
	Kenya	Nairobi	NBO	Nairobi Jomo Kenyatta International Apt
			WIL	Nairobi Wilson Apt
	Namibia	Windhoek	ERS	Windhoek Eros Apt
			WDH	Windhoek Hosea Kutako International
	South Africa	Johannesburg	HLA	Johannesburg Lanseria International Apt
			JNB	Johannesburg O.r. Tambo International
Asia	China	Beijing	NAY	Beijing Nanyuan Apt
			PEK	Beijing Capital Intl Apt
			PKX	Beijing Daxing Intl.
		Shanghai	PVG	Shanghai Pudong International Apt
			SHA	Shanghai Hongqiao International Apt
	Hong Kong (sar) China	Hong Kong	HHP	Sheung Wan Heliport
			HKG	Hong Kong International Apt
	Japan	Nagoya	NGO	Nagoya Chubu Centrair International Apt
			NKM	Nagoya Komaki Airport
		Osaka	ITM	Osaka Intl (Itami)
			KIX	Osaka Kansai International Airport
			UKB	Osaka Kobe Airport
		Sapporo	CTS	Sapporo New Chitose Apt
			OKD	Sapporo Okadama Apt
		Tokyo	HND	Tokyo Intl (Haneda)
			NRT	Tokyo Narita Intl
	Korea Republic of	Seoul	GMP	Seoul Gimpo International Airport
			ICN	Seoul Incheon International Airport
			SSN	Seoul Air Base
	Chinese Taipei	Taipei	TPE	Taipei Taiwan Taoyuan International Apt
			TSA	Taipei Songshan
	India	Hyderabad	BPM	Hyderabad Begumpet Airport
			HYD	Hyderabad Rajiv Gandhi Intl Arpt
	Sri Lanka	Colombo	CMB	Bandaranaike Intl
			RML	Colombo Ratmalana Apt
	Indonesia	Jakarta	CGK	Jakarta Soekarno-Hatta Apt
			HLP	Jakarta Halim Perdanakusuma Apt
	Malaysia	Kuala Lumpur	KUL	Kuala Lumpur International Airport
			SZB	Kuala Lumpur Sultan Abdul Aziz Shah Apt
	Singapore	Singapore	SIN	Singapore Changi Apt
			XSP	Singapore Seletar Apt
	Thailand	Bangkok	BKK	Bangkok Suvarnabhumi International Apt
			DMK	Bangkok Don Mueang International Arpt
Latin America	Dominica	Dominica	DCF	CaneField
			DOM	Dominica Melville Hall Apt
	Dominican Republic	Santo Domingo (DO)	JBQ	Santo Domingo Dr. J Balaguer
			SDQ	Santo Domingo Las Americas Intl
	Jamaica	Kingston (JM)	KIN	Norman Manley Intl
			KTP	Tinson Pen
	Saint Lucia	St Lucia	SLU	St Lucia George F.I. Charles Apt
			UVF	Hewanorra Intl
	Puerto Rico	San Juan (PR)	SIG	San Juan F.L.Ribas Doiminicci
			SJU	San Juan Luis Munoz Marin Intl Apt
	Virgin Islands, US	St Thomas Island	SPB	St Thomas Charlotte Amalie SPB
			STT	St Thomas Cyril E King Apt
		St Croix Island	SSB	St Croix SPB
			STX	St Croix Henry E. Rohlsen Apt
	Belize	Belize City	BZE	Belize City Goldson Intl Apt
			TZA	Belize City Municipal Apt
	Costa Rica	San Jose	SJO	San Jose Juan Santamaria Apt
			SYQ	San Jose Tobias Bolanos Apt
	Mexico	Mexico City	MEX	Mexico City Juarez Intl
			TLC	Mexico City Toluca-A.Lopez Mateos
	Panama	Panama City (PA)	PAC	Panama City Marcos A.Gelabert Intl
			PTY	Panama City Tocumen International
	Argentina	Buenos Aires	AEP	Buenos Aires Aeroparque J. Newbery
			EZE	Buenos Aires Ministro Pistarini

