InterVISTAS

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Economic Impact of European Airports

A Critical Catalyst to Economic Growth

PREPARED FOR

ACI EUROPE

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Foreword

The European economic narrative of the past few years has been very much focused on short-term dynamics. As Europe has been rocked by a seemingly endless series of existential challenges, this is understandable. Yet as we tentatively emerge from the worst of the crises, it is now time to look towards the future, and to give more thought as to how Europe's economy will fare not after six months or a year, but rather in 10 or 20 years, or ever further ahead. It is time to make the reforms and investments today in order to reap the benefits in the future. This long term perspective is, of course, an approach which airports will be very comfortable with.

Just like airport investors, those making a longer-term investment in Europe will look beyond the current difficulties being faced, and will focus more on the underlying inherent characteristics of the region. In this regard, Europe has significant strengths to call upon.

The fact is that today's struggles are taking place within a wider step change in the global economy.

As the world becomes more tightly bound together, global supply chains are continuing to fan out across the surface of the planet. The goods and services we consume are increasingly sourced from a wide range of different locations across the globe. Competition between countries and regions is less and less for specific industries, and more and more for specific components of multiple supply chains. It will no longer be enough - if it ever was - to be the cheapest country in which to produce or hire. As technology spreads and global transport continues to strengthen companies will have plenty of places to choose from, which are all capable of cheaply producing massive quantities of the same products. The race to the bottom is only going to get more and more intense, and it is a race that Europe cannot, and should not aim to win.

The real challenge will be not to be simply a part of these supply chains, but rather to occupy a segment of those chains where most value is created, and where the rewards are correspondingly greater. More than ever, those societies with the greatest standards of living will not be those assembling the latest consumer electronic device, for example, but those creating the concept of the device, designing its next iteration and marketing it. The regions that succeed in these endeavours will be those that have the right people for these tasks – those with creativity, flexibility, empathy and imagination.

In parallel it is becoming increasingly apparent that technology, long a net generator of employment, may now be replacing workers, without generating alternative jobs. Computers and machines are getting ever smarter, ever more adoptable and ever more capable - and they are working their way up the social ladder. While previously machines could be stronger and faster than humans, they are now becoming more intelligent. There will still be a place for labour in this future, but it will have to be a very 'human' form of labour. The peoples of the future that succeed will be those with skills and attributes that machines cannot replicate. Again - creativity, flexibility, empathy, imagination.

These two sophisticated economic trends boil down to a very simple concrete fact – the future strength of a region or country will depend more so than ever upon the strength of its people. Those people with the right skills, competencies and human qualities, if adequately connected to each other and to the wider world, will thrive.

So where does Europe fit into this?

For all the talk of decline and stagnation, it is often forgotten that Europe is amongst the most educated and culturally diverse regions of the world, and unparalleled in terms of its tightly bound political and economic links. This unity in diversity is a huge and very real potential economic strength - offering a possibility for innovation, creativity and collaboration associated with the intermingling of one of the most well-educated and diverse populations on the earth. The resulting fresh perspectives, new ideas and lateral thinking are just the strengths necessary in a century where change happens at an ever faster rate, and where economic rewards are increasingly elusive. This strength positions Europe extremely well for the global economy of the 21st century.

But before we can unlock this enormous potential dividend, Europe needs to be connected, both internally and to the wider world.

The economic benefits associated with our diversity will be denied to us if we cannot sit down in a room together and engage. European unity and free movement of labour means nothing if we cannot readily reach each other. Ultimately, political and economic union will be a half empty concept if it is not underpinned by a physical, tangible real network of connections.

Similarly all our cooperation and innovation will be for nothing, if we are only engaging amongst ourselves. Even if Europe is the most competitive and innovative region in the world, this will not translate into jobs and improvements in our quality of life unless we take what we have created to the wider world.

There are broad swathes of the globe which are set for, or are mid-way through, the wave of growth that Europe itself has surfed in the 2nd half of the 20th century. This represents millions if not billions of people who will trade with Europe, invest in Europe, visit Europe, and ultimately experience the best that Europe has to offer.

This potential trade and investment, and the ensuing growth and jobs will be but a missed opportunity, if we are not properly connected with these people. In parallel, there are equal numbers of people who will compete against Europe, for investment, trade, and the

development of new goods and services. A Europe which is not adequately connected to the wider world will only play to their advantage.

It is an undeniable fact that today aviation is the only sector which can both allow Europeans to physically connect with each other, whilst simultaneously allowing those same Europeans to tangibly connect with the wider global economy. It is no surprise therefore that a strong link has been established between a country's air connectivity and the wealth of its citizens.

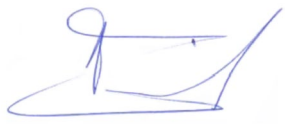
Europe's historical position as a dominant aviation power has served the region well in the second half of the 20th century. 21st century trends make it clear that connectivity between people – both within and beyond Europe – will be crucial if we are to secure a quality position within the global economy that will deliver growth and jobs. While the rise of other regions in the world will inevitably result in a relative decline in European aviation dominance, this need not and indeed must not lead to an absolute decline in the quality of our air connectivity.

The history of Europe has shown that the right policy decisions can have a massively positive impact upon the prosperity and quality of life of its citizens. In order to safeguard Europe's economic future, it is more so than ever essential that the right policy decisions concerning aviation are made in the years ahead.

With this in mind, ACI EUROPE has commissioned InterVISTAS to produce this study on the Economic Impact of European Airports. Together with ACI EUROPE's Airport Industry Connectivity Report, which looks at how the nature of Europe's air connectivity has changed over the last decade, this work is part of the industry's contribution towards a better understanding of the role of European aviation for the economy, to help ensure that the right policy paths can be taken.

Undertaking an economic impact study implies looking and choosing from a range of possible approaches towards the calculation of a sector's economic impact and these can sometimes produce varying results. To guard against possible misinterpretation and ensure a sound result, InterVISTAS has taken a transparent approach. The statistical methodology behind the figures is explained in significant detail. Where key assumptions are made, these are stated. Underlying economic data is only from reliable sources which are clearly cited. And results are not over-interpreted – where there is nuance, this is acknowledged.

I hope you find this work as stimulating and thought-provoking as we have, and that it takes its place as one small but meaningful brick in a much large path towards Europe's future economic prosperity.



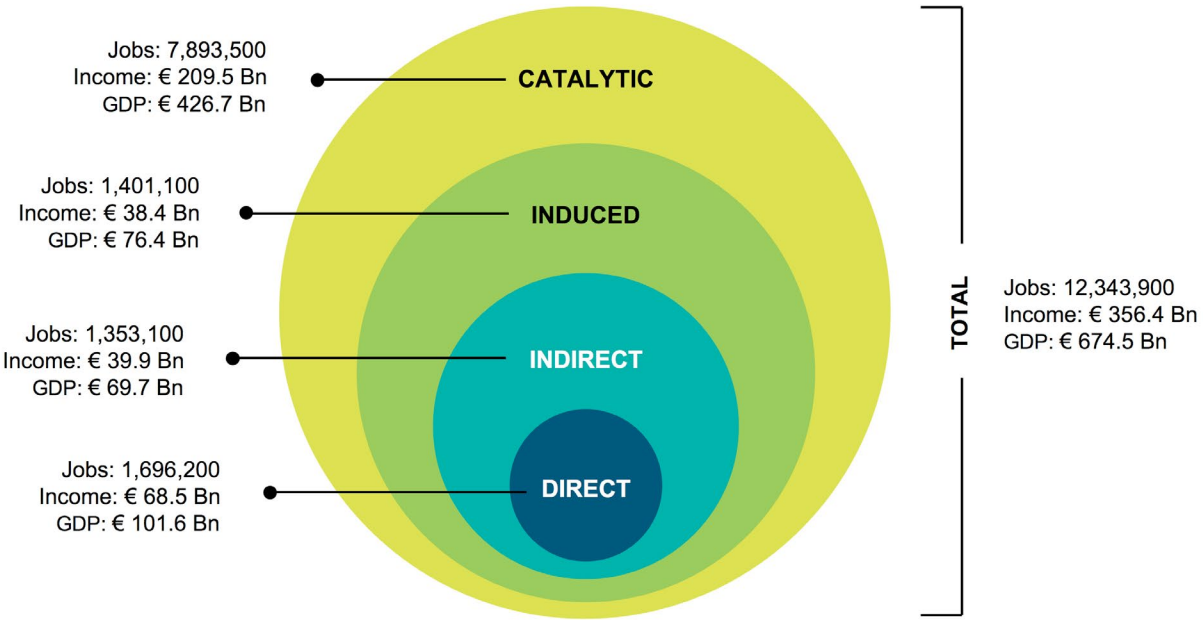
Arnaud Feist
President of ACI EUROPE & CEO of Brussels Airport Company

January 2015

Executive Summary

The role of aviation today in the modern European economy is not merely a service provider to other industries and members of the public, but a key driver of economic and social growth and prosperity. Airports Council International Europe (ACI EUROPE) commissioned Inter*VISTAS* Consulting LTD (Inter*VISTAS*) to independently quantify and document the economic contribution, or economic impact, of airports within Europe. The key findings are presented below.

European airports contribute to the employment of 12.3 million people earning € 356 billion in income annually, and generate € 675 billion in GDP each year, equal to 4.1% of GDP of Europe.



Numbers may not add up due to rounding.

The economic impact of European airports and associated aviation activity comprises the following:

- **Direct Economic Impact**. The employment, income and GDP associated with the operation and management of activities at the airports including firms on-site at the airport and airport-related businesses located elsewhere near the airport. This includes activities by the airport operator, the airlines, airport air traffic control,[1] general aviation, ground handlers, airport security, immigration and customs, aircraft maintenance, and other activities at the airport.
- **Indirect Economic Impact**. The employment, income and GDP generated by down-stream industries that supply and support the activities at the airport. For example, these could include: wholesalers providing food for inflight catering, oil refining activities for jet fuel, companies providing accounting and legal services to airlines, travel agents booking flights, etc.
- **Induced Economic Impact**. This captures the economic activity generated by the employees of firms directly or indirectly connected to the airport spending their income in the national economy. For example, an airline employee might spend his/her income on groceries, restaurants, child care, dental services, home renovations and other items which, in turn, generate employment in a wide range of sectors of the general economy.
- **Catalytic Impacts**. Also known as Wider Economic Benefits, catalytic impacts capture the way in which the airport facilitates the business of other sectors of the economy. As such, air transportation facilitates employment and economic development in the national economy through a number of mechanisms:

- **Trade** – air transport provides connections to export markets for both goods and services.
- **Investment** – a key factor many companies take into account when making decisions about the location of offices, manufacturing plants or warehouses in proximity of an international airport.
- **Tourism** - air service facilitates the arrival of larger numbers of tourists to a country. This includes business as well as leisure tourists. The spending of these tourists can support a wide range of tourism-related businesses: hotels, restaurants, entertainment and recreation, car rentals and others.
- **Productivity** – air transportation offers access to new markets which in turn enables businesses to achieve greater economies of scale. Air access also enables companies to attract and retain high quality employees.

These impacts are discussed in the sections below.

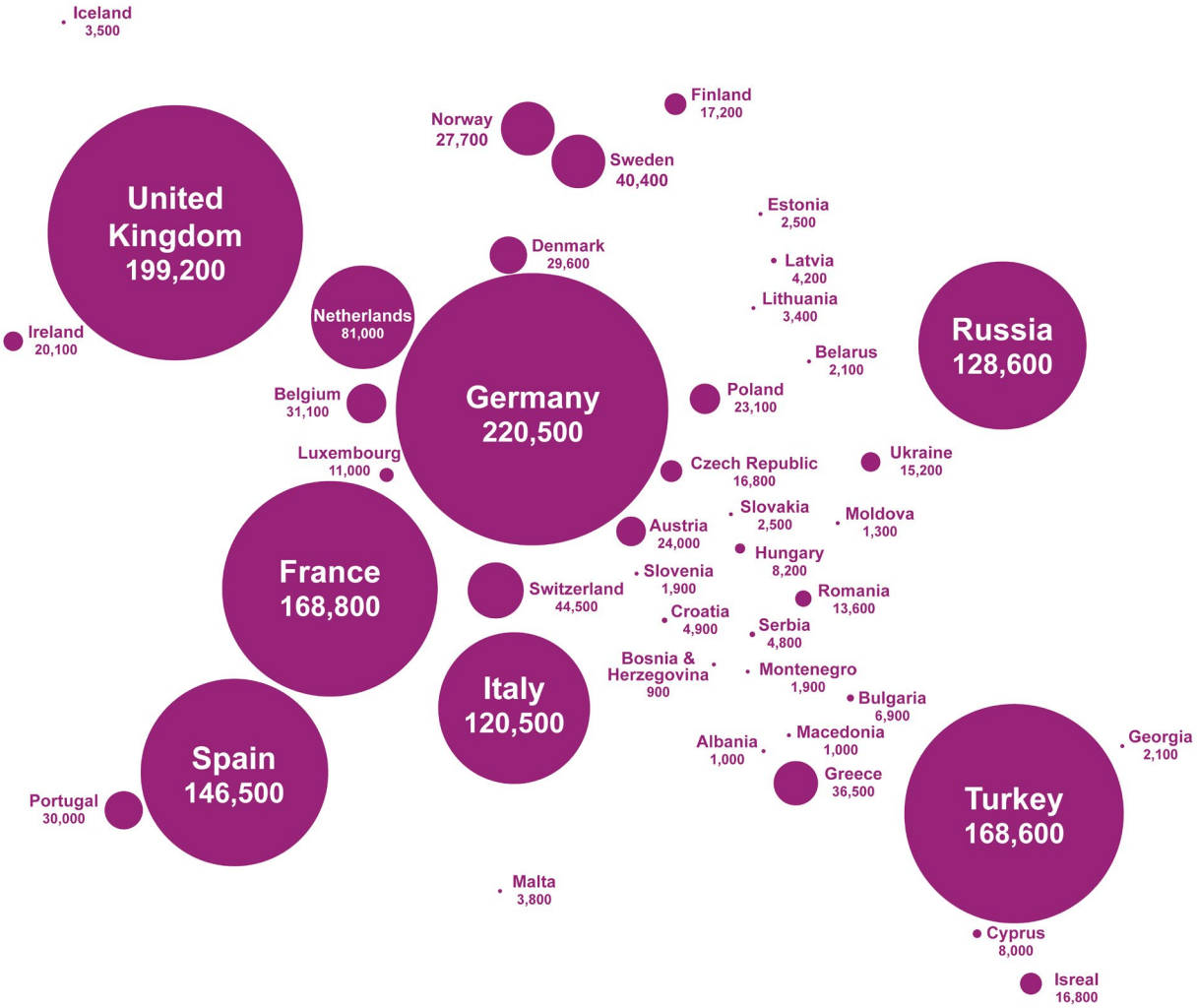
[1] Airport air traffic control includes air traffic control activities associated with aircraft approach, landing and take-off and ground movements. It does not include Area Control Centres that control aircraft in flight between airports (i.e. enroute).

Direct Impacts: day-to-day activities at airports in Europe employ almost 1.7 million people

Activities by the airport operator, the airlines, airport air traffic control, general aviation, ground handlers, airport security, immigration and customs, aircraft maintenance, and other airport related activities result in almost 1.7 million direct jobs in Europe.

The geographic breakdown on these jobs is provided in **Figure ES-2**. The top five countries (Germany, United Kingdom, France, Spain and Turkey), accounted over half (53%) of the direct employment.

Figure ES-2: Map of the Direct Employment at Airports in Europe, 2013



European airports are a source of a wide variety of job categories, with different positions spread on-site and off-site across the airports.

A breakdown of direct jobs at airports in Europe, by employment type, is provided in **Figure ES-3**.

Figure ES-3: Direct Jobs by Employment Type

Numbers may not add up due to rounding.

The direct employment generated by airports is affected by the size of the airport and the mix of traffic handled.

Direct employment data was gathered from 125 airports representing 71% of European passenger traffic. For those airports where no employment information could be obtained an econometric model was developed to infer their direct employment. Analysis was conducted of the airports from which data was collected to analyse the relationship between direct employment and characteristics of the airport. The results are summarised in **Figure ES-4** below.

Figure ES-4: Factors Determining Airport Direct Employment

Airport Size / Traffic Type	Comment
Less than 1 million traffic units	Each increase of 1000 traffic units increases employment by 1.2 Jobs
1 million - 10 million traffic units	Each increase of 1000 traffic units increases employment by 0.95 Jobs
Over 10 million traffic units	Each increase of 1000 traffic units increases employment by 0.85 Jobs
Connecting passengers	Connecting passengers generate 3% less direct jobs than origin/destination passengers
LCC passengers	LCC passengers generate 20% less direct jobs than non-LCC passengers

The estimated parameters showed evidence of economies of scale: the employment generated by each additional 1000 traffic units for small airport is greater than that for large airports. Furthermore, connecting passengers have a marginally smaller (3%) direct employment impact than origin/destination passengers. This may reflect the fact that connecting passengers do not consume certain services at airports such as car parking, car rental and other ground transportation. Passengers flying on Low Cost Carriers (LCCs), have a smaller direct employment impact (20% less) than other types of traffic. This may be due to the lower staffing levels at LCCs, reduced auxiliary services (such as inflight catering and airport lounges), and reduced LCC passenger spending on commercial offerings.

It should be noted that these ratios do not attempt to find relationships between passenger numbers and the impact on total employment – in particular the impact upon catalytic impact. For example, connecting passengers may require a lower proportion of direct workers, but if connecting passengers allows the operation of routes which would otherwise not be viable, than this leads to an increase in traffic, which would not be factored into this ratio. Similarly, although LCC passengers also require less direct workers, LCC traffic has been for many airports and areas, the major if not sole provider of growth in recent years. In such cases this traffic has contributed to the catalytic impact of airports, which is again not captured in the ratios.

Indirect and Induced Impacts: Including indirect and induced impacts, European airports generate an estimated almost 4.5 million jobs and contributed € 248 billion in GDP

As summarised in **Figure ES-4**, the combined direct, indirect and induced employment generated by European airports is estimated at nearly 4.5 million jobs, earning a total of € 146.9 billion in income (wages, salaries, bonuses and other remuneration), and contributing € 247.8 billion to GDP (1.5% of the total GDP of the countries in the study).

Figure ES-4: Direct, Indirect and Induced Economic Impact, 2013

Impact	Jobs	Income (€ Billions)	GDP (€ Billions)
Direct	1,696,200	€ 68.5	€ 101.6
Indirect	1,353,100	€ 39.9	€ 69.7
Induced	1,401,100	€ 38.4	€ 76.4
Total	**4,450,400**	**€ 146.9**	**€ 247.8**

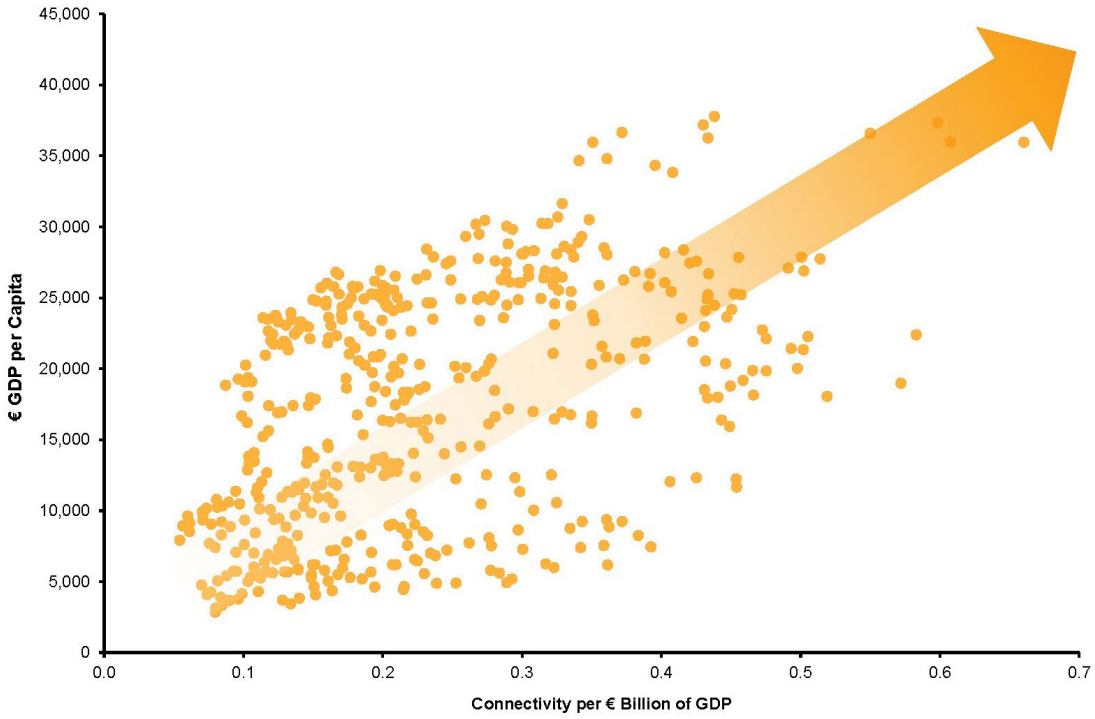
Numbers may not add up due to rounding.

Catalytic Impacts: Econometric analysis demonstrates a significant relationship between the air connectivity supported by airports and economic growth

The relationship between aviation and economic growth was analysed using data on the aviation connectivity and GDP per capita for 40 countries in ACI EUROPE between 2000 and 2012.

Figure ES-5 shows the relationship between air connectivity divided by GDP and GDP per capita.[2] The chart clearly shows a positive relationship between connectivity and GDP per capita. There is considerable scatter of observations which is not surprising, given that there are a large number of other factors that affect economic growth. Nevertheless, even given these sources of variation, there is a clear pattern just by plotting connectivity against GDP per capita.