	Brazil	Rio de Janeiro	GIG	Rio de Janeiro Galeao-A.C.Jobim Int Apt
			SDU	Rio de Janeiro Santos Dumont Apt
		Sao Paulo	CGH	Sao Paulo Congonhas Apt
			GRU	Sao Paulo Guarulhos Intl Apt
			VCP	Sao Paulo Viracopos-Campinas Intl Apt
	Colombia	Medellin	EOH	Medellin Enrique Olaya Herrera Apt
			MDE	Medellin Jose Maria Cordova Intl
	Suriname	Paramaribo	ORG	Paramaribo Zorg En Hoop Apt
			PBM	Paramaribo Johan A Pengel Intl Apt
Middle East	United Arab Emirates	Dubai	DWC	Dubai Al Maktoum Intl
			DXB	Dubai International
	Israel	Tel Aviv-yafo	SDV	Tel Aviv-Yafo Sde Dov
			TLV	Tel Aviv-yafo Ben Gurion International
	Iran Islamic Republic of	Tehran	IKA	Tehran Imam Khomeini International Apt
			THR	Tehran Mehrabad International Airport
	Jordan	Amman	ADJ	Amman Marka Intl Airport
			AMM	Amman Queen Alia International Apt
North America	Canada	Nanaimo	YCD	Nanaimo Cassidy Apt
			ZNA	Nanaimo Harbour
		Montreal	YHU	Montreal St Hubert Apt
			YMX	Montreal Mirabel Intl Apt
			YUL	Montreal Pierre Elliott Trudeau Int Apt
		Ottawa	YND	Ottawa Gatineau Airport
			YOW	Ottawa McDonald - Cartier Intl Apt
		Toronto	YHM	Toronto John C Munro Hamilton
			YKF	Toronto Region of Waterloo Int
			YTZ	Toronto Billy Bishop City A/P
			YYZ	Toronto Lester B Pearson Intl
		Vancouver	CXH	Vancouver Coal Harbour SPB
			YDT	Vancouver Boundary Bay Apt
			YVR	Vancouver International Apt
		Victoria (CA)	YWH	Victoria Inner Harbour Apt
			YYJ	Victoria International Apt
	USA	Atlanta	ATL	Atlanta Hartsfield-jackson Intl Apt
			PDK	Atlanta De Kalb-Peachtree
		Boston	BOS	Boston Edward L Logan Intl Apt
			PSM	Portsmouth Pease International Airport
		Chicago	MDW	Chicago Midway Intl
			ORD	Chicago O'Hare International Apt
			RFD	Chicago/Rockford International
		Cleveland	BKL	Cleveland Burke Lakefront Apt
			CLE	Cleveland Hopkins International Apt
		Columbus (US) OH	CMH	Columbus John Glenn Intl Apt
			LCK	Columbus Rickenbacker Intl Apt
		Cincinnati	CVG	Cincinnati Northern Kentucky Intl
			LUK	Cincinnati Municipal (Lunken Fld) Apt
		Dallas	DAL	Dallas Love Field
			DFW	Dallas Dallas/Fort Worth Intl Apt
		Detroit	DTW	Detroit Metropolitan Wayne County
			YIP	Detroit Willow Run Apt
		El Paso	BIF	El Paso Biggs Aaf
			ELP	El Paso International Apt
		Fort Lauderdale	FLL	Fort Lauderdale/Hollywood Intl Apt
			FXE	Fort Lauderdale Executive Apt
		Grand Canyon (US) AZ	FLG	Grand Canyon Flagstaff Pulliam
			GCN	Grand Canyon National Park Apt
		Houston	HOU	Houston William P. Hobby Apt
			IAH	Houston George Bush Intercont.
		Chignik	KCG	Chignik Apt
			KCL	Chignik Lagoon Apt
			KCQ	Chignik Lake Apt
		Las Vegas (US) NV	BLD	Las Vegas Boulder City Airport
			LAS	Las Vegas McCarran International Apt
		Kansas City	MCI	Kansas City International Apt
			MKC	Kansas City C B Wheeler Downtown Apt
		Mobile	BFM	Mobile Downtown Apt
			MOB	Mobile Regional Apt