Figure ES-5: Relationship Between Air Connectivity and GDP per Capita in Europe, 2000-2012



Source: InterVISTAS Analysis Based on Diio Mi Schedule Data and World Bank, World Development Indicators.

[2] The connectivity index has been divided by GDP to control for size of economy effects (i.e. large, rich economies with large populations generally have higher levels of air service).

Econometric analysis was conducted to further investigate the relationship between connectivity and GDP per capita. This analysis allowed the relationship between economic growth and connectivity to be isolated and quantified while controlling for other factors that may have an impact (such as education levels, research and development, capital spending, institutional and regulatory factors, etc.).

This analysis found that **a 10% increase in connectivity was associated with an increase in GDP per capita of 0.5%**. Additional analysis found evidence that this relationship was two-way. That is, as an economy grows, it supports a larger air transport sector, but it is also the case that growth in air transport supports economic growth. Air transport is not merely following economic growth but also acting as a catalyst for growth.

Catalytic Impacts: The catalytic impacts of European airports facilitate a further 7.9 million jobs and € 427 billion in GDP

Based on the econometric analysis, the catalytic impact of airports in Europe was estimated. It is estimated that a total of 7.9 million jobs are associated with the catalytic impacts of airports in Europe, earning € 209.5 billion in income. The catalytic impacts of these airports generated approximately € 426.7 billion in GDP. This is approximately 2.6% of the total GDP of the European countries in 2013.

The size of the catalytic impact as a proportion of the national economy varies greatly between countries from 1.1% in Hungary to 7.1% in Cyprus. Countries with relatively large tourism industries tend to have larger catalytic impacts, such as Cyprus, Spain, Greece and Turkey, reflecting the importance of aviation to their tourism industries. More remote or island nations also tend to have larger catalytic impacts (e.g. Malta, Iceland), suggesting the importance of air connectivity to integrating those nations with the global economy.

While these figures may seem dramatic at first glance, it is worth considering how these economies might look if they had substantially reduced air connectivity levels. For example, if many of the direct and highly frequent services did not exist, passengers would have limited or no options to travel to/from these countries, or would have to travel via other hub airports. In such a scenario, it is easy to imagine that tourism to these countries would be much lower, that the overall volume of trade would be substantially lower, and that some companies would choose not to locate or expand in these countries. The net effect of this would be smaller, slower-growing economies. See **Chapter 7** for an overview of pre-existing work on the catalytic impact of airports and associated aviation activity.

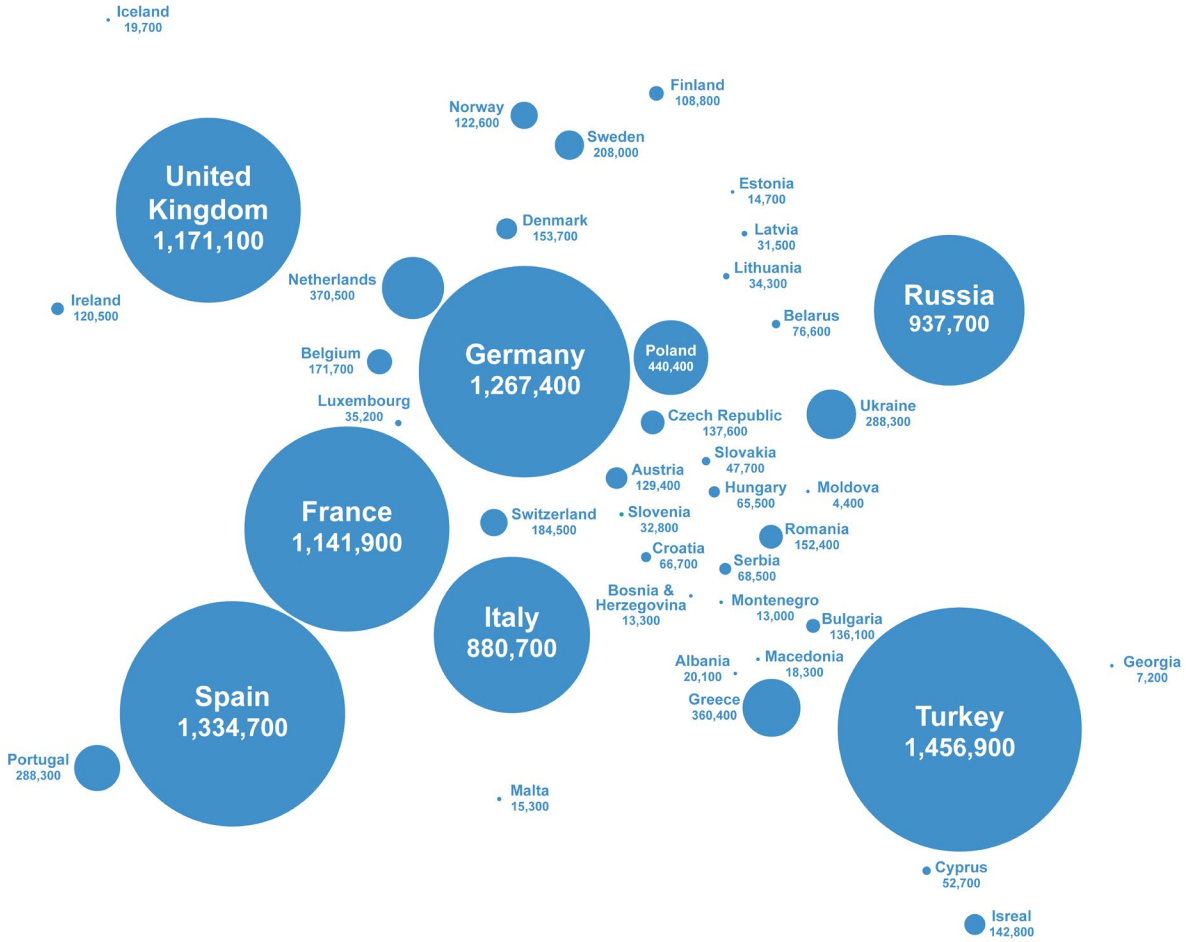
It should be noted that these figures are not attempting to credit airports with solely creating 2.6% of the European economy. These economies are far more complex than that. It clearly takes a wide range of players acting together to generate economic growth – government, business, infrastructure providers, residents and others. For example, if no one had decided to build large amounts of hotels in many of these countries, tourism would also be substantially lower. What the estimates do show is that without European airports, and particularly without the diverse and affordable connectivity supported by these airports, the economies of these countries would not be as large, affluent or diverse as they are today.

Total Impact: Combining the direct, indirect, induced and catalytic impacts, airports in Europe generate or facilitate over 12.3 million jobs and € 675 billion in GDP

Including the activity directly related to the airports, the indirect and induced impacts that flow from that, and the other sectors of the economy facilitated by air connectivity, European airports contribute to the employment of 12.3 million people, earning a total of € 356.4 billion in 2013. In addition, a total of € 674.5 billion in GDP was generated, equal to 4.1% of GDP of the Europe.

Figure ES-6 shows the total employment by country.

Figure ES-6: Map of Total (Direct+Indirect+Induced+Catalytic) Employment by Country, 2013



Ensuring the Future Economic Contribution of Europe's Airports: Based on EUROCONTROL's air traffic forecasts, if airport capacity fails to keep up with demand, then by 2035, a total of over 2 million jobs and € 97 billion in GDP across Europe could be forgone on an annual basis.

As part of its *Challenges of Growth* series, in 2013 EUROCONTROL released a report forecasting air traffic in Europe in 2035.[3] In EUROCONTROL's most likely forecast, unconstrained passenger demand is forecast to reach over 1.5 billion departures in 2035. However, due to projected capacity constraints at European airports, only 1.3 billion departures are anticipated to be accommodated, leaving a gap (unfulfilled demand) of nearly 225 million departures.

As shown in **Figure ES-7**, the forgone economic impact associated with this unmet demand is estimated to be 2 million jobs, € 47 billion in income and € 96.7 billion in GDP, including direct activity at the airport, indirect and induced impacts, and the lost tourism, trade and investment due to low connectivity growth. This is roughly one sixth of the 2013 economic impact of airports in the EUROCONTROL countries.[4] Furthermore, the majority of this loss is in the general economy, not the airports or aviation sector.

Figure ES-7: Foregone Economic Impact Due to Capacity Constraints at European Airports, 2035

	Jobs	Income (€ Billions)	GDP (€ Billions)
Foregone Economic Impact in Scenario C: Regulated Growth (Most Likely)			
Direct	313,000	9.3	14.3
Indirect	266,000	5.3	9.5
Induced	259,000	4.7	10.0
Catalytic	1,197,000	27.8	62.8
Total	**2,035,000**	**47.0**	**96.7**

All financial figures are in 2013 prices. Numbers may not add up due to rounding.

[3] https://www.eurocontrol.int/sites/default/files/article/content/documents/official-documents/reports/201306-challenges-of-growth-2013-task-4.pdf.
[4] Geographic area covered in the EUROCONTROL forecasts is slightly different to ACI EUROPE, and does not include Russia or Israel.

Contents

PART I:

INTRODUCTION AND OVERVIEW

1 Introduction

The role of aviation today in the modern European economy is not merely a service provider to other industries and members of the public, but a key driver of economic and social growth and prosperity.

Airports Council International Europe (ACI EUROPE) commissioned Inter*VISTAS* Consulting LTD (Inter*VISTAS*) to independently quantify and document the economic contribution, or economic impact, of airports within Europe. This report is the summary of that study, which was conducted between January and December of 2014.

The report is structured into five sections:

Section 1 provides an overview of the aviation sector in ACI EUROPE, the economic concepts behind the study, and the methodology applied.

Section 2 documents the employment, earnings and Gross Domestic Product (GDP) generated in and around airports from the day-to-day activities at the airport. It also covers the down-stream impacts to businesses that supply and support airport activities and the impact of the spending of employees in the general economy.

Section 3 examines how European airports facilitate tourism, trade, investment and productivity in the wider economy, and estimates the jobs and GDP associated with this activity.

Section 4 totals the overall economic contribution of airports in Europe and forecasts the future economic impact of these airports, focussing on the potential economic benefits that could be forgone if airports are not able to develop to fully meet air travel demand.

Section 5 contains a number of appendices providing additional technical detail on the study.

2 Aviation and Airports in Europe

This chapter provides a background to the European airports sector in Europe.

2.1 ACI EUROPE

Airports Council International Europe (ACI EUROPE) was formed in 1991 as one of the regional bodies of Airports Council International, a worldwide professional association of airport operators. ACI EUROPE is a non-profit organisation based in Brussels which represents over 450 airports in 45 European countries, covering over 90% of commercial European air traffic. Its sister organisations include ACI North America, ACI Asia-Pacific, ACI Latin-America and Caribbean, and ACI Africa. All regional ACI offices are part of ACI World, the only global federation of airports, located in Montreal, Canada. A map of the 45 ACI EUROPE countries is shown in Figure 2-1.

Figure 2-1: Map of ACI EUROPE Countries

ACI EUROPE's membership is comprised of airport operators of all sizes, along with national airport associations, world business partners and educational establishments, working together in an active association to ensure effective communication and advocacy with legislative, commercial, technical, environmental, passenger and other interests. The members of ACI EUROPE are competitors in the airport market place and support free and fair competition as a trade policy and legal concept.

ACI EUROPE is performing work in areas such as: airport safety and security, airport capacity and slots, airport economics, environmental issues, traffic rights liberalisation, facility and border control, and air traffic management (Single European Sky).

2.2 Air Traffic in ACI EUROPE

Total passenger traffic at airports in Europe grew by 2.8% in 2013 from 2012, reaching a total of 1.73 billion passengers. While international passengers increased by 3.8% from 2012 to 2013, domestic passengers remained constant relative to 2012.

Nearly two-thirds of the total traffic in Europe is attributable to the seven largest markets: United Kingdom, Germany, Spain, France, Turkey, Italy, and Russia.

In 2013, airports in Europe handled a total of 16.8 million metric tonnes. The largest European air cargo market was Germany, accounting for nearly one quarter of the European market in 2013. Combined with the other top five markets for air cargo (the United Kingdom, France, Netherlands and Belgium), the top five countries accounted for nearly two-thirds of all European air cargo.

Total commercial aircraft movements in Europe totalled 20.8 million in 2013. Movements in Europe decreased in 2013 by 1.2%, for the second year in a row (-2.6% in 2012 compared to 2011). Thus, average passengers per aircraft have actually increased over the last two years in Europe. Over half of the total commercial aircraft movements in Europe in 2013 were in the top five countries: the United Kingdom, Germany, France, Spain, and Italy.

Information on passenger traffic by country is provided in **Appendix A**.

3 How European Airports Contribute to the Economy

3.1 What is Economic Impact?

Economic impact is a measure of the employment, spending and economic activity associated with a sector of the economy, a specific project (such as the construction of new infrastructure), or a change in government policy or regulation. In this case, economic impact refers to the economic contribution associated with the on-going activities at airports within Europe.

As the economic impact results from the end-product supplied, which is created by partners in the supply chain, all figures in this study therefore refer to the economic impact of both airports AND the associated activities by players such as airlines, ground handlers, airport air traffic control and others.

Economic impact is most commonly measured in several ways, including employment, income, and contribution to Gross Domestic Product (GDP), as summarised in **Figure 3-1**.

Figure 3-1: Measures of Economic Impact

Employment	The number of people with jobs due to employment generated by or facilitated by European airports.
Income	The wages, salaries, bonuses, benefits and other remuneration earned by people linked to airport activities.
Contribution to Gross Domestic Product (GDP)	A measure of the money value of final goods and services produced by aiport activities. Includes operating surplus of businesses, employee remuneration and net indirect government taxes.

The GDP contribution of an individual business or industry is sometimes referred to as Gross Value Added (GVA). GVA is broadly equivalent to GDP, whereby national GDP is the sum of the GVA of all industries plus taxes less subsidies on production. In this report, the term GDP is used to refer the contribution to GDP provided by the airport industry.

Economic impact attempts to assess the gross level of activity or expenditure associated with European airports.[5] It should not be confused with Cost Benefit Analysis, which is a "net" measure that weighs benefits against costs, and which serve a different purpose. Economic impact is a useful and important means of demonstrating the economic contribution of the airport sector. The merits of using economic impact analysis are discussed further in **Appendix B**.

3.2 Categories of Economic Impact

There are four distinct types or categories of economic impact associated with airports, as described in the sections below.

3.2.1 Direct Economic Impact

This is the employment, income and GDP associated with the operation and management of activities at the airports including firms on-site at the airport and airport-related businesses located elsewhere in the vicinity of the airport. This includes activities by the airport operator, the airlines, airport air traffic control,[6] general aviation, ground handlers, airport security, immigration and customs authorities, aircraft maintenance companies, and other entities at the airport.

Businesses closely connected to airport activities, but not based at the airport (or only partially based at the airport), such as airline headquarters, logistics operators and air cargo, are also included in the direct impact. These businesses are an integral part of normal airport activities, but are simply located off-site at the airport. Therefore, off-airport businesses closely linked to airport activities were also included as part of the direct economic impact.

3.2.2 Indirect Economic Impact

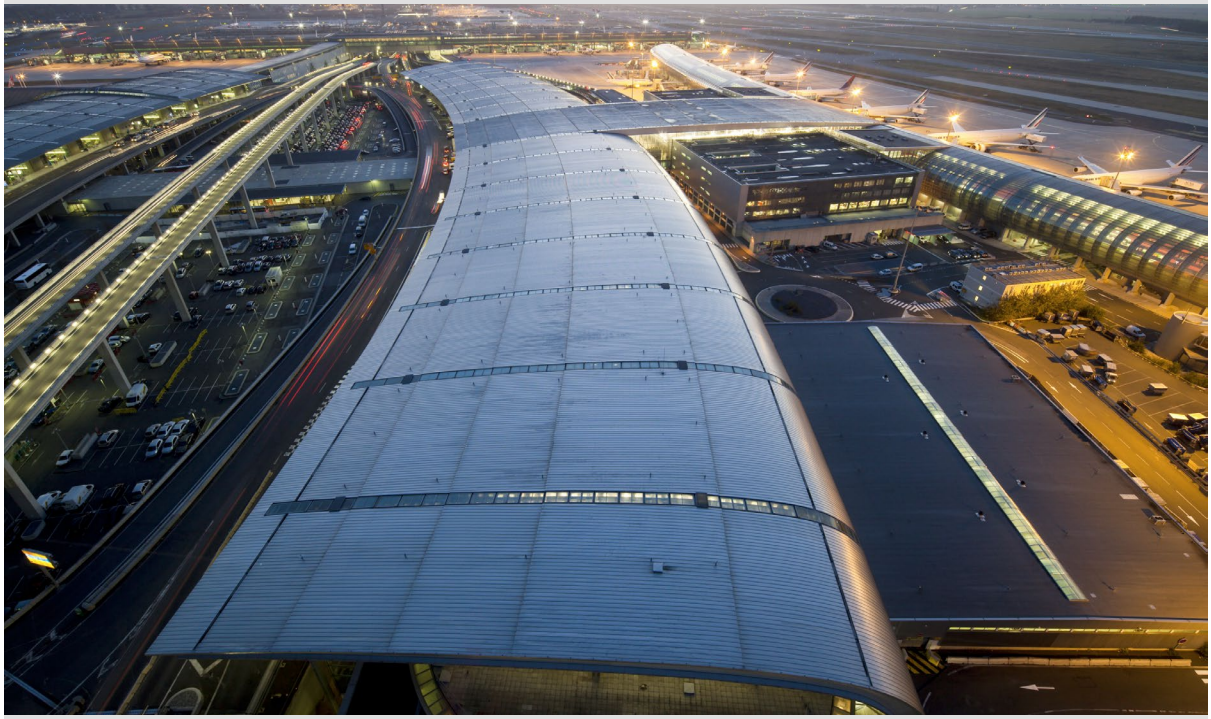
The employment, income and GDP generated by down-stream industries that supply and support the activities at the airport. For example, these could include: wholesalers providing food for inflight catering, oil refining activities for jet fuel, companies providing accounting and legal services to airlines, travel agents booking flights, etc.

The way in which the indirect impact of airport activities can ripple out into the economy is illustrated in the case study overleaf.

[5] In this report, *"airports in Europe"* refers to all airports in the ACI EUROPE countries, as defined in Chapter 2.
[6] Airport air traffic control includes air traffic control activities associated with aircraft approach, landing and take-off and ground movements. It does not include Area Control Centres that control aircraft in flight between airports (i.e. enroute).

CASE STUDY

The Local Ripple Effect of Airport and Associated Aviation Activity - Paris



In 2013, a consortium of Paris Roissy – Charles De Gaulle regional institutions conducted an analysis of the economic impact generated by air transport services at Charles De Gaulle (CDG) and Le Bourget airports.[7] The study highlighted the wide range of services and products needed to operate a passenger flight, particularly from industries in the geographic area around CDG and Le Bourget airport that includes more than 110 municipalities, 4 French departments from the Ile De France region and represents 1.5 million inhabitants.

To gain an understanding of the impact that passengers air services may have on the regional economy, the study focused on the large range of products and activities needed to prepare a single passenger aircraft flight, other than the aircraft maintenance or aircraft landing and take-off. The figure below illustrates the large range of products and services identified in the analysis. A large proportion of these services and products are provided and purchased in the region and create value and jobs for the local community.

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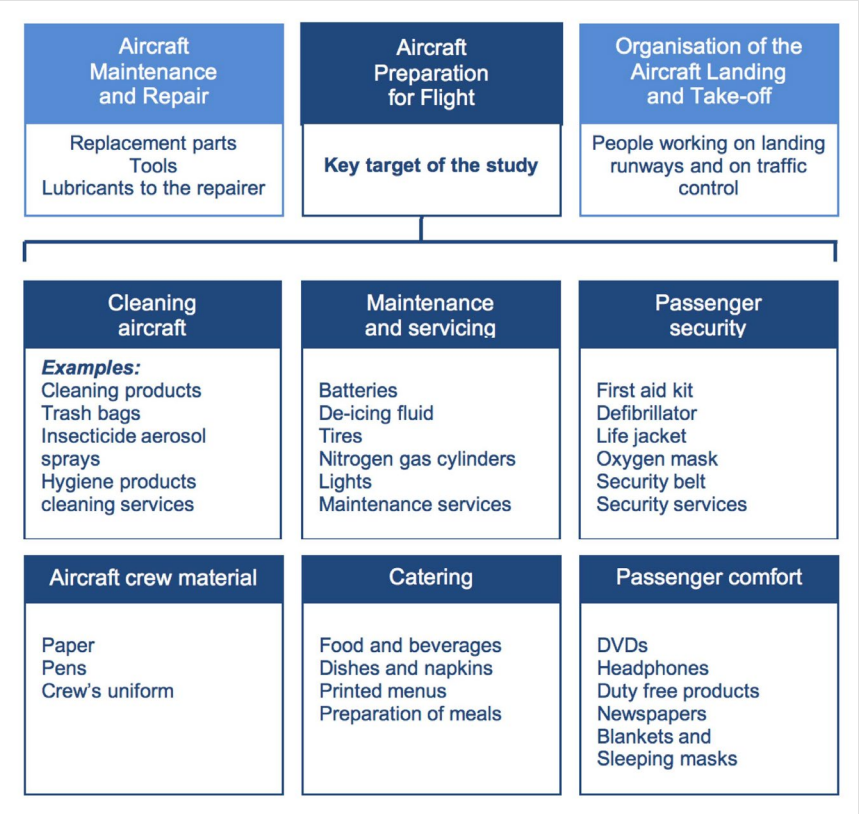
[7] "Analyse des richesses économiques générées par le transport aérien", November 2013, http://www.aeropage-paris-lebourget.fr/files/NL18-decembre2013/EtudeTransportAerien-Synthese-131107.pdf.

The study found that more than 1,000 products and services are used to prepare a flight or during a flight. This large range of products and services is provided by more than 1,000 suppliers in different sectors from agriculture and food sector to security and cleaning products. For example, Air France has around 1,000 suppliers among which 500 are located in the Ile de France region. The study shows that 31% of Air France expenditures (not including fuel) are realised in Ile de France region which represented € 1.3 billion in 2011.

Among these suppliers, is the largest ground handling company in Paris. This company is specialised in air services activities including ground operations, aircraft cleaning, aircraft loading, unloading inbound passengers and their baggage and catering. 91,000 meals are produced every day for airlines, which represents 16,300 tons of food delivered every year. The company also cleans 68,800 seats every day and delivers 53 million newspapers and 8.5 million magazines per year.

Through all of its activities, Paris Charles De Gaulle airport generates an estimated direct 86,000 jobs and contributes € 9.5 billion to France's GDP. Including indirect and induced impacts, the employment impact of the airport is estimated to be over 195,000 jobs and € 17.0 billion in GDP. [8]



[8] Source: Evaluation des impacts économique et social des aéroports Paris-Charles de Gaulle, Paris-Orly, Paris-Le Bourget pour l'année 2010, Aeroports de Paris, 15 February 2012.

3.2.3 Induced Economic Impact

This captures the economic activity generated by the employees of firms directly or indirectly connected to the airport spending their income in the national economy. For example, an airline employee might spend his/her income on groceries, restaurants, child care, dental services, home renovations and other items which, in turn, generate employment in a wide range of sectors of the general economy.

3.2.4 Catalytic Economic Impacts

While the economic impact described above can be seen as down-stream impacts resulting from activities at the airport, catalytic impacts (also known as Wider Economic Benefits) capture the way in which the airport facilitates the business of other sectors of the economy. As such, air transportation facilitates employment and economic development in the national economy through a number of mechanisms:

- **Trade in Goods and Services**.
  Although air cargo accounts for 0.5% of the volume of global trade shipments, it accounts for almost 35% by value, meaning that air cargo is high value, often times perishable or time-sensitive.[9] Both the trade of goods and the trade of services are facilitated by passenger air services. Face-to-face meetings play a crucial role in making sales and delivering services and support. The ability to be at a client's side rapidly and cost-effectively is important to many industries. Much of the time, these functions cannot be adequately replaced by teleconferencing or other forms of communication.

  Air transport connects businesses to a wide range of global markets, providing a significantly larger customer base for their products than would be accessible otherwise. It is particularly important for high-tech and knowledge-based sectors, and suppliers of time-sensitive goods.

  East Midlands Airport in the UK has become a significant air cargo airport, due in large part to air freight operators such as TNT, UPS and DHL using the airport as a major hub. The airport's strong air cargo operations are part of what makes it a vibrant economic hub, supporting over 6,000 jobs and generating around £300 million for the region.[10]

- **Investment**.
  Air connectivity is important in attracting international business headquarters and foreign investment into a country. A key factor many companies take into account when making decisions about the location of offices, manufacturing plants or warehouses, is proximity of an international airport.

  For example, Cork Airport Business Park was set up in 1998 adjacent to Cork Airport to leverage air services at the airport in attracting business to the Cork region. Tenants at the park include Amazon, Atkins, Marriott and IBM.

[9] Source: Air Transport Action Group: http://www.atag.org/.
[10] http://www.eastmidlandsairport.com/emaweb.nsf/Content/AboutOurGroup

- **Tourism**.
  Air service facilitates the arrival of larger numbers of tourists to a region or country. This includes business as well as leisure tourists. The spending of these tourists can support a wide range of tourism-related businesses: hotels, restaurants, entertainment and recreation, car rentals, and others. Of course, air service also facilitates outbound tourism, which can be viewed as reducing the amount of money spent in an economy. However, even outbound tourism involves spending in the home economy, on airlines based in the country, travel agents, taxis to the airport, etc. Also, it is not necessarily the case that money spent by tourists flying abroad would be spent on tourism at home if there were no air service. In any case, the net contribution of tourism is positive, even if the distribution of this impact varies.

  Consider the Portuguese island of Madeira located nearly 1,000 kms southwest of Portugal in the Atlantic Ocean. Tourism is a major industry on the island, accounting for 20% of GDP.[11] Given the island's fairly remote location, the air services at the island's main commercial airport, Madeira Funchal Airport, are vital in transporting these tourists. While the island does benefit from day visits by cruise passengers, the majority of tourists (and nearly all long staying tourists) arrive by air. In 2013, the airport had seasonal or year-round service to over 70 destinations in Europe, and handled 2.4 million passengers, ensuring that diverse range of tourists are able to access the island.[12]

- **Productivity**
  Air transportation offers access to new markets, which in turn enable businesses to achieve greater economies of scale. Examples of productivity increases associated with aviation include the emergence of global supply chains for example, ensuring each part of the production process is performed as efficiently as possible. Foreign direct investment can equip workers with tools they would not otherwise have access to, allowing them to produce more. It also allows workers to improve their own prospects, either via access to more training and education opportunities, or simply by giving them more freedom to travel to those areas where their particular skills are most in demand.

The overall effect of all these mechanisms is an increase in employment and GDP. Without effective air transportation links, it is much harder for economies to attract tourists, to conduct trade and attract investment from other countries. As a result, the country's economy and employment potential would suffer.

Catalytic impacts are not a simple matter of the airport generating employment and economic activity in the same way that direct, indirect and induced impacts arise. National economies are far more complex than that. It clearly takes a wide range of players acting together to generate economic growth – government, business, infrastructure providers, residents and others. For example, if no one had decided to build hotels in a country, tourism would also be substantially lower. However, what the catalytic impacts do show is

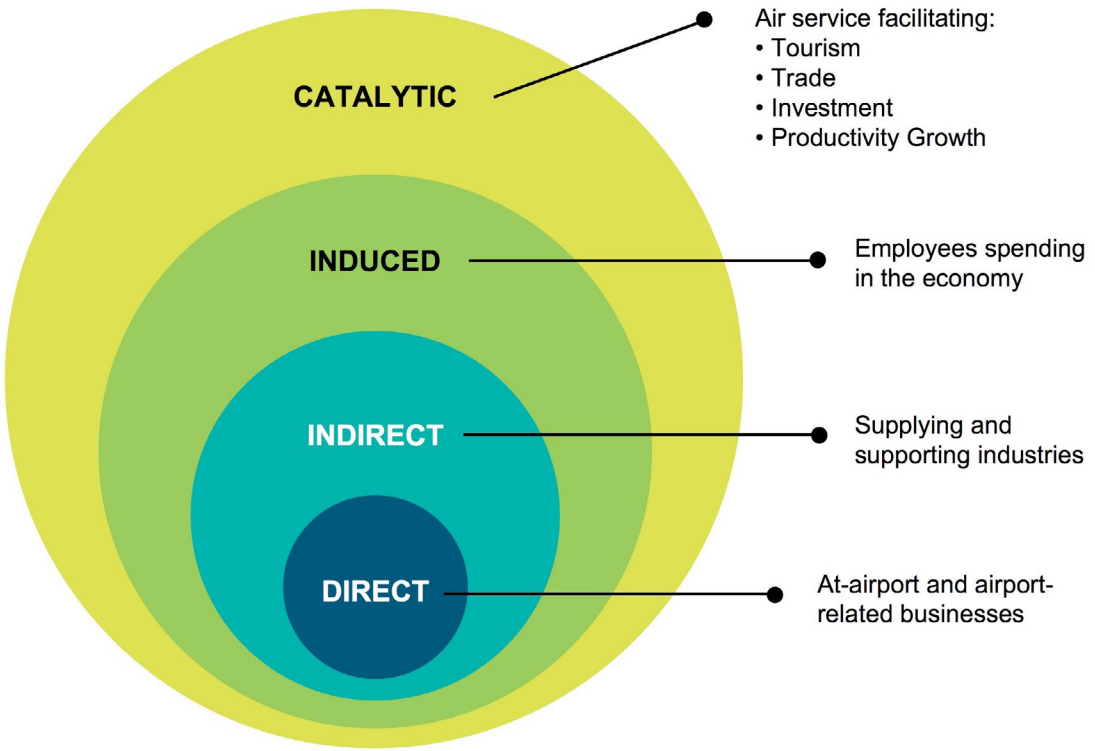
[11] http://www.tomadeira.com/economy_madeira.html
[12] http://routelab.ana.pt/en-US/Airports/Madeira/TheAirport/About/Documents/Madeira%20Airport_Facts%20and%20Figures.pdf

that without these airports and the air services they support, the economy would not be as large or affluent. Thus, catalytic impacts are about the economic value and employment that airports facilitate, rather than directly generate. The connectivity enabled by airports is not sufficient on its own to fully support economic activity, but it is a necessary element of economic growth and development.

In discussing catalytic impacts, the issue of causality often arises. For example, while air service can facilitate trade, it is also true that increased trade leads to increased demand for air services. This study recognises that there is a two-way relationship between air connectivity and economic growth, and indeed finds statistical evidence of this (See **Chapter 8**). Economic growth stimulates demand for air services while at the same time, these air services open up new opportunities for trade, business development, investment and tourism. This in turn stimulates further demand for air services, and so on, in a "virtuous cycle". The analysis in this study examines and controls for this two-way relationship. Catalytic impacts are discussed in greater detail in **Chapter 7**.

These four categories of impacts are summarised in **Figure 3-1**.

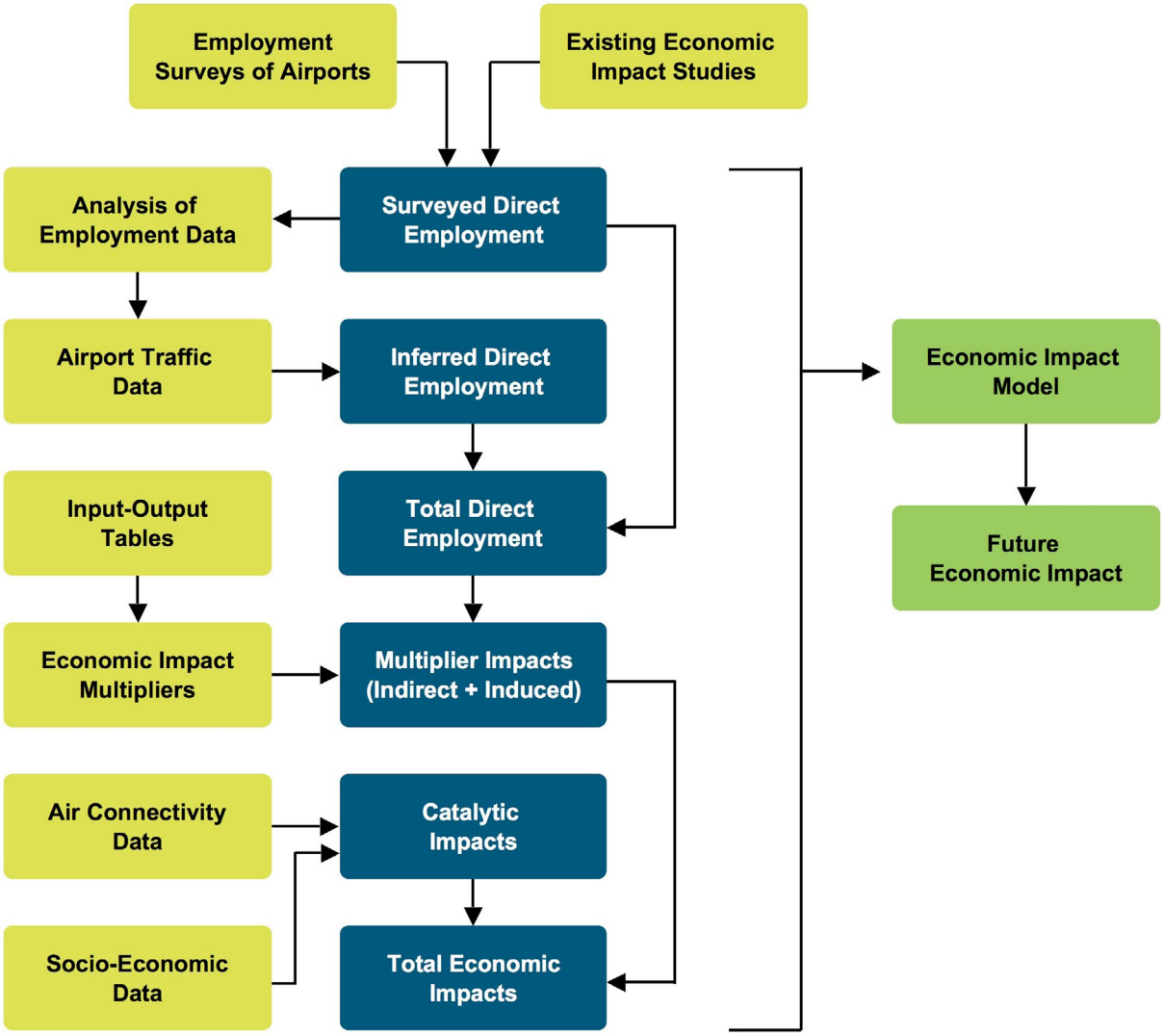
Figure 3-1: Categories of Economic Impact Generated and Facilitated by European Airports



4 Study Methodology

A data-driven methodology, appropriate to a pan-European study, was applied to evaluate the economic impact of European airports. Reliable and recognised data sources were used as the basis of the analysis, and established quantitative techniques were used to validate, process and analyse the data. The study methodology comprised of a number of work elements, as summarised in **Figure 4-1**. Each of the major elements are described in the following sections.

Figure 4-1: Study Methodology



4.1 Surveyed Direct Employment

The basis for much of the economic impact estimates was the direct employment in and around the airport. All ACI member airports were sent a survey requesting information on the employment at the airport, including employment at the airlines, the airport company/ authority, courier/integrators, ground handlers, government agencies, aircraft maintenance firms, freight forwarders and air cargo companies, car rental firms, hotels, commercial concessionaires, and others. Employment data was collected rather than financial data such as revenues or profits, as it is generally a simpler and more verifiable figure to collect,[13] and is not as commercially sensitive.

The survey questionnaire collected information on:

- Passenger and cargo traffic volumes;
- Employment at the airport, broken down by function/activity;
- Number of security passes issued (as a cross-check on the employment figures);
- Annual payroll or average salary per employee;
- Off-airport employment related to airport activities.

The surveyed airports were asked to provide information for calendar year 2013 wherever possible. The survey questionnaire is provided in **Appendix C**.

The questionnaires were initially sent out by email. Telephone follow-up was conducted to increase the response rate. Particular effort was made to ensure that survey responses were obtained from large airports and that a representative sample of smaller airport across Europe was achieved. In addition, internet searches were conducted to obtain economic impact reports for airports that did not respond to the survey.

The survey was conducted between February and April of 2014. In total, employment information was collected on 125 airports, representing approximately 71% of air traffic in Europe (the 125 airports are listed in **Appendix D**).[14] The employment data was processed, cleaned and validated. For example, employment levels were checked to ensure a reasonable consistency with traffic level and security passes issued.

4.2 Inferred Direct Employment

As not all airports had been able to respond to the survey, it was necessary to estimate or infer the employment at these airports.

To infer the employment for these airports, econometric analysis was conducted of the airports from which data was collected to analyse the relationship between direct

[13] For example, company revenue and profits can be subject to different account standards, one-off charges and other factors that may not be reflective of economic activity.
[14] Some non-airports which did not respond to the survey had published economic impact studies, the results of which were used in this analysis. However, to ensure that the results were consistent between airports, economic impact multipliers were not taken from these studies. Only direct impacts were taken, with indirect and induced figures derived via Inter*VISTAS* multipliers.

employment and characteristics of the airport. A variety of variables reflecting airport characteristics were tested. The final model selected (based on statistical fit and the plausibility of the parameters), related direct airport employment to the following variables:

- The volume of passengers and cargo at the airport (measured in terms of traffic units);[15]
- Proportion of connecting traffic;
- Proportion of LCC traffic.

The analysis also found economies of scale effects: the employment per traffic unit declined as the airport size increased. Details of the model specification and results are provided in **Appendix E**.

The inferred employment for the non-responding airports was combined with the survey data to provide an estimate of total direct employment in 2013.

4.3 Indirect and Induced Impacts

While the direct employment impacts were based on survey information, such an approach is not practical for estimating indirect and induced economic impacts. While it might be possible to conduct a survey of businesses impacted indirectly, the survey would need to cover tens of thousands of companies. For induced employment, the entire economy would need to be scrutinised. Given the combination of the sheer breadth of the exercise with the micro-level data required, the quality of responses would be suspect at best.

As an alternative to costly and inaccurate surveys, indirect and induced effects were estimated using *economic multipliers*, as is common practice for economic impact studies. In addition, the *direct* income and GDP contribution impacts were also estimated using economic multipliers.[16]

These multipliers were based on Input-Output models of the national economy in each ACI EUROPE country. An Input-Output (I-O) model is a representation of the flows of economic activity within a region or country. The model captures what each business or sector must purchase from every other sector in order to produce a euro's worth of goods or services. Using such a model, flows of economic activity associated with any change in spending may be traced either forwards (spending generating income which induces further spending) or backwards (visitor purchases of meals leads restaurants to purchase additional inputs - groceries, utilities, etc.). By tracing these linkages between sectors, I-O models can estimate indirect and induced impacts. These indirect and induced impacts are represented by economic multipliers, normally expressed as a ratio of total impacts (i.e. direct plus indirect plus induced) to direct impacts. Using the I-O model, multipliers can be produced for employment, income and GDP contribution, normally expressed in terms of a unit of direct impact (e.g. per direct job).

[15] Also known as Work Load Units (WLUs), traffic units are a commonly-used standardised measure of traffic at airports, which combines passenger and cargo traffic. One (1) traffic unit equals one passenger or 100kgs of cargo.
[16] For further details see Appendix F.

The size of these economic multipliers is a function of a number of factors:

- The nature of the industry or economic sector under consideration. Multipliers vary across different industries within the economy based on the mix of labour and other inputs, and the propensity of each industry to buy goods and services from within the economy. Some industries require large amounts of goods and services from other sectors of the economy and therefore have large multiplier impacts. Other sectors are more labour intensive and require fewer inputs from other sectors of the economy, resulting in smaller multiplier impacts.[17]
- The amount of imports needed as an input to production. Industries or economic sectors that require large amount of imports have lower multiplier impacts as this part of the spending goes outside of the national economy (in essence, this part of the multiplier impact is occurring in another country).
- Propensity to consume domestic goods. The spending patterns of consumers in the national economy will affect the induced impacts. The greater the propensity to consume domestically produced goods and services, the greater is the multiplier effect. Similarly, higher spending on imports or higher savings rates will dampen the induced multiplier.[18]
- Government taxation and spending has a complex influence on the size of the multiplier impacts. Higher taxation rates can dampen multiplier impacts, although this can be offset by how the government chooses to spend these tax revenues.

The multipliers used in this study were based on a number of sources:

- For the 28 EU Member States, the Input-Output tables (the I-O model output) were sourced from Eurostat.[19]
- For Switzerland, the I-O tables were sourced from Office fédéral de la statistique.[20]
- For Israel, the I-O tables were sourced from the Israeli Central Bureau of Statistics.[21]

The most current I-O tables available at the time of the study were used. The economic multipliers developed from the I-O tables have been updated to reflect 2013 price levels. It was not possible to obtain I-O tables for all countries in the study. For those countries, multipliers were used from the country that most closely matched the GDP per capita of the country with missing data.

[17] In such a case, the indirect impacts may be smaller than the induced impacts, as induced impacts are based on the spending of labour income.
[18] In the case of savings, this is a function of the time period examined. The multiplier impacts capture the economic impact occurring in a particular year. Savings represent deferred spending that will occur at some time in the future. However, there is no reliable technique for estimating these longer term multiplier impacts.
[19] http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database.
[20] http://www.bfs.admin.ch/bfs/portal/fr/index/themen/04/02/01/dos/02.html.
[21] http://147.237.248.50/reader/?MIval=cw_usr_view_SHTML&ID=966

As with any model of a complex economy, I-O models have their limitations. Nevertheless, I-O models are the most widely accepted and well-established means for estimating indirect and induced impacts and are based on real data unparalleled in its detail and breadth. See **Appendix B** for more information on the relative strengths and drawbacks of using I-O models.

Further details on the I-O tables, including the derivation of the indirect and induced multipliers, is provided in **Appendix F**.

4.4 Catalytic Impacts

Catalytic impacts are not generally reflected in Input-Output models of the economy described above. These models reflect the purchasing decisions of the businesses within the economy but the catalytic impact captures a different relationship between businesses. For example, hotels, restaurants and entertainment places do not purchase services from airlines to any great extent but they can benefit from the large number of tourists arriving by air that spend money in their businesses.[22] Similarly, a multinational company's decision to locate an office or facility in a country partially on the basis of air connectivity is not reflected in an I-O model.

Similarly measuring catalytic impact by surveys is also extremely difficult. To do so in detail would require a massive survey covering the majority of businesses in a country. Even with such a survey, some aspects of the catalytic impact would be difficult to ascertain. While measuring the trade transported by air cargo might be fairly easy, it is far more difficult to determine and value the presence of an airport as a factor affecting business location decisions, investment and expansion decisions, facilitating corporate mobility, and attracting international talent.

A more effective approach is to use generalised parameters drawn from statistical analysis of historical data. This analysis seeks to determine the contribution of air transport to economic growth by examining the relationship between these factors over time or compared between different countries (or both). The analysis attempts to control for other factors that also contribute to economic growth (education spending, government policies, investment, research and development spending, etc.), in order to isolate the impact of air transport.

The catalytic impacts of European airports on tourism, trade, investment and productivity were estimated in this way, using econometric analysis of air connectivity and GDP per capita. The full details of this analysis and the resulting economic impact estimates are provided in **Chapter 9**, with technical details in **Appendix I.**

[22] These businesses may purchase air services to support their business activities (e.g. visits to headquarters) but not for the larger number of tourists that benefit their business.