		New York	EWR	Newark Liberty International Apt
			JFK	New York J F Kennedy International Apt
			LGA	New York LaGuardia Apt
			SWF	New York Stewart International
		Orlando	MCO	Orlando International Apt
			SFB	Orlando Sanford International Airport
		Philadelphia	PHL	Philadelphia International Apt
			TTN	Philadelphia Trenton-Mercer Apt
		Phoenix	AZA	Phoenix Mesa Gateway Airport
			PHX	Phoenix Sky Harbor Intl Apt
		Pilot Point	PIP	Pilot Point Airport
			UGB	Pilot Point Ugashik Bay Apt
		Sacramento	SCK	Sacramento Stockton Metropolitan
			SMF	Sacramento International Apt
		San Diego	CLD	San Diego McClellan-Palomar Arpt
			MYF	San Diego Montgomery Field
			SAN	San Diego International
		San Antonio	SAT	San Antonio International Apt
			SKF	San Antonio Lackland AFB-Kelly Fld
		Savannah	SAV	Savannah Hilton Head International Apt
			SVN	Savannah Hunter Aaf
		Seattle	BFI	Seattle Boeing Fld-King Co Int
			LKE	Seattle Lake Union SPB
			SEA	Seattle-Tacoma International Apt
		Tampa	PIE	Tampa St Pete-Clearwater Intl Apt
			TPA	Tampa International Apt
		Destin/Ft Walton Beach	DSI	Destin/Ft Walton Beach Destin Exec Apt
			VPS	Destin/Ft Walton Beach Apt
		Washington (US) DC	DCA	Washington Ronald Reagan National Apt
			IAD	Washington Dulles International Apt
Pacific	Australia	Melbourne (AU)	AVV	Melbourne Avalon Airport
			MEB	Melbourne Essendon Apt
			MEL	Melbourne Airport
	New Caledonia	Noumea	GEA	Noumea Magenta Apt
			NOU	La Tontouta

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LIST OF ACRONYMS

- **ACI:** Airport council international
- **AEA:** Association of European Airlines
- **ASK:** Available Seats Kilometres
- **ATM:** Air Traffic Management
- **CAA:** Civil Aviation Authority
- **CAEP:** Committee on Aviation Environmental Protection
- **CO/CO2:** Carbon monoxide / dioxide
- **EEA:** European Environment Agency
- **EASA:** European Aviation Safety Agency
- **EC:** European Commission
- **ECAC:** European Civil Aviation Conference
- **ECB:** European Central Bank
- **EFTA:** European Free Trade Association
- **ETS:** EU Emissions Trading System
- **EU:** European Union
- **EU28:** 28 Member States of the European Union
- **FAA:** Federal Aviation Authority
- **FBO:** Fixed-Based Operator
- **FSNC:** Full Service Network Carrier
- **GDP:** Gross Domestic Product
- **GHG:** Greenhouse gas
- **HC:** Hydrocarbons
- **IAG:** International airlines group
- **IATA:** International Air Transport Association
- **ICAO:** International Civil Aviation Organisation
- **LCC:** Low-Cost Carrier
- **LF:** Load Factor
- **MPax:** Million passengers
- **MRO:** Maintenance, Repair, Overhaul
- **NOX:** Nitrogen oxides
- **PAX:** Passengers
- **PESTEL:** Political, economic, social, technological, environmental, legal
- **PSO:** Public Service Obligation
- **RPK:** Revenue Passenger Kilometre
- **RSK:** Revenue Seat Kilometre
- **RTK:** Revenue Ton Kilometre
- **SES:** Single European Sky
- **SESAR:** Single European Sky ATM Research
- **STOL:** Short Take-Off and Landing
- **WHO:** World Health Organisation

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