4.5 Economic Impact Model

The analysis described above provided a means for modelling and estimating the economic impact of airports based on their traffic characteristics. The parameters and indirect and induced multipliers estimated in the economic impact analysis were built into an easy-to-use economic impact model. This model allows airports to approximately estimate the economic impact associated with specific traffic levels and traffic mixes. Details of the economic impact model are provided in **Appendix K**.

It should be cautioned that the estimated figures from the model are approximate estimates based on the airport characteristics specified. They are not a replacement for a detailed economic impact study. The actual economic impact of the airport could differ substantially due to factors not specified in the generalised model.

4.6 Future Economic Impacts

As part of its *Challenges of Growth* series, in 2013 EUROCONTROL released a report forecasting air traffic in Europe in 2035.[23],[24] The report contains forecasts of unconstrained air traffic levels under four economic and political scenarios. EUROCONTROL also examined the current capacity expansion plans at European airports, and projected that not all future demand could be accommodated (i.e. there was a significant gap between unconstrained demand and capacity in 2035 under all four scenarios).

Inter*VISTAS* was asked to estimate the forgone economic impact associated with this unserved demand. In other words, the employment, income and GDP that would be lost as a result of not accommodating a proportion of the forecast 2035 traffic. This analysis was based on the detailed forecast data provided by EUROCONTROL. The economic impact was estimated for the unconstrained and constrained forecasts of 2035, using the economic impact model and allowing for future productivity improvements. The forgone economic impact was then calculated as the difference between the unconstrained and constrained results.

Details of this analysis are provided in **Chapter 11**.

[23] EUROCONTROL is a civil and military organisation established in 1963 to facilitate a safe, seamless pan-European Air Traffic Management (ATM) system. While the initial focus of the organisation was on safety and operations, its remit has expanded over time to include capacity management and development, operating costs, and fees and charges. EUROCONTROL is not an EU institution, but includes nearly all the EU members, as well as countries outside of the EU such as Switzerland, Turkey and Norway.
[24] *Task 4: European Air Traffic in 2035:* https://www.eurocontrol.int/sites/default/files/article/content/documents/official-documents/reports/201306-challenges-of-growth-2013-task-4.pdf.

PART II:

DIRECT, INDIRECT AND INDUCED ECONOMIC IMPACTS

5 Direct Economic Impact of European Airports

SUMMARY

In terms of direct airport activity, European airports generate almost **1.7 million jobs**, and contribute **€ 101.6 billion to Gross Domestic Product**, or approximately **0.6% of the total GDP of Europe**.

5.1 Total Direct Economic Impacts

Based on the methodology described in **Chapter 4**, airports in Europe directly account for a total of almost **1.7 million jobs**, as shown in **Figure 5-1**. This estimate is based on 1.14 million jobs identified from survey responses and existing economic impact studies (67% of the total), plus 0.55 million (33%) estimated using the inference methodology described in **Chapter 4** and **Appendix E**.

The total direct employment jobs of almost 1.7 million at European airports received an estimated **€ 68.5 billion in income** (wages, salaries, bonuses and other remuneration), an average of € 40,400 per job. This figure is considerably higher than the average income in the overall economy.[25] In all countries, the average income of direct airport employment was higher than the national average. This reflects the large number of high skilled positions that are supported by airport activity.

In addition to jobs and income, these airports directly contributed a total of **€ 101.6 billion to national GDP**. This is approximately **0.6% of the total GDP** of Europe in 2013.[26] For non-Euro countries, the GDP impacts have been calculated using average 2013 exchange rates. The income and GDP figures are not adjusted for cost of living in each country (i.e. they are not at purchasing power parity). The estimates of income and GDP were based on multipliers derived from I-O tables as described in **Chapter 4** and **Appendix F**.

Figure 5-1: Total Direct Jobs, Income, and GDP (2013)

	Direct Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
Direct Impact	1,696,200	€ 68.5	€ 101.6	0.6

[25] Source: Eurostat.
[26] Based on Eurostat and World Bank data, the total GDP of the ACI EUROPE countries was €16,619 billion in 2013.

5.2 Factors Determining Airport Direct Employment

As discussed in **Section 4.2**, an econometric model was developed to infer the direct employment of those airports for which no employment information could be obtained. Analysis was conducted of the airports from which data was collected to analyse the relationship between direct employment and characteristics of the airport. The results are summarised in **Figure 5-2** below.

Figure 5-2: Factors Determining Airport Direct Employment

Airport Size / Traffic Type	Comment
Less than 1 million traffic units	Each increase of 1000 traffic units increases employment by 1.2 Jobs
1 million - 10 million traffic units	Each increase of 1000 traffic units increases employment by 0.95 Jobs
Over 10 million traffic units	Each increase of 1000 traffic units increases employment by 0.85 Jobs
Connecting passengers	Connecting passengers generate 3% less direct jobs than origin/destination passengers
LCC passengers	LCC passengers generate 20% less direct jobs than non-LCC passengers

The analysis reveals interesting information about the drivers of direct employment:

- The estimated parameters showed evidence of economies of scale: each additional 1000 traffic units for an airport less than 1 million traffic units increases employment by 1.2 jobs, whereas the same traffic increase for an airport of over 10 million traffic units increases employment by 0.85 jobs (a 29% reduction in the incremental employment growth).
- Connecting passengers have a marginally smaller (3%) direct employment impact than origin/destination (O/D) passengers. This may reflect the fact that connecting passengers do not consume certain services at airports such as car parking, car rental and other ground transportation.
- Passengers flying on Low Cost Carriers (LCCs), have a smaller direct employment impact (20% less) than other types of traffic.[27] This may be due to the lower staffing levels at LCCs, reduced auxiliary services (such as inflight catering and airport lounges), and reduced LCC passenger spending on commercial offerings.

[27] We note that the definition of LCCs can vary, and the boundary between LCCs and other types of carriers is becoming increasingly blurred. For this analysis, LCCs were defined as those carriers that are members of the European Low Fares Airline Association (ELFAA) as of April 2014: EasyJet, Ryanair, Jet2, flybe, Norwegian Air Shuttle, Sverige Flyg, Transavia Airlines, Vueling, Volotea and Wizz.

It should be noted that these ratios do not attempt to find relationships between passenger numbers and the impact on total employment – in particular the impact upon catalytic impact. For example, connecting passengers may require a lower proportion of direct workers, but if connecting passengers allows the operation of routes which would otherwise not be viable, than this leads to an increase in traffic, which would not be factored into this ratio. Similarly, although LCC passengers also require less direct workers, LCC traffic has been for many airports and areas, the major if not sole provider of growth in recent years. In such cases this traffic has contributed to the catalytic impact of airports, which is again not captured in the ratios.

Further details of the analysis are provided in **Appendix E**.

5.3 Direct Economic Impacts by Country

A breakdown by country of direct jobs, incomes and GDP is provided in **Figure 5-3**. A map of the direct employment is provided in **Figure 5-4**.[28]

Germany, the United Kingdom and France had the most direct jobs at their airports in 2013, accounting for 13.0%, 11.7% and 10.0% of total airport direct jobs, respectively. These three countries accounted for approximately a third of the direct employment in Europe. The top five countries (i.e. also including Spain and Turkey), accounted over half (53.3%) of the direct employment.

Unsurprisingly, the direct employment in each country is fairly closely linked to volume of air traffic and associated air connectivity in that country. Germany has the largest direct employment impact due to the volume of its passenger and cargo traffic (Germany is the second largest air passenger market after the UK and the largest air cargo market). However, other factors may also influence the economic impacts in each country:

- The number of airports in the country: due to geography and traffic requirements, some countries may have greater number of airports per head of population than other countries. The analysis described in **Section 5.2** indicated that larger airports achieve greater economies of scale. Therefore, countries with traffic dispersed over more airports, due to geography and traffic requirements, may have larger direct employment impact than those with traffic concentrated at fewer airports.
- Traffic and airline mix: as the analysis in **Section 5.2** demonstrated, LCC traffic has a smaller economic impact, per passenger, than network carriers. Similarly, countries that have higher proportions of long haul passengers and services may have larger direct employment at their airports (all else being equal) due to additional requirements for long haul traffic (immigration services, inflight services, business class facilities, etc.).

[28] In April 2014, the Air Transport Action Group (ATAG) released *Aviation: Benefits Beyond Borders* (http://aviationbenefits.org/), which includes estimates of the economic impact of aviation in European countries. The estimates in the ATAG report do not necessary match those in this report as it also includes the economic impact of aircraft manufacturing and Area Control Centres that control aircraft in flight between airports (i.e. enroute).

- The network and base structure of the airlines based in the country. The presence of a large home carrier, particularly a hub carrier, may affect overall direct employment in the country.

As a result, there is not a perfect correlation between a country's air traffic and the direct economic impact of its airports. For example, while Spain is the third largest country by passenger volumes, it is the fifth largest in terms of direct employment.

On a per capita basis, the direct employment impacts are quite different as shown in **Figure 5-5**. Smaller countries, such as Norway, Switzerland, Luxembourg, Iceland and Denmark had the highest concentration of employment in 2013, while the UK, Germany and France were lower. The lowest concentration of direct employment was in Eastern Europe, reflecting the relatively low levels of air traffic in those countries.

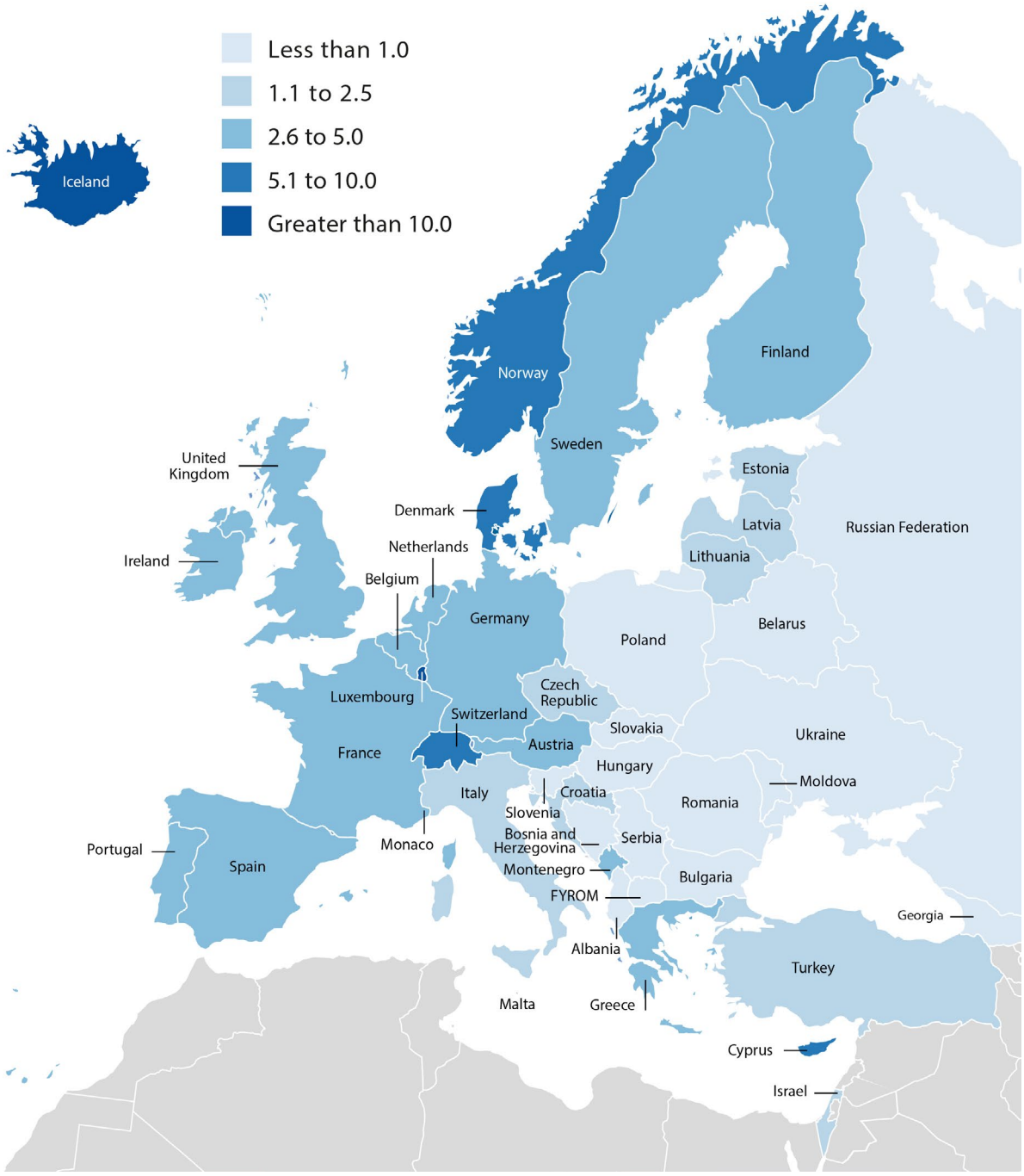
Figure 5-3: Direct Jobs, Income and GDP by Country (2013)

Country	Direct Jobs	Income (€ Billions)	GDP (€ Billions)
Germany	220,500	10.55	16.62
United Kingdom	199,200	8.63	14.68
France	168,800	8.73	12.40
Turkey	168,600	2.19	3.53
Spain	146,500	5.62	7.19
Russia	128,600	3.65	5.95
Italy	120,500	4.79	6.73
Netherlands	81,000	4.04	5.42
Switzerland	44,500	3.92	4.34
Sweden	40,400	2.09	3.50
Greece	36,500	1.15	1.96
Belgium	31,100	1.51	1.96
Portugal	30,000	0.89	1.22
Denmark	29,600	1.57	2.62
Norway	27,700	2.45	2.71
Poland	23,100	0.53	0.62
Austria	24,000	1.21	1.70
Ireland	20,100	0.96	2.20
Finland	17,200	0.96	1.43
Israel	16,800	0.49	0.79
Czech Republic	16,800	0.46	0.77
Ukraine	15,200	0.15	0.24
Romania	13,600	0.16	0.27
Luxembourg	11,000	0.59	0.96
Hungary	8,200	0.20	0.22
Cyprus	8,000	0.23	0.32
Bulgaria	6,900	0.06	0.11
Croatia	4,900	0.11	0.13
Serbia	4,800	0.04	0.07
Latvia	4,200	0.06	0.11
Malta	3,800	0.12	0.21
Iceland	3,500	0.12	0.16
Lithuania	3,400	0.05	0.09
Slovakia	2,500	0.06	0.09
Estonia	2,500	0.04	0.07
Belarus	2,100	0.02	0.03
Georgia	2,100	0.02	0.03
Montenegro	1,900	0.02	0.03
Slovenia	1,900	0.06	0.08
Moldova	1,300	0.01	0.02
Albania	1,000	0.01	0.02
Macedonia	1,000	0.01	0.02
Bosnia & Herzegovina	900	0.01	0.01
Total	**1,696,200**	**68.53**	**101.61**

Numbers may not add up due to rounding.

Figure 5-4: Map of Direct Employment of European Airports, 2013

Figure 5-5: Direct Employment Per Capita, 2013



5.4 Direct Economic Impacts by Region

Figure 5-6 presents the direct jobs, income and GDP broken down into the EU 28 countries, the EFTA countries and all other countries in ACI EUROPE.

The EU 28 countries accounted for 1,276,200 direct jobs in 2013, 75.2% of total direct jobs at airports in Europe, earning approximately € 55.4 billion in direct income. The direct GDP contribution in the EU 28 countries was approximately € 83.7 billion.

In the EFTA countries, total annual direct jobs were estimated at 75,700, accounting for 4.5% of total direct jobs, earning € 6.5 billion in direct income and contributing approximately € 7.2 billion to GDP.

The remaining countries accounted for 344,300 jobs (20.3% of total direct jobs), earning € 6.6 billion in direct income and contributing approximately € 10.7 billion to GDP. It is notable that the total income of the *other* countries is almost the same as that of the EFTA countries, despite having over four times the amount of jobs. This reflects the lower per capita income levels in these other countries, especially in comparison with high income countries such as Norway and Switzerland.[29]

Figure 5-6: Direct Jobs, Income and GDP by Region (2013)

Region	Direct Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
EU 28	1,276,200	55.4	83.7	0.6%
EFTA	75,700	6.5	7.2	0.8%
Other Countries	344,300	6.6	10.7	0.4%
Total	**1,696,200**	**68.5**	**101.6**	**0.6%**

Numbers may not add up due to rounding.

The EU 28 consists of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

EFTA consists of Iceland, Liechtenstein, Norway and Switzerland. As Liechtenstein has no airport, the figures are based on the remaining three countries.

The other countries are Albania, Belarus, Bosnia & Herzegovina, Georgia, Israel, Macedonia, Moldova, Monaco, Montenegro, Russia, Serbia, Turkey and Ukraine.

[29] As indicated previously, the financial figures are not adjusted for cost of living in each country (i.e. they are not at purchasing power parity).

5.5 Direct Economic Impacts by Employment Type

European airports countries are a source of a wide variety of job categories, with different positions spread on-site and off-site across the airports. A significant proportion of this employment is attributed to firms and employees supporting operations and activities at the airport.

A breakdown of direct jobs at airports in ACI EUROPE countries, by employment type, is provided in **Figure 5-7**.

Figure 5-7: Direct Jobs by Employment Type, 2013

Numbers may not add up due to rounding.

The employment breaks down as follows:

- **Airline Services** support the highest amount of direct jobs at airports in Europe and includes employment of pilots, flight attendants and other airline staff. This also covers airline employees within the terminal, such as check-in agents, gate agents, escorts (e.g. for Persons with Reduced Mobility) supervisors and the airline's overhead staff. Airline services accounted for about 472,100 direct jobs at airports in European airports in 2013 (28% of total direct jobs).
- **Ground Handling** includes jobs in ramp crew, bag room, fuelling, grooming and airline catering. Also considered in this category are cargo operators. There were 241,800 direct jobs within this category in 2013 (14% of total direct jobs).
- **Airport/ATC Support** includes employees in air traffic control, in the airport company or authority and other airport operations attributed to air service. Airport/ATC support employment comprised 238,500 direct jobs (14% of total direct jobs).
- **Food & Beverage** includes employment at the airport in food and beverage businesses, such as restaurants, kiosks and fast food chains. Food and beverage employment comprises 130,300 direct jobs (8% of total direct jobs).
- **Airport Security & Passenger Screening** includes the security screening of passengers and baggage, and other security related services. Although this differs between countries, these services are generally provided by the airport company and/or third party providers. This sector accounted for about 106,700 direct jobs (6% of total direct jobs).
- **Maintenance, Repair and Operations (MRO)** provides employment of mechanics and related positions, and accounted for 102,400 direct jobs (6% of total direct jobs).
- **Retail & other In-terminal services** includes retail and concessions, car rental, and any other in-terminal services. There were 107,200 direct jobs within this category (6% of total direct jobs).
- **Customs, Immigration and Other Government** provide essential services for the airport such as customs and border protection and control, policing and, in some cases, fire services. This sector accounted for about 90,900 direct jobs (5% of total direct jobs).
- **Ground Transportation** includes employees providing ground transportation services, such as buses, rail, taxi and limousine services. Ground transportation comprised 79,100 direct jobs at airports in Europe (5% of total direct jobs).
- **Other** includes jobs such as engineers, IT specialists, project managers, janitorial staff, waste collectors, parking and other activities. Other employment comprised 127,200 direct jobs (7% of total direct jobs).

6 Indirect and Induced Impacts of European Airports

SUMMARY

Including indirect and induced impacts (suppliers and spending in the wider economy), European airports generate just under **4.5 million jobs**, and **€ 252.2 billion in Gross Domestic Product** which equates to **1.5% of the total GDP** of Europe.

As noted previously, the economic impact of airports does not end with the direct impacts. Other sectors of the economy benefit from airport activities. As described in Section 3.2, this includes indirect impacts in businesses that supply the goods and services to the direct activities linked to the airport, and induced impacts resulting from direct and indirect employees spending their wages in the general economy. Thus, the total impact of European airports must include the sum of the direct, indirect and induced impacts.[30] The indirect and induced impacts were estimated using economic multipliers derived from government data, as detailed in Section 4.3.

6.1 Direct, Indirect and Induced Economic Impacts in Total

Figure 6-1 summarises the direct, indirect and induced employment, income and GDP attributable to ongoing operations at European airports in 2013.

Figure 6-1: Direct, Indirect and Induced Economic Impact, 2013

Impact	Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
Direct	1,696,200	€ 68.5	€ 101.6	0.6%
Indirect	1,353,100	€ 39.9	€ 69.7	0.4%
Induced	1,401,100	€ 38.4	€ 76.4	0.5%
Total	**4,450,400**	**€ 146.9**	**€ 247.8**	**1.5%**

Numbers may not add up due to rounding.

[30] As well as the catalytic impacts, which are considered in Part III

Based on the application of economic multipliers, it was estimated that **1,353,100 indirect jobs** are related to European airports. In other words, 1,353,100 jobs are indirectly generated in industries that supply the businesses directly related to operations at the airports. The **income** (wages, salaries, bonuses and other remuneration) associated with the total indirect employment are estimated at **€ 39.9 billion per annum** and indirect **GDP contribution** is estimated at **€ 69.7 billion per year.**

The induced employment is the result of demand for goods and services generated by income earnings of those directly or indirectly linked to the airport. The induced employment attributable to European airports in 2013 is estimated at **1,401,100 jobs**, generating **€ 38.4 billion per annum in income** and contributing **€ 76.4 billion per annum to GDP**. The induced income is lower than indirect income despite there being more induced jobs (1.40 million vs 1.35 million). This is because of the lower per person incomes in the induced impacts, which is close to the national average compared with higher income level in supplier industries such as oil refining and aircraft manufacturing.

The direct, indirect and induced impacts sum up to 4,450,400 jobs, € 146.9 billion in income and € 247.8 billion, or 1.5% of GDP.

The scale of the economic impact that can be generated by a single airport is illustrated in the case study below.

CASE STUDY

Airport City – Amsterdam Schiphol Airport

In 2013, Amsterdam Schiphol Airport handled 52.5 million passengers and 1.5 million tonnes of cargo, making it one of the largest airports in Europe. However, Schiphol has become more than a place for the take-off and handling of planes, and the transportation of passengers and cargo. It has become a small city – an airport city – supporting a wide range of business and leisure activities.

Leveraging its strong air connectivity, as well as its intermodal links with road and rail, Schiphol has developed into a major provider of office, warehousing, retail and other commercial space. Within the airport grounds, there are three hotels, numerous shops and restaurants and even a museum – the Rijksmuseum Amsterdam Airport – and a library. The airport's extensive office and commercial space has attracted tenants such as Microsoft, intel, Cisco Systems, Citibank, Tommy Hilfiger, Canon and Boeing. In total, there are over 500 global firms located in the airport city. Part of the Schiphol AirportCity development is CargoWorld which combines the air cargo process with the latest facilities in a cargo area with good roads, facilities and real estate. Leading international airlines, cargo companies, couriers and transport companies are represented at CargoWorld including Menzies, Expeditors, Hankyu Cargo, Deutsche Post Danzas, KWE, Jan de Rijk, Yusen Cargo, KLM, Lufthansa, etc.

As a result of the high volume of air service activity at the airport and the interactions with the AirportCity businesses, the economic impact of Amsterdam Schiphol is one of the largest in Europe. The activities at Schiphol are an important engine that drives the Dutch economy and generates employment. Every year, aviation contributes over € 26 billion to the Dutch GDP. The Schiphol site alone accommodates some five hundred companies that provide jobs for approximately 65,000 employees. The Amsterdam region offers an attractive business climate for internationally oriented companies and institutions. Thanks to its network of destinations, Schiphol is one of Europe's four major airports. This is a remarkable achievement, considering its relatively small domestic market in the Netherlands.

6.2 Direct, Indirect and Induced Economic Impacts by Country

Figure 6-2 shows the total (sum of direct, indirect, and induced) jobs, income and GDP generated on a country level in 2013. The total employment by country is also shown in **Figure 6-3**. Detailed breakdowns of the multipliers at the country level can be found in **Appendix G**.

Germany, the United Kingdom and Turkey had the most total jobs in 2013, reaching 522,000, 491,400, and 477,000 total jobs, respectively. As with the direct impacts, the size of the total employment impact is closely related to traffic volumes in the country. However, it is also impacted by the structure and development of the national economy which is captured in the indirect and induced multipliers.

It should be noted that there are considerable differences between the employment impacts and the income/GDP impacts due to differing income and economic development levels between countries. For example, while Turkey's airports have the third largest employment impact, in part due to its size, the GDP impact ranks considerably lower (10th, below Sweden). This is because average incomes and GDP per capita in Turkey are considerably lower than countries such as Sweden, Germany, France and the UK.

The total GDP contribution as percentage of total national GDP (shown in the last column of **Figure 6-2**) varied between 0.2% (Belarus) and 5.1% (Malta). The percentage contribution to national GDP is a function of number of factors, including:

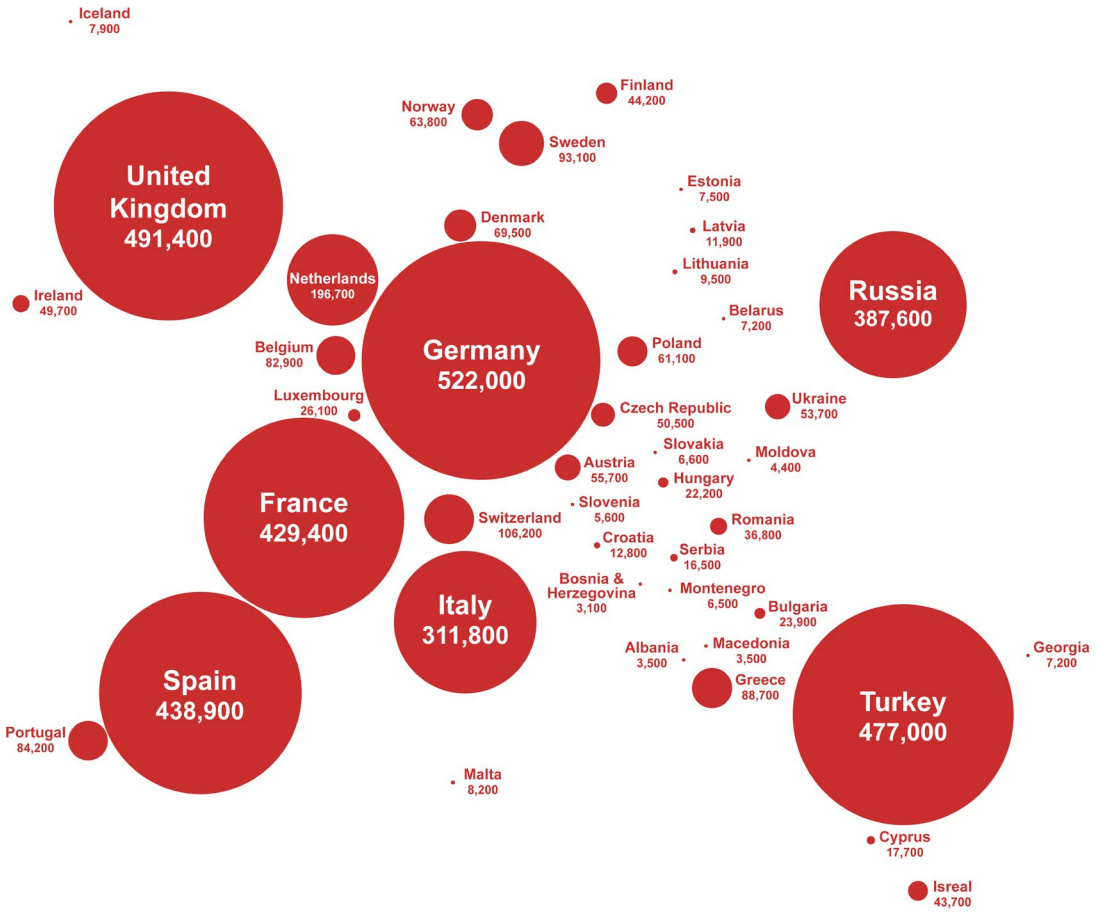
- The relative development of the airports and aviation section. Where countries have a small volume of air traffic at its airports, the economic contribution of this sector is necessarily going to be smaller. Countries such as Belarus, Albania and Romania have relatively small contributions (0.2%, 0.5% and 0.4% respectively) from the airport and aviation sector, as this sector of the economy is fairly small. Conversely, nations with relatively large aviation sectors, due to geography, history or for business reasons, will see a larger economic contribution.
- The size and diversity of the national economy. In most large, high diversified economies, the contribution of aviation is moderately by the other large volume of other activities in the economy. For example, while Germany and the UK have the largest air markets in Europe, the contribution to national GDP is below or close to the European average (1.4% and 1.8% respectively).

Figure 6-2: The Total of Direct, Indirect and Induced Economic Impacts by Country, 2013

Country	Total Jobs	Total Income (€ Billions)	Total GDP (€ Billions)	% of National GDP
Germany	522,000	21.50	38.99	1.4%
United Kingdom	491,400	19.03	34.49	1.8%
Turkey	477,000	3.97	7.77	1.3%
Spain	438,900	14.65	20.68	2.0%
France	429,400	20.02	30.46	1.5%
Russia	387,600	7.57	14.45	0.9%
Italy	311,800	10.10	17.59	1.1%
Netherlands	196,700	8.27	13.51	2.2%
Switzerland	106,200	7.86	11.62	2.4%
Sweden	93,100	4.33	7.81	1.9%
Greece	88,700	2.17	3.94	2.2%
Portugal	84,200	1.79	3.11	1.9%
Belgium	82,900	3.65	5.71	1.5%
Denmark	69,500	3.27	5.90	2.4%
Norway	63,800	4.75	6.96	1.8%
Poland	61,100	0.93	1.43	0.4%
Austria	55,700	2.49	3.99	1.3%
Ukraine	53,700	0.33	0.67	0.5%
Czech Republic	50,500	0.97	1.88	1.3%
Ireland	49,700	2.11	4.51	2.7%
Finland	44,200	2.09	3.41	1.8%
Israel	43,700	1.11	1.89	0.9%
Romania	36,800	0.30	0.59	0.4%
Luxembourg	26,100	1.23	2.19	4.8%
Bulgaria	23,900	0.15	0.29	0.7%
Hungary	22,200	0.34	0.52	0.5%
Cyprus	17,700	0.39	0.65	3.9%
Serbia	16,500	0.10	0.20	0.6%
Croatia	12,800	0.19	0.30	0.7%
Latvia	11,900	0.12	0.26	1.1%
Lithuania	9,500	0.10	0.20	0.6%
Malta	8,200	0.21	0.37	5.1%
Iceland	7,900	0.24	0.41	3.7%
Estonia	7,500	0.11	0.19	1.0%
Belarus	7,200	0.04	0.09	0.2%
Georgia	7,200	0.04	0.09	0.8%
Slovakia	6,600	0.10	0.21	0.3%
Montenegro	6,500	0.04	0.08	2.6%
Slovenia	5,600	0.13	0.21	0.6%
Moldova	4,400	0.03	0.05	1.0%
Albania	3,500	0.02	0.04	0.5%
Macedonia	3,500	0.02	0.04	0.6%
Bosnia & Herzegovina	3,100	0.02	0.04	0.3%
Total	**4,450,400**	**146.87**	**247.78**	**1.5%**

Numbers may not add up due to rounding.

Figure 6-3: Map of the Total of Direct, Indirect and Induced Employment by Country, 2013



Relationship of Indirect and Induced Jobs with Direct Jobs

The indirect and induced impact on employment is closely related to the overall size of the airport-related activities, with countries with more and larger airports typically having correspondingly larger indirect and induced employment (as well as larger indirect and induced GDP impacts).

However the degree to which the overall size of the airport-related activities impacts the wider economy will depend on the characteristics of the national economy in question.

The indirect jobs in an economy supported by airports and associated aviation activities will also depend upon the nature of the wider aviation supply chain in each specific country. Countries where direct aviation activities source a significant proportion of their supplies from within the country will experience a relatively higher number of indirect jobs, compared to countries where many suppliers are supplied from abroad.

While there can be many factors impacting this, as a general trend, countries which have a longer tradition of hosting aviation activities, or which have large aviation manufacturing or supply industries (e.g. oil refining), will have a higher ratio of indirect jobs to direct jobs. In contrast, smaller remote or island economies tend to have a significantly lower ratio, as

they do not have the scale to support a deep or wide supply chain for aviation, and will often depend more heavily on imports of goods and services. The productivity or relative efficiency of the industries supplying aviation activities will also impact on the indirect ratio. Countries with high levels of automation and high-technology processes may have lower indirect impact ratios.

The impact on induced jobs is also a factor of the number of indirect jobs, and so the ratio of induced to direct jobs will be influenced by the initial relationship between direct and indirect jobs. Beyond this, the overall impact on induced employment will depend on a number of factors:

- The relative income levels of the jobs directly and indirectly employed. If the industry in question provides very high paying jobs, then there will be more disposable income to spend in the national economy, increasing the ratio between induced and direct jobs.
- Propensity to consume domestic goods. The spending patterns of consumers in the national economy will affect the induced impacts. The greater the propensity to consume domestically produced goods and services, the greater is the multiplier effect. Similarly, higher spending on imports or higher savings rates will dampen the induced multiplier.[31]
- Government taxation and spending has a complex influence on the size of the multiplier impacts. Higher taxation rates can dampen multiplier impacts, although this can be offset by how the government chooses to spend these tax revenues.

6.2.1 Average Direct, Indirect and Induced Income

Analysis of the economic role of airports in individual countries also revealed the average income (wages, salaries, bonuses and other remuneration) of workers employed either directly or indirectly in airports and associated aviation activity. In addition the average income of those employed as part of the wider induced impact was also calculated. Over the entire region, the average income per job was found to be:

- Direct Job: € 40,400 per annum.
- Indirect job: € 29,500 per annum.
- Induced job: € 27,400 per annum.

The average income for employees directly involved was significantly higher than the average income per job in the wider economy, at both a European and an individual country basis. In fact, there was no country were average income of a direct job was less the national average. This primarily reflects the large numbers of high skilled positions that are supported by airport activity.

[31] In the case of savings, this is a function of the time period examined. The multiplier impacts capture the economic impact occurring in a particular year. Savings represent deferred spending that will occur at some time in the future. However, there is no reliable technique for estimating these longer term multiplier impacts.

The average income of employees involved in indirectly airport-related activity was lower than the direct income, but still above the national average. This reflects the specialised skills involved in some elements of aviation supply, such as airframe assembly, but also the wide range of more typical jobs experienced in the wider economy, which many sectors depend upon.

Finally, the average income of induced employees is lower again, closely resembling an average national income in most instances. This can be attributed to the fact that, generally, directly and indirectly employed people have the typical tastes and spending patterns of other sectors. Therefore, their induced impact will be smaller but a reasonably representative slice of the wider economy.

While the higher average income of directly employed workers is primarily a reflection of the higher skill levels required within airports and associated aviation activity, it is also a reflection of the diversity of job types and workers within the sector. The survey of European airports revealed a wide range of employment types, as outlined in **Section 5.6**. Furthermore, other data has found that air transport has a much greater degree of female participation in the workforce (38%), compared to land transport such as rail and road (only 14%).[32]

Within each category of employment, there are a range of different disciplines and positions, with differing levels of remuneration. For example, a study for the European Commission found that while pilots experienced a real increase in wages (+14%) between 2003 and 2010, other staff such as cabin crew saw a real decrease of -5% over the same period. Hourly wages for ground handling staff were reduced, while salaries amongst air traffic controllers seem to have increased.[33]

This divergence of average wage levels, amongst directly employed workers reflects the diverging skill levels required for the various roles. For example a significant proportion of direct jobs are associated with the provision of food and beverage, security and ground handling services.

Therefore the higher average income overall for direct jobs is likely to reflect higher wages for professions such as pilots or airport management, which demand a high degree of skills and excellence, but also captures lower wages for a range of other disciplines, which require less training and qualification.

Airports therefore provide a mix of employment opportunities for people with a wide range of skills within the regions where they are located. Alongside the higher wage employment for more highly skilled individuals, there is likely to be a significant number of jobs available for those with fewer qualifications. These offer entry points into a growing industry and opportunities for career development. Unlike many less skilled jobs, many direct airport jobs

[32] 'Creating Jobs', European Commission infographic, based on Eurostat Labour Force Survey 2013 data, available at http://ec.europa.eu/transport/_static/pdf/connect-to-compete-jobs-v2_en.pdf
[33] http://ec.europa.eu/transport/modes/air/studies/doc/internal_market/employment_project_final_report_for_publication.pdf

such as ground handling and security have to be employed on-site.[34] In a world of increased globalisation and with a large pool of unskilled available in emerging economies, these jobs provide much needed employment across Europe, which might otherwise not be available.

6.3 Direct, Indirect and Induced Economic Impacts by Region

Figure 6-4 shows direct, indirect, induced and total jobs, income and GDP at airports in the EU 28, EFTA and other countries.

Total direct, indirect and induced jobs sum up to over 3.2 million for the EU 28 region, 75.2% of the ACI EUROPE total. For the EFTA region, the total is 177,900 (4.5% of European airport employment), and for the remaining countries the total is 1 million (20.3% of total employment).

Income associated with these total jobs sum up to € 121 billion, € 13 billion, and € 13 billion, for EU 28, EFTA and the other countries, respectively. The total GDP contribution is estimated at € 203 billion, € 19 billion, and € 25 billion per annum for EU 28, EFTA and other countries, respectively.

[34] It must be acknowledged that this is not true of all direct airport associated jobs. The mobile nature of aircraft means that maintenance and repair operations can increasingly take place at a wide range of locations. In addition, there is a trend for flight crew to be employed under contracts from specific jurisdictions.

CASE STUDY

Zurich Airport

Zurich Airport is the largest airport in Switzerland and the main hub to Swiss International Airlines. In 2013, the airport handled 24.9 million passengers. A report by Zurich Airport documents the economic significance of the airport.[35] More than 280 companies are based at the airport, generating direct spending of CHF 4 billion per annum. Including indirect and induced impacts, an estimated total of over CHF 13 billion per annum of spend is injected into the Swiss economy.

A total of 25,500 people were directly employed by the activities at Zurich Airport in 2013, almost as much as the entire Swiss railways. The airport provides a wide range of job opportunities - not only aircrew and staff in the ground-handling services, but also sales staff, catering professionals, architects, gardeners, engineers, financial and human resource practitioners, and many others. With the addition of indirect and induced impacts, the total employment generated by Zurich Airport is estimated to be around 75,000 jobs.

The air cargo services at the airport have an important role for the Swiss economy. Although only 3.7% of the tonnage of exports passes through Zurich Airport, this represents 35% of the value of exported products from Switzerland. In additional 2,100 of the direct jobs at the airport are attributable to air cargo.

[35] "Flughafen Zürich als Wirtschaftsmotor: Die volkswirtschaftliche Bedeutung", Flughafen Zurich, August 2013.

Figure 6-4: Direct, Indirect and Induced Economic Impact by Region, 2013

	Impact	Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
EU 28	Direct	1,276,200	€ 55.4	€ 83.7	0.6%
	Indirect	945,800	€ 32.6	€ 55.8	0.4%
	Induced	1,036,600	€ 32.7	€ 64.0	0.5%
	Total	**3,258,600**	**€ 120.7**	**€ 203.4**	**1.6%**
EFTA	Direct	75,700	€ 6.5	€ 7.2	0.8%
	Indirect	54,700	€ 3.5	€ 5.9	0.7%
	Induced	47,500	€ 2.8	€ 5.9	0.7%
	Total	**177,900**	**€ 12.8**	**€ 19.0**	**2.1%**
Other	Direct	344,300	€ 6.6	€ 10.7	0.4%
	Indirect	352,600	€ 3.8	€ 8.1	0.3%
	Induced	317,000	€ 2.8	€ 6.6	0.2%
	Total	**1,013,900**	**€ 13.3**	**€ 25.4**	**1.0%**
Total	Direct	1,696,200	€ 68.5	€ 101.6	0.6%
	Indirect	1,353,100	€ 39.9	€ 69.7	0.4%
	Induced	1,401,100	€ 38.4	€ 76.4	0.5%
	Total	**4,450,400**	**€ 146.9**	**€ 247.8**	**1.5%**

Numbers may not add up due to rounding.

PART III:
CATALYTIC IMPACTS

7 Evidence of the Catalytic Impact of Airports and Air Connectivity

SUMMARY

A body of research has developed over the last 15 years or so which has examined and quantified the contribution of air transport to trade, investment, tourism, productivity and ultimately, economic growth. Through the use of different empirical methods and data sets, this research has consistently found a significant and positive relationship between aviation connectivity and economic growth. Furthermore, much of the research has established that air transport growth has been a cause of economic growth, rather than simply economic growth leading to increased air transport levels.

7.1 Introduction

As discussed in **Chapter 3**, catalytic impacts (or Wider Economic Benefits) capture the way in which the airport facilitates the business of other sectors of the economy. This comprises:

- **Trade** – air transport provides connections to export markets for both goods and services.
- **Investment** – a key factor companies take into account when making decisions about the location of offices, manufacturing plants or warehouses in and around an international airport.
- **Tourism** - air service facilitates the arrival of larger numbers of tourists to a country. This includes business passengers as well as leisure tourists. The spending of these tourists can support a wide range of tourism-related businesses: hotels, restaurants, entertainment and recreation, car rentals, and others.
- **Productivity** – air transportation offers access to new markets which in turn enables businesses to achieve greater economies of scale. Air access also enables companies to attract and retain high quality employees.

The case study below illustrates the role of air connectivity in supporting business development.

This chapter examines the empirical evidence and research around the catalytic impacts of airports and aviation, while subsequent chapters summarise analysis conducted by Inter*VISTAS* to quantify the catalytic impacts of European airports.

A number of studies have demonstrated that air transportation plays an important role in trade, tourism, investment and business location decisions, while additional studies have uncovered empirical evidence demonstrating a strong linkage between air service and employment and economic growth. These studies are summarised in the following sections.

CASE STUDY

Regional Airports to Supporting Local Industry - Kristiansand Airport

Kristiansand Airport (KRS) is located in southern Norway, approximately 16 kms northeast of the City of Kristiansand, the county capital of Vest-Agder county. The county has a population of 172,408, with the majority of the county's population located within the Kristiansand municipality. KRS is located approximately 320 kms southwest of Oslo by road.

The airport has a single 2,000m runway and in 2013 handled 1,066,897 passengers. KRS has scheduled service provided by five airlines; Widerøe, SAS, Norwegian, KLM, and Wizz Air. Widerøe, a regional airline, is the largest carrier operating at KRS with 36% of the market share of seats in 2014, followed by SAS (32%), Norwegian (19%), KLM (11%), and Wizz Air (2%). Between them, these airlines serve four destinations in Norway, and one each in Croatia, Denmark, the Netherlands, Poland, and Spain.

>>

Survey of Local Businesses

Businesses in Kristiansand and Vest-Agder County were surveyed about their use of KRS airport. Many survey respondents in some way were related to the oil and gas industry, representing manufacturers and suppliers of equipment and machinery, as well as engineering, safety, and training services to clients in the energy industry. These twelve businesses employed 8,033 persons and had combined reported gross salary payments of 3,402,000 NOK in 2013.

These businesses reported that, in 2013, their local staff took over 14,000 air journeys from KRS and had nearly 10,000 inbound trips by visitors to their businesses. All of the respondents indicated that air service at KRS is somewhat or absolutely essential to overall business activities. These businesses indicated that air service was most important for sales activities, client contacts, and internal business journeys. However, despite the prevalence of manufacturing and goods supplying businesses responding to the survey, passenger travel was seen as more important than air freight.[36] This may be due to the nature of the goods such businesses deal in (dense and heavy goods are less likely candidates for transport via air cargo), as well as the relatively short distance that freight shipped from Oslo by truck would take to reach Kristiansand (between four to six hours).

When asked why their businesses attribute such importance to air service at KRS, two major themes emerged from the responses. First, the surveyed businesses operate in an environment where ready and reliable access to air transport is important for their business and their clients – both domestically within Norway and internationally throughout Europe and the world. Secondly, quality air service at KRS was important not only to bring clients to the Kristiansand area, but also to allow for efficient transport for internal business purposes and with business partners in the wider supply chain, located in other cities and regions. The speed that air service offers was highlighted as vital to a number of businesses, particularly those in the oil and gas industries where rapid response is an important part of their business strategies.

Looking to the future, nine out of the twelve (75%) responding businesses expected that their use of Kristiansand Airport would increase in the future and no respondent reported that they would be likely to decrease their use of KRS. Respondents indicated that they expected their use of KRS to grow because they see opportunities for their companies expand and strengthen international business relations. Respondents also provided suggestions as to how KRS could improve its air service to benefit their businesses. Themes from those suggestions centred around increasing flight frequency to Oslo as well as providing more direct or non-stop service from KRS to help businesses reduce their costs associated with travelling.

[36] Three respondents (two in oil and gas and one in logistics) did indicate that air cargo was absolutely essential to their business.

7.2 Trade

A number of research papers have produced evidence that air services at airports positively supports the trade of both goods and services, and that increases in air connectivity lead to increases in trade.

Cech (2004): higher levels of air cargo services contribute to increased earnings and increased employment. The author used a cross-section statistical comparison method to investigate how air cargo services affect local economies, including: 1) the attractiveness of an area for the creation of new jobs and retention of existing jobs (measured by employment), 2) the impact on economic growth (measured by earnings) and 3) the impact on added value created by employees and subsequent improvement of efficiency and competitiveness (measured by earnings per employee).[37] The author grouped 125 U.S. counties with similar population size into seven groups depending on the number of airports to which they connected, the volume of cargo handled and the frequency of flight service. The author concluded that there is a positive catalytic effect related to accessibility to air cargo services. More specifically, the catalytic effect can lead to an increase in the number of jobs and increased employee earnings. The transportation sector is most influenced by the accessibility of air cargo services. However, construction, retail and wholesale trade industries were also positively influenced.

EUROCONTROL (2005): net contribution of air transportation to trade was € 55.7 billion across the EU. A study commissioned by EUROCONTROL examined the catalytic effects of air transportation in Europe.[38] The study estimated the net contribution of air transportation to trade (i.e. export minus imports) to be € 55.7 billion in 2003 across the then 25 EU members.

UK Institute of Directors (2008): the use of air travel strongly linked to business trade and sales. In 2008, the UK Institute of Directors surveyed 500 businesses about their use and the importance of air transportation.[39] The survey found that the use of air travel was strongly linked to trade and sales. More than a third of businesses who use air transport do so mainly in order to meet clients or potential clients for the purposes of negotiating sales. A further quarter said that the main reason for business travel was in order to attend conferences or to network and make new contacts. Almost three quarters of businesses using passenger air services said that their business would be adversely affected if the amount of air travel they could undertake was significantly curtailed.

[37] Cech P. (2004), "The Catalytic Effect of the Accessibility to Air Cargo Services", TIACA Graduate Research Paper Competition.
[38] Cooper, A. and Smith, P. (2005), "The Economic Catalytic Effects of Air Transport in Europe," Commissioned by EUROCONTROL.
[39] UK Institute of Directors (2008), "High Fliers: Business Leaders' View on Air Travel", http://www.iod.com/MainWebSite/Resources/Document/policy_paper_high_fliers.pdf

Poole (2010): a 10% increase in business travel to the U.S. by non-residents led to a 1.2% increase in the volume of exports from the U.S. and 0.3% increase in export margins. Poole (2010) examined the relationship between business travel to the U.S. from non-residents and international trade.[40] Using trade and travel data from 1993 to 2013, the analysis found that a 10% increase in business travel to the U.S. by non-residents led to a 1.2% increase in the volume of exports from the U.S. and 0.3% increase in export margins. It also increased the variety of exports sold. The effect was strongest for travel from non-English speaking countries, suggesting that business travel help overcome language barriers in trade relationships.

PWC (2013): A 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%. PWC examined the relationship between the UK's international air seat capacity and international trade.[41] Controlling for other factors affecting trade, the analysis found that increases in seat capacity were associated with increases in both the export and import of goods and of services. A 10% increase in seat capacity increased the UK's goods exports by 3.3% and its goods imports by 1.7%; the same seat capacity increase was associated with a 6.6% increase in service imports and a 2.5% increase in service exports.

7.3 Investment and Business Location

The impact of airports and associated aviation activity on investment and business location decisions has been the subject of a number of papers. Some have conducted econometric analysis to examine this relationship, while others have conducted surveys of businesses. All found evidence of air connectivity at airports contributing to increased investment and location decision for the surrounding regions or the country.

Hansen and Gerstein (1991): the amount of Japanese investment in each U.S. state was causally linked to the air service between Japan and that state. Hansen and Gerstein (1991) investigated the relationship between Japanese air service to the United States and Japanese direct investment in the United States.[42] Using data from 1982 to 1987, the analysis related the amount of Japanese investment in each U.S. state to measures of level of air service operated between Japan and that state (and other background factors). The analysis found a significant positive relationship between investment and air service. The issue of causality is also addressed (i.e. 'does more air service lead to greater investment or does greater investment lead to more air service?') with the authors concluding that the evidence indicates that air service impacts on investment rather than the other way around.

[40] Poole, J. (2010), "Business Travel as an Input to International Trade", http://www.scu.edu/business/economics/upload/Poole.pdf
[41] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.
[42] Ishutkina M.A. and Hasnman R.J. (2009), "Analysis of the interaction between air transportation and economic activity: a worldwide perspective", PhD thesis, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology.

EUROCONTROL (2005): a 10% increase in air transportation usage increases business investment by 1.6%. A EUROCONTROL commissioned study analysed the relationship between air transportation and business investment, and found that a 10% increase in air transportation usage will tend to increase business investment by 1.6% in the long run (the impact takes approximately five years to fully manifest).[43] The study authors estimate that between 1994 and 2003, air transportation increased business investment by 5.8% in the 25 EU member countries, worth € 66 billion.

IATA (2005): 25% of surveyed businesses in five countries indicated that 25% of their sales were dependent on good air transport links; 30% of Chinese firms reported that they had changed investment decisions because of constraints on air services. A study commissioned by IATA surveyed 625 businesses in five countries (China, Chile, United States, Czech Republic and France), and found that 25% of their sales were dependent on good air transport links.[44] This percentage rose to 40% for high tech companies. In regards to access to effective air transport links, 63% of firms stated that it was vital or very important to investment decisions, while a further 24% said it was somewhat important. On average, 18% of firms reported that the lack of good air transport links had affected their past investment decisions, while 30% of Chinese firms reported that they had changed investment decisions because of constraints on air services.

Bel and Fageda (2008): a 10% increase in supply of air service at an airport was associated with a 4% increase in the number of large firm headquartered nearby. An academic research paper published in 2008 analysed the relationship between international air service and the location of large firm's headquarters across major European urban areas.[45] The research found that the supply of non-stop intercontinental flights was a significant factor in determining the location of headquarters (along with other economic, business, labour and tax factors). Empirical research indicated that a 10% increase in supply of intercontinental air service was associated with a 4% increase in the number of large firm headquarters located in the corresponding urban area.

Arndt et al. (2009): access to air connectivity is one of the four most important factors affecting location decisions. A survey of 100 foreign-owned businesses in Germany found that access to air connectivity was the third most important factor affecting location decisions (out of 30 factors considered in the survey), with 86% of businesses indicating that air connectivity was important or very important to location decisions. In furthermore, 57% of businesses indicated that they would have chosen another location had air connectivity been weaker.[46]

[43] Cooper, A. and Smith, P. (2005), "The Economic Catalytic Effects of Air Transport in Europe," Commissioned by EUROCONTROL.
[44] *Airline Network Benefits*, IATA Economic Briefing No. 3, 2006.
[45] Bel, G. and Fageda, X. (2008), "Getting There Fast: Globalization, Intercontinental Flights and Location of Headquarters", Journal of Economic Geography, Vol. 8, No. 4.
[46] Arndt, A., et al. "Economic catalytic impacts of air transport in Germany–The influence of connectivity by air on regional economic development." ATRS Conference. 2009.

PWC (2013): a 1% increase in international seat capacity was associated with a 0.47% increase in FDI inflows and a 0.19% increase in FDI outflows. PWC examined the relationship between the UK's air connectivity, air seat capacity and Foreign Direct Investment (FDI).[47] Controlling for other factors affecting investment, the analysis found that for manufacturing FDI, a 1% increase in connectivity is associated with a 1.1% increase in UK manufacturing sector FDI inflows. For the whole economy, a 1% increase in international seat capacity was associated with a 0.47% increase in FDI inflows and a 0.19% increase in FDI outflows.

7.4 Tourism

A number of research papers have produced evidence that air services at airports positively support tourism, and that increases in air service results in an increase of tourist activity.

Warnock-Smith and Morrell (2008): liberalising air policy in the Caribbean contributes to increased tourism growth in the region. The authors examine the impact of liberalising extra-regional air services on air traffic growth and tourism growth for the region.[48] Using data from 1995 to 2003, the authors found that the U.S.-Caribbean market pairings which did not liberalise traffic rights saw lower passenger traffic growth compared to those that had.

Graham and Dennis (2008): the introduction of air services in Malta is partly responsible for increases in tourism traffic. The authors examined the effect of the Maltese government's decision in 2006 to provide incentives low cost carriers (LCCs) to fly to the islands.[49] The study focuses on the impact of new LCC operations on both the volume and profile of leisure passengers visiting Malta. The research made use of data on passenger/tourist numbers, passenger survey results, and airline schedules. The authors conclude that traffic to Malta significantly increased in 2007, in large part due to LCC services. Furthermore, they find that the LCCs attract a younger more affluent and more independent tourist, which differs from a charter or package tourist.

Dennis (2007): low-cost airlines have enabled additional holidays to be taken abroad each year. The author uses data from the UK such as tourist arrival information, air passenger traffic, survey data and airline ticket information to conclude that air travel increases tourism abroad.[50] Dennis contends that as air travel becomes a smaller portion of the vacation cost, the penalty for taking shorter, more frequent trips is reduced.

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[47] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.
[48] Warnock-Smith, D., Morrell, P., 2008. Air transport liberalisation and traffic growth in tourist-dependent economies: a case study of some US-Caribbean markets, *Journal of Air Transportation Management*
[49] Dennis, N., Graham, A. (2008) The Impact of Low Cost Airline Operations To Malta, *48th Congress of the European Regional Science Association, August*
[50] Dennis, N (2007) Impact of The Low-Cost Scheduled Airlines On Charter Operations And The Inclusive Tour Holiday Market, *Association for European Transport and Contributors 2007*

Rey (2011): low cost carriers strongly influenced the number of tourist arrivals in Spain between 2004 and 2009. Rey examines tourist demand from the principal EU-15 member states to estimate the impact of low-cost airlines on Spanish tourism.[51] The findings suggest that the expansion of LCC activity had a strong positive effect on the number of tourist arrivals.

7.5 Impact on Employment, Economic Growth and Productivity

The increased trade, investment, business activity and tourism facilitated by airports and associated aviation activity ultimately results in increases in economic productivity (e.g. GDP per worker), in GDP and in employment. A number of research papers have examined the overall impact on the economy and employment as a result of the catalytic effects of aviation.

Irwin and Kasarda (1991): expansion of the airline network serving a region had a significant positive impact on employment. A study by Irwin and Kasarda examined the relationship between the structure of airline networks and employment growth at 104 metropolitan areas in the United States.[52] Using data for a 30-year period, the researchers conducted statistical analysis which found that expansion of the airline network serving a region had a significant positive impact on employment in that region, particularly in service sector employment.[53] In addition, the analysis found changes in the airline network position was a cause rather than a consequence of this employment growth. The paper concludes that the reorganization of the airline network has been a critical factor transforming and integrating the spatial economy of the U.S.

Button, Lall, Stough and Trice (1999): presence of a hub airport increased high-tech employment by an average of 12,000 jobs in a region. The authors examined empirically the link between high-tech employment in a region and whether the region is served by a hub airport.[54] Using data from 321 U.S. metropolitan areas in 1994, the authors regressed high-tech employment against a number of controlling factors including a dummy indicating that the region was served by a hub airport.[55] The analysis found that the presence of a hub airport increased high-tech employment by an average of 12,000 jobs in a region. An additional case study of medium sized hub and non-hub cities also determined that the

[51] Rey, B (2010) Effect of low-cost airlines on tourism in Spain. A dynamic panel data model, *Journal of Air Transport Management*
[52] Irwin, M. and Kasarda, J. (1991), "Air Passenger Linkages and Employment Growth in U.S. Metropolitan Areas", *American Sociological Review*, Vol. 56, No. 4, August 1991.
[53] The analysis was conducted using non-recursive models which confirmed that increases in the airline network were a cause rather than a consequence of this employment growth.
[54] Button, K., Lall, S., Stough, R. and Trice, M. (1999), "High-technology employment and hub airports," Journal of Air Transport Management, Vol. 5, Issue 1, January 1999.
[55] "High-tech" employment included IT, telecoms, biotechnology, electronics, and certain types of high-value manufacturing. It excludes aviation (except for manufacturing) and tourism. The study used the Federal Aviation Authority's standard definition for a hub airport (using this definition, there were 56 hub airports in the U.S. in 1994).

effect of a city being a hub, irrespective of the total volume of airline traffic passing through it, attracts more high-technology employment than a comparable non-hub city. Finally, the authors addressed the issue of causality (i.e. does the presence of a hub airport lead to more employment, or does higher employment in a region increase the likelihood of a hub airport being developed?). Using the Granger causality test, the authors found that there was statistically significant evidence that the presence of a hub airport caused an increase in high-tech employment, rather than airlines selecting cities as hubs simply because they are already economically dynamic.

Button and Taylor (2000): increasing the number of routes between the U.S and Europe from 3 to 4 at an airport generated approximately 2,900 "new economy" jobs in the surrounding region. Button and Taylor examined the link between international air service and economic development.[56] Using data for 41 metropolitan areas in the U.S., the authors regressed "new economy" employment against a number of control factors including the number of direct routes to Europe offered by airports in the region. The analysis found that there was a strong and significant relationship between employment and air services to Europe. The impact was largest for regions which initially had very limited services to Europe. For example, increasing the number of European routes served from 3 to 4 (40,000 additional passengers per annum) generated approximately 2,900 "new economy" jobs. However, increasing the number of routes served from 20 to 21 (10,000 passengers) generated 440 "new economy" jobs. To address the issue of causality (and to allow for a lagged response to the new air service), employment in 1996 was regressed against the number of routes in 1994.

Brueckner (2002): a 10 percent increase in departing passengers in a metropolitan area leads to an approximately 1 percent increase in employment in service-related industries. In a similar study, Brueckner also examined the impact of air service on employment in the U.S.[57] The author regressed employment in 94 metropolitan areas in the U.S. against a number of factors including measures of air service. The analysis found that a 10 percent increase in departing passenger in a metropolitan area leads to an approximately 1 percent increase in employment in service-related industries. Frequent service to a variety of destinations, reflected in the high levels of departing passengers was found to both attract new firms to the metro area and stimulate employment at established enterprises. However, the analysis found that there was no impact on manufacturing and other goods-related employment, suggesting that air travel is less important to these industries than it is to service-related industries. The analysis included instruments to control for reverse causality between employment and traffic.

Ishutkina and Hansman (2009): statistical evidence of a (two-way) feedback relationship between air transport and economic activity. Ishutkina and Hansman analysed the interaction between air transportation and economic activity on a worldwide basis.[58] The study used a feedback model, literature reviews, aggregate data and case study

[56] Button, K. and Taylor, S. (2000), "International air transportation and economic development", *Journal of Air Transport Management*, Vol. 6, Issue 4, October 2000.
[57] Brueckner, J. (2002), "Airline Traffic and Urban Economic Development".
[58] Ishutkina M.A. and Hasnman R.J. (2009), "Analysis of the interaction between air transportation and economic activity: a worldwide perspective", PhD thesis, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology.

analyses. The authors concluded that a feedback relationship between air transport and economic activity exists. Air transportation provides employment and supports economic activities which are dependent on the availability of air transportation services. In turn, economic activity drives the demand for air transportation services. Specifically, aggregate and individual country-level data were analysed in terms of the relationship between air transportation passengers and GDP. A data analysis of 139 countries over a time period of 30 years (1975 to 2005) showed that in the majority of the countries with positive growth rates, significant changes were observed. On the air transportation supply side, changes in the regulatory framework and infrastructure capability, and on the air transportation demand side, changes such as economic liberalisation reforms and supporting infrastructure investment lead to positive growth rates.

PWC (2013): 10% change in the growth rate of seat capacity in the UK leads to approximately a 1% change in the growth rate of the UK's GDP. PWC examined the relationship between the UK's quarterly GDP and air seat capacity.[59] Using an Error Correction Model of data between 1991 and 2010, the analysis found a significant relationship between the two variables, such that a 10% change in the growth rate of seat capacity leads to approximately a 1% change in the growth rate of GDP. The analysis also found evidence of a two-way relationship between the variables – GDP growth causes seat capacity and seat growth causes GDP growth.

[59] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.

8 Investigating the Catalytic Impact of European Airports

SUMMARY

Econometric analysis of European air connectivity and economic data found that a 10% increase in connectivity (relative to GDP) increases GDP per capita by 0.5%. Additional analysis also supported the proposition that air connectivity does contribute to economic growth and that this relationship is two-way. These findings are consistent with the view that there is a positive synergistic relationship between air transport and economic growth. As an economy grows, it supports a larger air transport sector, but it is also the case that growth in air transport supports economic growth. Air transport is not merely following economic growth but also acting as a catalyst for growth.

8.1 Analysing the Relationship Between Air Connectivity and Economic Growth

Econometric analysis was undertaken to examine the relationship between air connectivity and economic growth in Europe, as a means to calculating the catalytic impact of airports. In order to do so, a measure of connectivity developed by IATA was used in the analysis. The IATA connectivity index seeks to measure the scope of access between an individual airport, region or country, and the global economy. The index measures the number and size (in terms of passenger air traffic) of destinations served, as well as the frequency of service to each destination and the number of onward connections available from those destinations. The index is described in more detail in **Appendix H**.

The relationship between air connectivity and economic growth was analysed using data on the IATA connectivity index and GDP per capita for 40 countries in ACI EUROPE between 2000 and 2012.[60] This is referred to as panel data, as it incorporates both time series variation (changes over time) and cross-sectional variation (changes between countries). The list of countries is provided in **Figure 8-1**.

[60] Data for 2013 was not included due to significant gaps in the economic data for many countries.

Figure 8-1: Countries Included in the Catalytic Impacts Analysis

Albania	Austria	Belarus	Belgium	Bulgaria
Croatia	Cyprus	Czech Republic	Denmark	Estonia
Finland	France	Germany	Greece	Hungary
Iceland	Ireland	Israel	Italy	Latvia
Lithuania	Luxembourg	Macedonia	Malta	Montenegro
Netherlands	Norway	Poland	Portugal	Romania
Russia	Serbia	Slovakia	Slovenia	Spain
Sweden	Switzerland	Turkey	Ukraine	United Kingdom

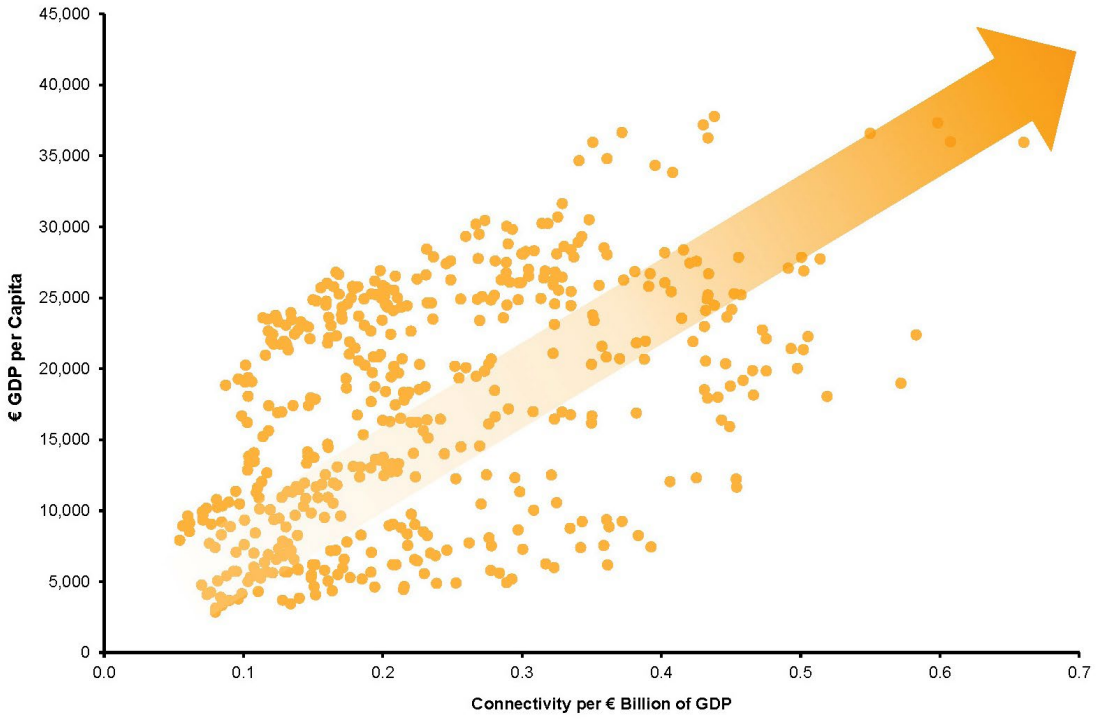
Note: It was not possible to include Georgia, Monaco, Moldova, and Montenegro due to lack of available data.

Figure 8-2 shows the relationship between air connectivity divided by GDP and GDP per capita.[61] The connectivity index has been divided by GDP to control for size of economy effects (i.e. large, rich economies with large populations generally have higher levels of air service).

The chart clearly shows a positive relationship between connectivity and GDP per capita. There is considerable scatter of observations which is not surprising, given that there are a large number of other factors that affect economic growth. Nevertheless, even given these sources of variation, there is a clear pattern just by plotting connectivity against GDP per capita.

[61] The GDP and GDP per capita data is sourced from the World Bank World Development indicators and is in constant Euros (i.e. inflation adjusted) converted at purchasing power parity.

Figure 8-2: Relationship Between Air Connectivity and GDP per Capita in European Countries, 2000-2012



Source: InterVISTAS Analysis Based on Diio Mi Schedule Data and World Bank, World Development Indicators.

To further investigate the relationship between connectivity and GDP per capita, econometric analysis of the data was undertaken. Regression analysis was conducted relating GDP per capita to connectivity (divided by GDP) and other variables that might be expected to have an impact on economic growth. The analysis allows the relationship between economic growth and connectivity to be isolated and quantified while controlling for other factors that may have an impact (such as education levels, research and development, capital spending, institutional and regulatory factors, etc.).

Full details of this econometric analysis are provided in **Appendix I**. In terms of the key results, the analysis found a positive and statistically significant relationship between connectivity (divided by GDP) and GDP. The coefficient estimate strongly suggests that **a 10% increase in connectivity (relative to GDP) increases GDP per capita by 0.5%**.

Additional statistical analysis was also conducted to examine the issue of causality. In other words, does air connectivity growth increase GDP per capita or does GDP growth increase air connectivity, or do both effects arise? To some extent, dividing connectivity by GDP controls for the influence of economic growth on connectivity, allowing for analysis of the contribution of connectivity to GDP growth. However, in order to address this issue more rigorously, further analysis was undertaken.

Using Granger Causality analysis (a method for examining causality), there was statistically significant evidence that connectivity/GDP causes growth in GDP per capita and that GDP per capita growth Granger-causes connectivity/GDP. The technical details of this analysis are also provided in **Appendix I**.

This Granger Causality test supported the proposition that air connectivity does contribute to economic growth. It also provided some evidence that this relationship is two-way. The causality findings are consistent with the view that there is a synergistic relationship between air transport and economic growth. As an economy grows, it supports a larger air transport sector, but it is also the case that growth in air transport supports economic growth. Air transport is not merely following economic growth but also acting as a catalyst for growth.

9 Estimating the Catalytic Impacts of European Airports

SUMMARY

The catalytic impacts of European airports facilitated an estimated **7.9 million jobs**, **€ 209.5 million** in income and **€ 426.7 billion in Gross Domestic Product** (approximately **2.6% of the total GDP** of Europe).

The analysis presented in **Chapter 8** provides evidence of the contribution of air connectivity to economic growth, finding that a 10% increase in connectivity (relative to GDP) increases GDP per capita by 0.5%. This parameter value was used to estimate the catalytic impact of European airports.

To quantify the catalytic impact, Inter*VISTAS* considered the additional air connectivity that airports in Europe have supported since 1993 (i.e. the 20 years between 1993 and 2013). The year 1993 was selected as it ties in with the completion of the EU's liberalisation of aviation (the "third package" came into place in 1993, which fully opened up the EU market for all EU airlines) and the start of the Low Cost Carrier phenomenon (for example, EasyJet was founded in 1995). Using the results from **Chapter 8**, the analysis estimates the GDP per capita (and from that, national GDP) that has been contributed by the growth in connectivity since 1993. In other words, it is the amount of GDP that would have been foregone if air connectivity in Europe had been unchanged since 1993. Arguably, this is a conservative approach to estimating the catalytic impacts, as it does not consider connectivity changes prior to 1993.

As an example, between 1993 and 2013, the UK's connectivity index (divided by GDP) increased by 48%. Applying the catalytic parameter, this suggests that the contribution to per capita GDP growth was 0.05 x 48% = 2.4%[62]. This percentage was applied to the GDP per capita of the UK in 1993 (inflated to 2013 prices) and multiplied by the 2013 UK population:

€ 26,800 x 2.4% x 64.1 million = € 41.5 billion

Similar calculations were performed for each country. The GDP attributable to the catalytic impacts of European airports is the result of incremental economic activity supported and stimulated by air connectivity – greater trade, new investment, increased tourism visits and spending. This activity supports additional jobs in the economy, which were estimated by dividing the GDP estimate by the average GDP per worker in each country. Similarly, the income impacts were based on the average income figures.

[62] Rounded from 2.416%.

9.1 Total Catalytic Impacts

The estimated catalytic impact of airports in Europe is provided in **Figure 9-1**. It is estimated that almost **7.9 million jobs** are associated with the catalytic impacts of airports in Europe, earning € 209.5 billion in income (wages, salaries, bonuses and other remuneration). The catalytic impacts of these airports generated approximately **€ 426.7 billion in GDP**. This is approximately **2.6% of the total GDP** of Europe in 2013.[63]

Figure 9-1: Jobs, Income and GDP Generated by Catalytic Impacts (2013)

	Jobs	Income (€ Billions)	GDP (€ Billions)
Catalytic Impact	7,893,500	€ 209.5	€ 426.7

These catalytic impacts are generated by airports across Europe, both large and small. The case study in the box below illustrates the contribution of regional airports to business development.

[63] Based on Eurostat and World Bank data, the total GDP of the ACI EUROPE countries was €16,619 billion in 2013.

CASE STUDY

Importance of Regional Airports to Business Development - Transilvania Târgu Mureş Airport

Transilvania Târgu Mureş Airport (TGM) is located in Central Romania, approximately 14 km southwest of Târgu Mureş Romania. TGM serves the nearby cities of Târgu Mureş (the administrative seat of Mureş County), Sighişoara, Reghin, and Târnăveni. Mureş County has an estimated population of 576,000 persons of which roughly half are located in Târgu Mureş metropolitan area.[64]

In 2013, the airport handled over 363,000 passengers in 2013,[65] and was served by three scheduled airlines; Ryanair, Tarom (the Romanian flag carrier), and Wizz Air.[66] Wizz Air was the largest carrier, making up 87% of the scheduled seat capacity at TGM in 2013. These airlines flew to 16 European destinations, of which 15 were outside of Romania (Tarom offers domestic service to Bucharest). Italy and Germany were the best served international destinations in Europe from TGM, with 4 destinations in Italy and 3 in Germany. The airport also had service to the UK, Spain, Hungary, France and Belgium.

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[64] INESS (Romanian National Institute of Statistics), Table POP101A - *Stable (de facto) population, by sex, urban and rural areas, macroregions, development regions and counties, at January 1st*, 2014.
[65] Source: EUROCONTROL.
[66] Source: Diio Mi schedule data, January to December 2013.

Survey of Local Businesses

In 2014, businesses in Mureş County were surveyed about their use of TGM airport. These businesses were primarily located in the metropolitan Târgu Mureş area and in communities nearby TGM. A total of 39 businesses responded, including businesses in the following sectors:

- Manufacturing (17);
- Commerce (6);
- Transport (2);
- Waste management (2);
- Construction (2);
- Other (10).

The 39 businesses surveyed employed 6,665 persons and had combined revenues of over € 567 million in 2013. The responding businesses reported taking 1,223 business trips by air in the past year (183 trips for every 1000 employees), with 511 (42%) of those were out of TGM (most of the remainder of the trips were from Cluj International Airport, Romania's second largest airport.

Nearly all of the businesses (95%) responding indicated that a nearby airport was essential or absolutely essential to their business. The most commonly given reason for using TGM (cited by 53% of respondents) was visiting clients or customers. Other reasons included internal business travel (e.g. visiting headquarters), visiting suppliers, importation of goods and business promotion. Respondents indicated that air travel for business is important as it allows for more timely and efficient travel, and makes it easier for clients and customers to visit local businesses in Mureş County.

A clear majority (72%) of surveyed businesses indicated that future development of an airport would be somewhat or very important in improving their business growth. Respondents were also asked about what improvements could be made at TGM to improve the airport's impact upon their business. The overwhelming response was to add new routes and direct connectivity, with 81% of the respondents requesting additional air services at TGM, particularly to Germany [67]. Another important improvement was to increase the frequency of existing routes, which would help impact their business by making it easier to accomplish business trips in and out of TGM.

There is a clear desire from local businesses for air services at TGM to continue growing. When asked how their suggested improvements or investments at TGM would impact their business, there was a clear consensus amongst respondents that better air service options will save businesses time and money through increased connectivity. Respondents indicated that they would rather fly directly from TGM instead of travelling the roughly 100 km to Cluj Airport or approximately 115 km to Sibiu Airport to get a more direct flight to their destinations in Europe. Increased flight frequency and greater direct connectivity to the rest of Europe would benefit these businesses by improving their ability to visit clients and customers and for other persons and businesses to visit them without enduring long travel times.

[67] Requests for direct flights to Germany largely came from businesses that are owned or directly connected to German firms.

9.2 Catalytic Impacts by Country

Figures 9-2 and **9-3** show the catalytic impacts by country level at airports in Europe in 2013.

The size of the catalytic impact as a proportion of the national economy varies greatly between countries from 1.1% in Hungary to 7.1% in Cyprus. Countries with relatively large tourism industries tend to have larger catalytic impacts, such as Cyprus, Spain, Greece and Turkey, reflecting the importance of aviation to tourism. More remote or island nations also tend to have larger catalytic impacts (e.g. Malta, Iceland), suggesting the importance of air connectivity to integrating those nations with the global economy. A number of other factors affect the differing catalytic impacts across the countries: the relative size of the aviation sector and overall economy (a large economy with a small aviation sector is likely to have a smaller catalytic impact), the structure of the economy (e.g. whether the economy has large proportion of industries that are particularly dependent on air connectivity), and the historical growth in connectivity (countries with faster growing connectivity tend have larger catalytic impacts, all else being equal).

While these figures are large, it is worth considering how many of these economies might look if they had substantially reduced air connectivity levels. For example, if many of the direct and highly frequent services did not exist, passengers would have limited or no options to travel to/from these countries, or would have to travel via other hub airports. In such a scenario, it is easy to imagine that tourism to these countries would be much lower, that the overall volume of trade would be substantially lower, and that some companies would chose not to locate or expand in these countries. The net effect of this would be smaller, slower-growing economies.

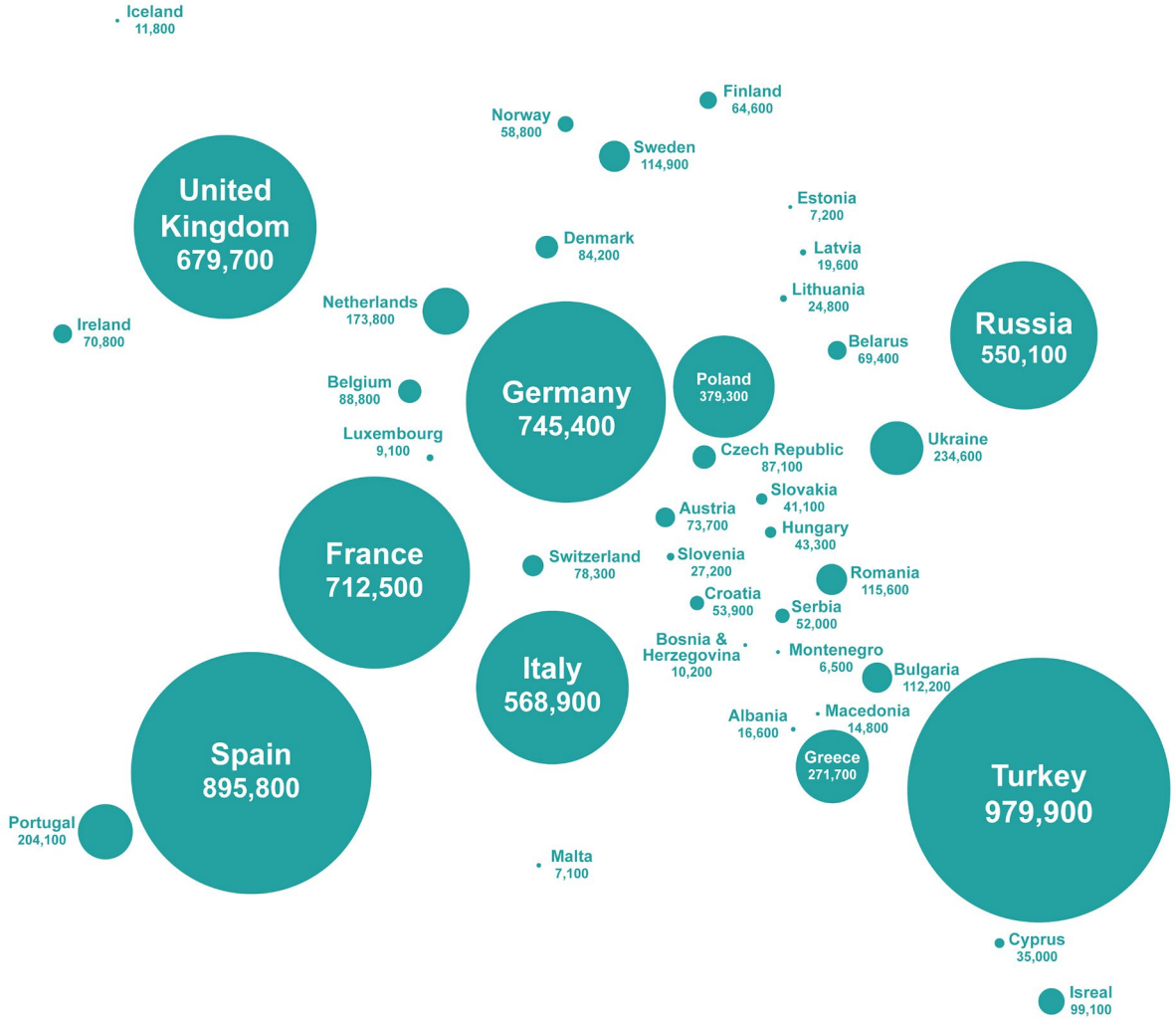
It should be noted that these figures are not attempting to credit airports with solely creating 2.6% of the European economy. These economies are far more complex than that. It clearly takes a wide range of players acting together to generate economic growth – government, business, infrastructure providers, residents and others. For example, if no one had decided to build large amounts of hotels in many of these countries, tourism would also be substantially lower. What the estimates do show is that without European airports, and particularly without the diverse and affordable connectivity supported by these airports, the economies of these countries would not be as large, affluent or diverse as they are today. This needs to be borne in mind when considering the future development of the airport sector and civil aviation in general, something that is explored further in **Chapter 11**.

Figure 9-2: Catalytic Impacts by Country, 2013

Country	Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
Turkey	979,900	13.64	36.27	5.9%
Spain	895,800	26.33	39.65	3.9%
Germany	745,400	28.16	60.27	2.2%
France	712,500	28.6	51.14	2.5%
United Kingdom	679,700	19.23	41.53	2.2%
Italy	568,900	19.28	39.09	2.5%
Russia	550,100	10.49	22.67	1.4%
Poland	379,300	6.34	13.35	3.4%
Greece	271,700	4.74	9.94	5.5%
Ukraine	234,600	0.96	2.42	1.9%
Portugal	204,100	3.35	7.46	4.5%
Netherlands	173,800	6.67	13.7	2.3%
Romania	115,600	1.58	4.13	2.9%
Sweden	114,900	4.9	10.4	2.5%
Bulgaria	112,200	0.5	1.25	3.1%
Israel	99,100	2.41	5.49	2.7%
Belgium	88,800	4.51	8.95	2.3%
Czech Republic	87,100	1.5	3.24	2.2%
Denmark	84,200	3.58	7.59	3.0%
Switzerland	78,300	4.81	10.04	2.0%
Austria	73,700	3.29	6.93	2.2%
Ireland	70,800	2.44	4.89	3.0%
Belarus	69,400	0.57	1.44	3.1%
Finland	64,600	2.38	4.73	2.4%
Norway	58,800	3.99	8.33	2.2%
Croatia	53,900	0.78	1.65	3.8%
Serbia	52,000	0.32	0.8	2.5%
Hungary	43,300	0.49	1.04	1.1%
Slovakia	41,100	0.72	2.01	2.8%
Cyprus	35,000	0.53	1.18	7.1%
Slovenia	27,200	0.53	1.04	2.9%
Lithuania	24,800	0.27	0.66	1.9%
Latvia	19,600	0.21	0.52	2.2%
Albania	16,600	0.07	0.17	1.8%
Macedonia	14,800	0.09	0.24	3.4%
Iceland	11,800	0.32	0.64	5.8%
Bosnia & Herzegovina	10,200	0.06	0.16	1.3%
Luxembourg	9,100	0.56	1.17	2.6%
Estonia	7,200	0.11	0.22	1.2%
Malta	7,100	0.14	0.29	4.1%
Montenegro	6,500	0.03	0.07	2.4%
Total	**7,893,500**	**209.49**	**426.74**	**2.6%**

Note: Data for Georgia and Moldova not available. Numbers may not add up due to rounding.

Figure 9-3: Map of Catalytic Employment by Country, 2013



9.3 Catalytic Impacts by Region

Figure 9-4 presents the catalytic impacts broken down into the EU 28 countries, the EFTA countries and all other countries in Europe.

The catalytic impacts in the EU 28 countries accounted for 5.7 million jobs in 2013, 72.4% of the estimated catalytic jobs facilitated by airports in Europe, earning approximately € 171.7 billion in direct income. The direct GDP contribution in the EU 28 countries was approximately € 338 billion.

In the EFTA countries, the catalytic impacts totalled 148,900 jobs (1.9% of total catalytic jobs), earning € 9.1 billion in direct income and contributing approximately € 19 billion to GDP.

The remaining countries accounted for 2 million jobs (25.8% of total direct jobs), earning € 28.7 billion in direct income and contributing approximately € 69.7 billion to GDP.

Figure 9-4: Catalytic Impacts by Region (2013)

Region	Direct Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
EU 28	5,711,400	171.7	338.0	2.6%
EFTA	148,900	9.1	19.0	2.1%
Other Countries	2,033,200	28.7	69.7	2.6%
Total	**7,893,500**	**209.5**	**426.7**	**2.6%**

Numbers may not add up due to rounding.

PART IV:
TOTAL AND FUTURE IMPACTS

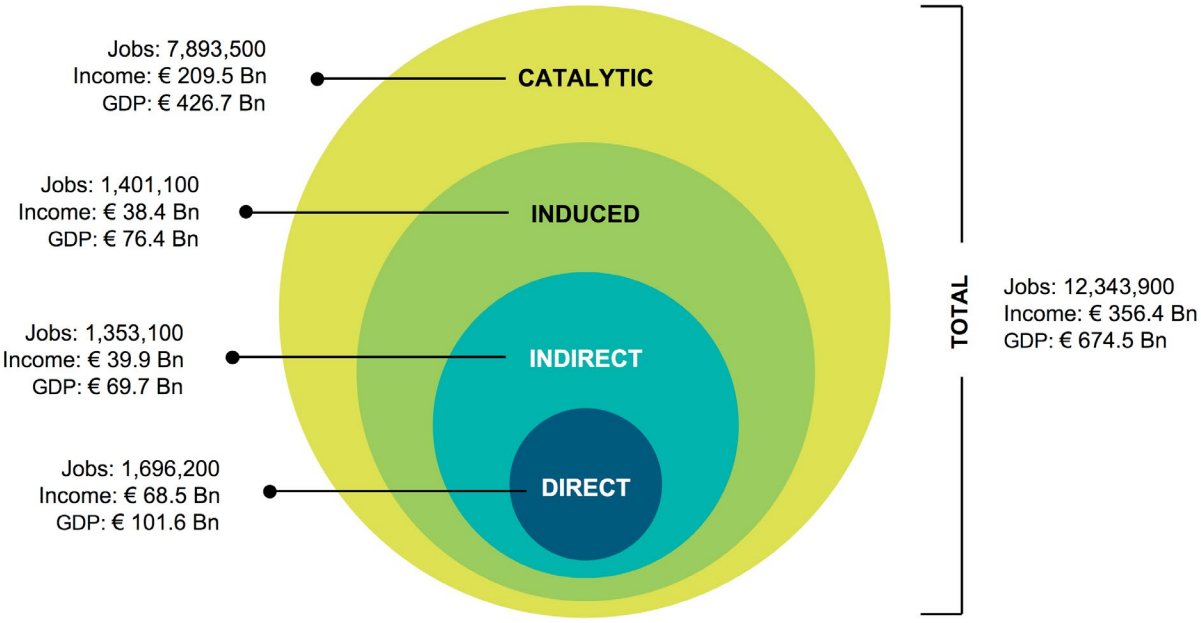
10 Total Economic Impact Generated and Facilitated by European Airports

SUMMARY

European airports contributed to the employment of almost **12.3 million people** and generated **€ 675 billion in GDP** in 2013, equal to **4.1% of GDP** of Europe.

The total economic impact both generated and facilitated by airports in Europe is shown in **Figure 10-1**. Including the activity directly related to the airports, the indirect and induced impacts that flow from that, and the other sectors of the economy facilitated by air connectivity, European airports contribute to the employment of **12.3 million people**, earning a total **of € 356 billion** in 2013. In addition, a total of **€ 675 billion** in GDP was generated, equal to **4.1% of GDP** of Europe.

Figure 10-1: Total Economic Impact Generated and Facilitated by Airports in Europe (Direct+Indirect+Induced+Catalytic), 2013



10.1 Total Impacts by Country

Figure 10-2 shows total jobs, income and GDP generated and facilitated on a country level in 2013. The total employment by country is also shown in **Figure 10-3**. Detailed breakdowns of the economic impacts at the country level can be found in **Appendix G**.

The total contribution to GDP ranges from 1.6% (Hungary) to 11% (Cyprus).[68] The contribution of aviation to each economy differs depending on a number of factors, including:

- The relative development of the airports and aviation section. Where countries have a small volume of air traffic at its airports, the economic contribution of this sector is necessarily going to be smaller.
- The size and diversity of the national economy. In most large, high diversified economies, the contribution of aviation is moderately by the other large volume of other activities in the economy.
- The nature of the supply chains supporting airport activity in each country (indirect impacts), and the spending behaviour of airport-related employees (induced impacts).
- Countries which have relatively large tourism industries tend to have a larger contribution from airports (e.g. Turkey, Spain, Greece, Cyprus), reflecting the important role of air connectivity in facilitating this industry.
- Small island nations (e.g. Iceland, Malta, Cyprus) also tend to have large contributions from airports, due their reliance on air connectivity to connect with the global economy.

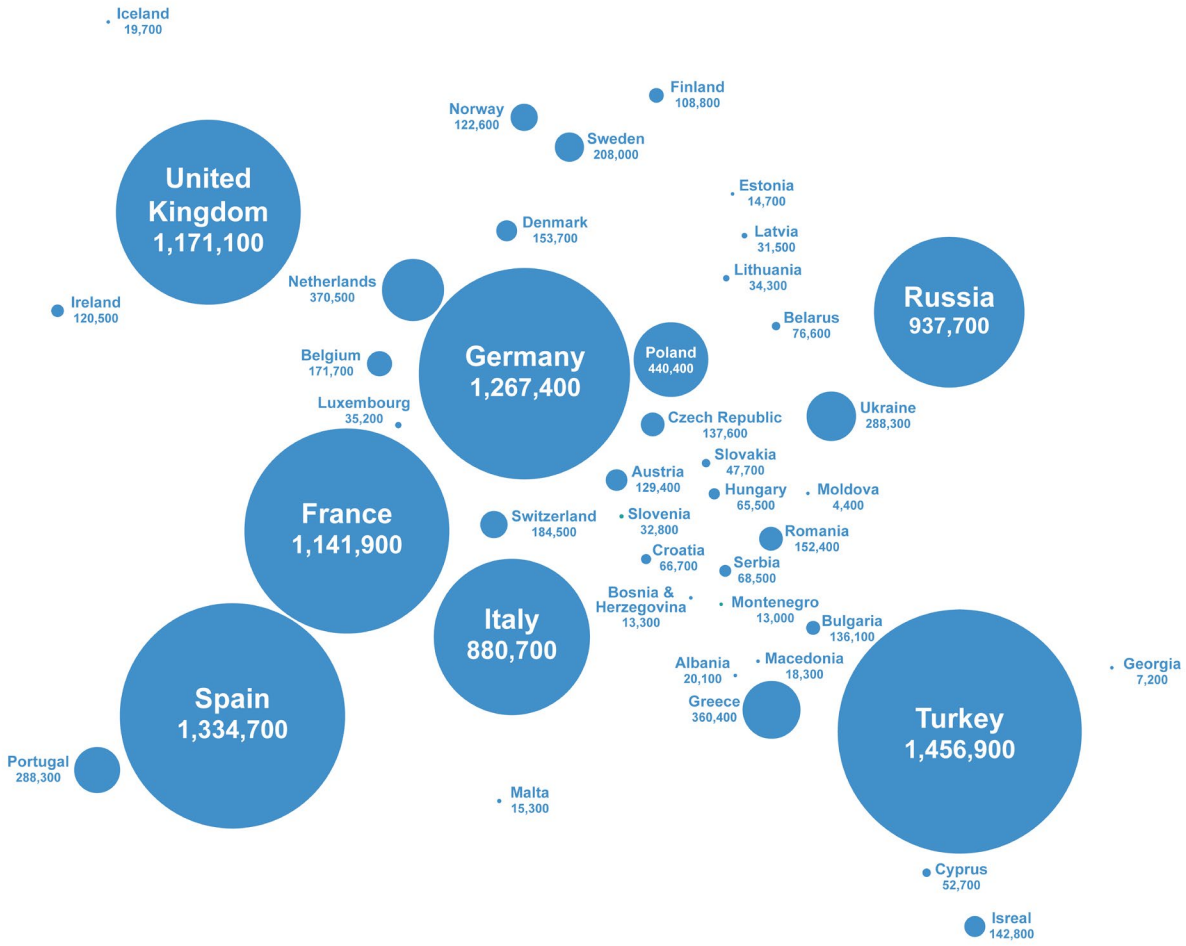
[68] The percentage of GDP figures for Georgia and Moldova are lower as they do not include catalytic impacts, which could not be estimated, and so have been excluded from this range.

Figure 10-2: Total Economic Impacts (Direct+Indirect+Induced+Catalytic) by Country, 2013

Country	Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
Turkey	1,456,900	17.61	44.04	7.1%
Spain	1,334,700	40.98	60.33	5.9%
Germany	1,267,400	49.65	99.25	3.6%
United Kingdom	1,171,100	38.26	76.01	4.0%
France	1,141,900	48.62	81.60	4.0%
Russia	937,700	18.06	37.13	2.4%
Italy	880,700	29.38	56.69	3.6%
Poland	440,400	7.27	14.78	3.8%
Netherlands	370,500	14.94	27.20	4.5%
Greece	360,400	6.91	13.88	7.6%
Portugal	288,300	5.14	10.58	6.4%
Ukraine	288,300	1.30	3.09	2.4%
Sweden	208,000	9.24	18.21	4.3%
Switzerland	184,500	12.67	21.65	4.4%
Belgium	171,700	8.16	14.66	3.8%
Denmark	153,700	6.84	13.48	5.4%
Romania	152,400	1.87	4.72	3.3%
Israel	142,800	3.52	7.38	3.7%
Czech Republic	137,600	2.47	5.12	3.4%
Bulgaria	136,100	0.65	1.54	3.9%
Austria	129,400	5.78	10.92	3.5%
Norway	122,600	8.74	15.29	4.0%
Ireland	120,500	4.55	9.40	5.7%
Finland	108,800	4.48	8.13	4.2%
Belarus	76,600	0.62	1.53	3.3%
Serbia	68,500	0.42	1.01	3.1%
Croatia	66,700	0.97	1.94	4.5%
Hungary	65,500	0.83	1.56	1.6%
Cyprus	52,700	0.92	1.82	11.0%
Slovakia	47,700	0.82	2.22	3.1%
Luxembourg	35,200	1.79	3.37	7.4%
Lithuania	34,300	0.37	0.87	2.5%
Slovenia	32,800	0.66	1.25	3.5%
Latvia	31,500	0.33	0.77	3.3%
Albania	20,100	0.09	0.21	2.2%
Iceland	19,700	0.56	1.05	9.5%
Macedonia	18,300	0.12	0.28	4.0%
Malta	15,300	0.34	0.66	9.2%
Estonia	14,700	0.22	0.41	2.2%
Bosnia & Herzegovina	13,300	0.08	0.19	1.6%
Montenegro	13,000	0.07	0.15	5.0%
Georgia	7,200	0.04	0.09	0.8%
Moldavia	4,400	0.03	0.05	1.0%
Total	**12,343,900**	**356.36**	**674.52**	**4.1%**

Note: Figures for Georgia and Moldova do not include catalytic impacts. Numbers may not add up due to rounding.

Figure 10-3: Map of Total (Direct+Indirect+Induced+Catalytic) Employment by Country, 2013



10.2 Total Impacts by Region

Figure 9-4 presents the total impacts broken down into the EU 28 countries, the EFTA countries and all other countries in Europe.

The total impacts in the EU 28 countries accounted for nearly 9 million jobs in 2013, 72.7% of total jobs generated or facilitated by airports in Europe, earning approximately € 292.4 billion in direct income. The direct GDP contribution in the EU 28 countries was approximately € 541.4 billion.

In the EFTA countries, the total impact was 326,800 jobs (2.6% of the Europe total), earning € 22 billion in direct income and contributing approximately € 38 billion to GDP.

The remaining countries accounted for over 3 million jobs (24.7% of total direct jobs), earning € 42 billion in direct income and contributing approximately € 95.1 billion to GDP.

Figure 9-4: Total Impacts (Direct+Indirect+Induced+Catalytic) by Region, 2013

Region	Direct Jobs	Income (€ Billions)	GDP (€ Billions)	% of National GDP
EU 28	8,970,000	292.4	541.4	4.1%
EFTA	326,800	22.0	38.0	4.3%
Other Countries	3,047,100	42.0	95.1	3.6%
Total	**12,343,900**	**356.4**	**674.5**	**4.1%**

Numbers may not add up due to rounding.

11 Ensuring the Future Economic Contribution of Europe's Airports

SUMMARY

Under EUROCONTROL's most likely air traffic forecasts, if airport capacity fails to keep up with demand, then by 2035, a total of **over 2 million jobs** and **€ 96.8 billion in GDP** could be forgone.

As part of its *Challenges of Growth* series, in 2013 EUROCONTROL released a report forecasting air traffic in Europe in 2035.[69] The report contains forecasts of unconstrained air traffic levels under four economic and political scenarios.[70] The forecast defined by EUROCONTROL as most likely is defined as follows:

> **Scenario C: Regulated Growth (Most Likely)**
> *"Moderate economic growth, with regulation reconciling the environmental, social and economic demands to address the growing global sustainability concerns. This scenario has been constructed as the 'most-likely' of the four, most closely following the current trends."* [71]

The remaining three scenarios forecast by EUROCONTROL are provided in **Appendix J**.

As well as the unconstrained forecasts, EUROCONTROL also examined the current capacity expansion plans at European airports. From this, it was projected that not all future demand could be accommodated (i.e. there was a significant gap between unconstrained demand for air travel and the airport capacity expected to be available to facilitate this demand in 2035).

Inter*VISTAS* was asked to estimate the forgone economic impact associated with this unserved demand. In other words, the employment, income and GDP that would be lost as a result of not accommodating a proportion of the forecast 2035 traffic. This analysis was based on the detailed forecast data provided by EUROCONTROL. The economic impact was estimated for the unconstrained and constrained forecasts of 2035, using the economic impact model and allowing for future productivity improvements. The forgone economic impact was then calculated as the difference between the unconstrained and constrained results.

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[69] https://www.eurocontrol.int/sites/default/files/article/content/documents/official-documents/reports/201306-challenges-of-growth-2013-task-4.pdf.
[70] The forecasts are unconstrained in the sense that they reflect underlying passenger demand before any possible constraints due to airport or airspace capacity.
[71] Ibid.

The results of this analysis should be treated with the necessary precautions, due to uncertainty about future air traffic and economic activity. Traffic volumes in 2035 could be considerably different to the forecasts, and future productivity and employment levels could diverge significantly from the assumptions made in this analysis. Nevertheless, the analysis does illustrate the scale of economic benefit that could be forgone without adequate airport capacity development.

11.1 EUROCONTROL Forecasts

The EUROCONTROL forecasts are summarised in **Figure 11-1**. In 2012, there were approximately 0.7 billion passenger departures in the EUROCONTROL countries (which does not include Russia and Israel). In Scenario C (the most likely forecast scenario), unconstrained passenger demand is forecast to reach over 1.5 billion departures in 2035. However, due to projected capacity constraints at European airports, only 1.3 billion departures are anticipated to be accommodated, leaving a gap (unfulfilled demand) of nearly 225 million departures. The size of the gap varies by scenario due to the difference in forecast demand and forecast capacity development. The forecasts for the other three scenarios are provided in **Appendix J**.

Figure 11-1: EUROCONTROL Most Likely Forecast of Passenger Departures, 2012-2035

Scenario	2012 Passengers	2035 Passengers		
		Unconstrained	Constrained	Gap
Scenario C: Regulated Growth	0.7 Billion	1.5 Billion	1.3 Billion	225 Million

Source: Forecast Data from the Challenges of Growth 2013 forecasts, provided by EUROCONTROL.
The geographic area covered in the forecasts is slightly different to ACI EUROPE, and does not include Russia or Israel.

11.2 Estimating the Foregone Economic Impact

The analysis considered the economic impact associated with the gap between constrained and unconstrained demand (the unfulfilled demand). This economic impact would be foregone if airport capacity is unable to match demand.

The future economic impact was estimated for each of the scenarios for both the constrained and unconstrained forecasts and the difference taken between them. To do this, it was assumed that the economic impact (employment, income, GDP) associated with the airports would increase as traffic at the airport increases. However, our experience has been that

the aviation sector achieves productivity gains and economies of scale, handling increasing numbers of passengers per employee as traffic increases. Therefore, the increases would not be linear, i.e. a 1% increase in traffic would lead to a less than 1% in the economic impact.

To estimate the forgone economic impact, the following assumptions were made:

- The economic impacts were estimated based on EUROCONTROL forecasts for individual countries or groups of countries and then totalized for the entire region.
- The direct employment impacts were estimated based on the analysis described in **Appendix E**, which found that each 1 million traffic units (equal to 1 million passengers), increased employment by 854 for large airports.[72] Furthermore, to account for future gains in productivity associated with technological advances, competition-induced efficiency gains, etc. **this parameter was reduced by 33%.**
- The indirect and induced impacts were estimated from the direct impacts, using the 2013 economic impact multipliers.
- To be conservative, it was assumed that air connectivity would increase at a slower rate than passenger traffic, such that **each 1% increase in passengers would result in only a 0.75% increase in connectivity**. The connectivity parameter was then applied to projected increase in connectivity to estimate the catalytic impacts.

The resulting estimates of the economic impact forgone under the most likely forecast are provided in **Figure 11-2**. For reference, the table also shows the 2013 economic impact of the EUROCONTROL countries (i.e. excluding Russia and Israel).

In EUROCONTROL's most likely forecast scenario (Scenario C: Regulated Growth), the forgone economic impact associated with this unmet demand is estimated to be just over 2 million jobs, € 47 billion in income (wages, salaries, bonuses and other remuneration) and € 96.7 billion in GDP, including direct activity at the airport, indirect and induced impacts, and the lost tourism, trade, investment and productivity due to low connectivity growth. This is roughly one sixth of the 2013 economic impact of airports in the EUROCONTROL countries.

The projected forgone economic impact in the other forecast scenarios is provided in **Appendix J**.

[72] The analysis found that the impact per million traffic units was greater for smaller airports. However, to be conservative, and due to the fact that capacity constraints will be felt at larger airports, the lower parameter value was used..

Figure 11-2: Foregone Economic Impact Due to Capacity Constraints at European Airports, 2035

	Jobs	Income (€ Billions)	GDP (€ Billions)
Total 2013 Economic Impact in the EUROCONTROL Countries			
Direct	1,550,800	64.4	94.9
Indirect	1,200,100	37.4	64.5
Induced	1,268,200	36.4	72.1
Catalytic	7,244,300	196.6	398.6
Total	**11,263,400**	**334.8**	**630.0**
Foregone Economic Impact in Scenario C: Regulated Growth (Most Likely)			
Direct	313,000	9.3	14.3
Indirect	266,000	5.3	9.5
Induced	259,000	4.7	10.0
Catalytic	1,197,000	27.8	62.8
Total	**2,035,000**	**47.0**	**96.7**

All financial figures are in 2013 prices. Numbers may not add up due to rounding.

12 Conclusions

The analysis presented in this report demonstrates the vital role of airports in the functioning of European economies. The activities in and around airports alone supports almost 1.7 million jobs across Europe. This includes employment at the airport operator, the airlines, airport air traffic control, fixed base operators general aviation, ground handlers, airport security, immigration and customs, aircraft maintenance, and other activities. Many of these jobs are high paying jobs with the average wage in that sector considerably above the European average.

The economic impact of airports extends out into businesses and individuals that support the activities at the airports (indirect impacts) and the additional spending in the economy of airport-related employees (induced impacts). Once those impacts are included, a total of 4.5 million jobs are supported by airport activities, contributing € 247.8 billion in GDP (1.5% of the total GDP of Europe).

However, this report argues that airports are important not simply because they create employment and economic activity in the aviation and related sectors. Indeed, the most important role of airports may be in the way that they support a broad range of activities in the general economy. Very few people fly for the sake of it – rather, flying is a means to conduct other important activities – trade, business development, visits to business headquarters and regional offices, visit locations for holidays, and so on. Thus, airports act as critical infrastructure facilitating the interactions and networking of people and businesses across the globe. The value of these catalytic impacts in Europe was estimated at 7.9 million jobs and € 426.7 billion in GDP (2.6% of the ACI EUROPE economies).

In order for Europe's airports to continue to facilitate the wider economy, it is necessary for them to grow in line with underlying demand. Under EUROCONTROL's most likely forecasts, failure to expand Europe's airports could cost at least 2 million jobs and € 96.7 billion in GDP. Furthermore, the majority of this loss is in the general economy, not the airports or aviation sector.

PART V:
APPENDICES

Appendix A:
Traffic Volumes in ACI Europe Countries

Passenger Traffic

Total passenger traffic at airports in Europe grew by 2.8% in 2013 from 2012, reaching a total of 1.73 billion passengers. While international passengers increased by 3.8% from 2012 to 2013, domestic passengers remained constant relative to 2012.

Figure A-1 depicts total passenger traffic by country in 2013. Nearly two-thirds of the total traffic in Europe is attributable to the seven largest markets: United Kingdom, Germany, Spain, France, Turkey, Italy, and Russia.

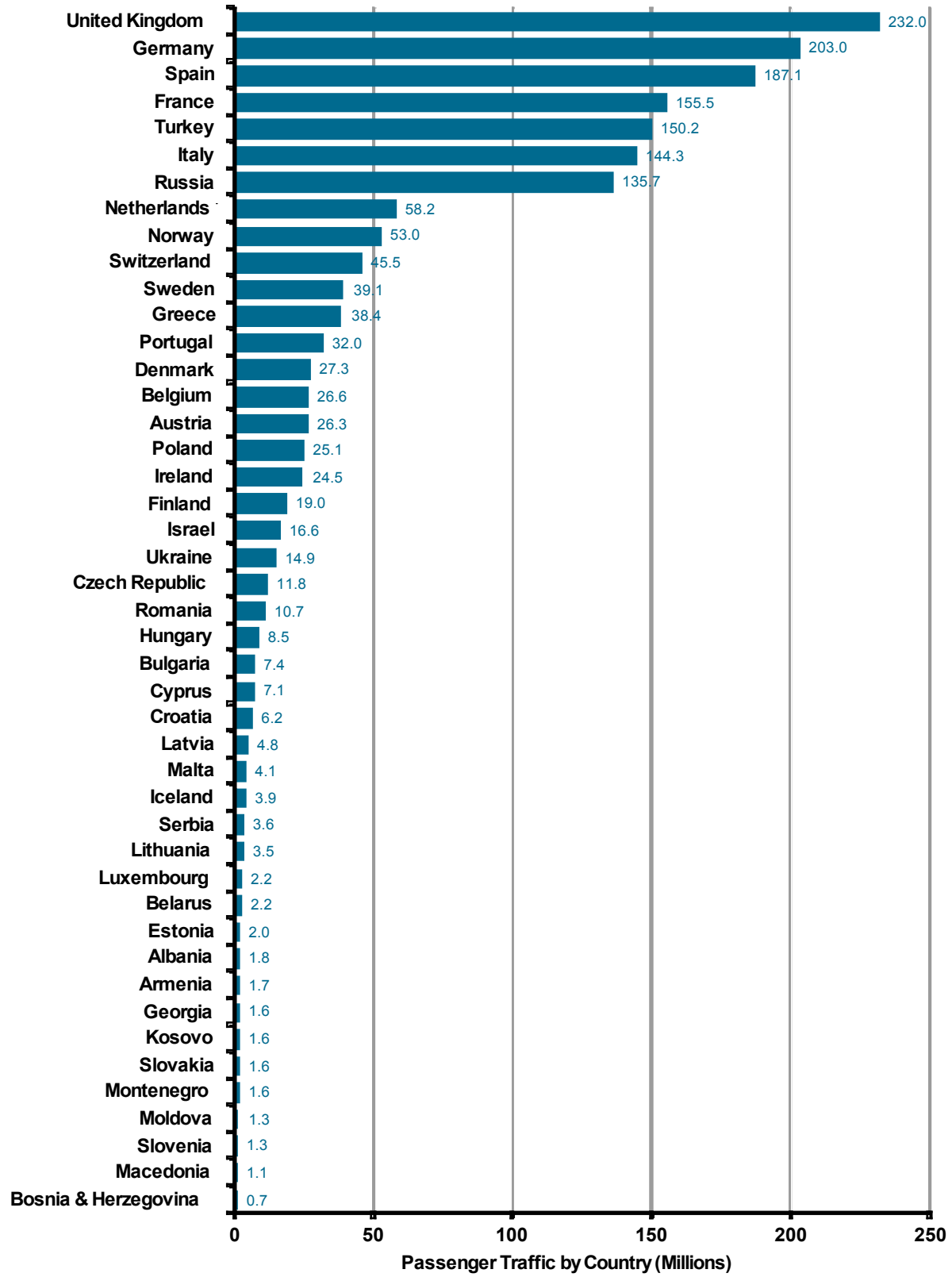
Air Cargo

In 2013, airports in Europe handled a total of 16.8 million metric tonnes. **Figure A-2** depicts the air cargo by country in 2013. The largest European air cargo market was Germany, accounting for nearly one quarter of the European market in 2013. Combined with the other top five markets for air cargo (the United Kingdom, France, Netherlands and Belgium), the top five countries accounted for nearly two-thirds of all European air cargo.

Commercial Aircraft Movements

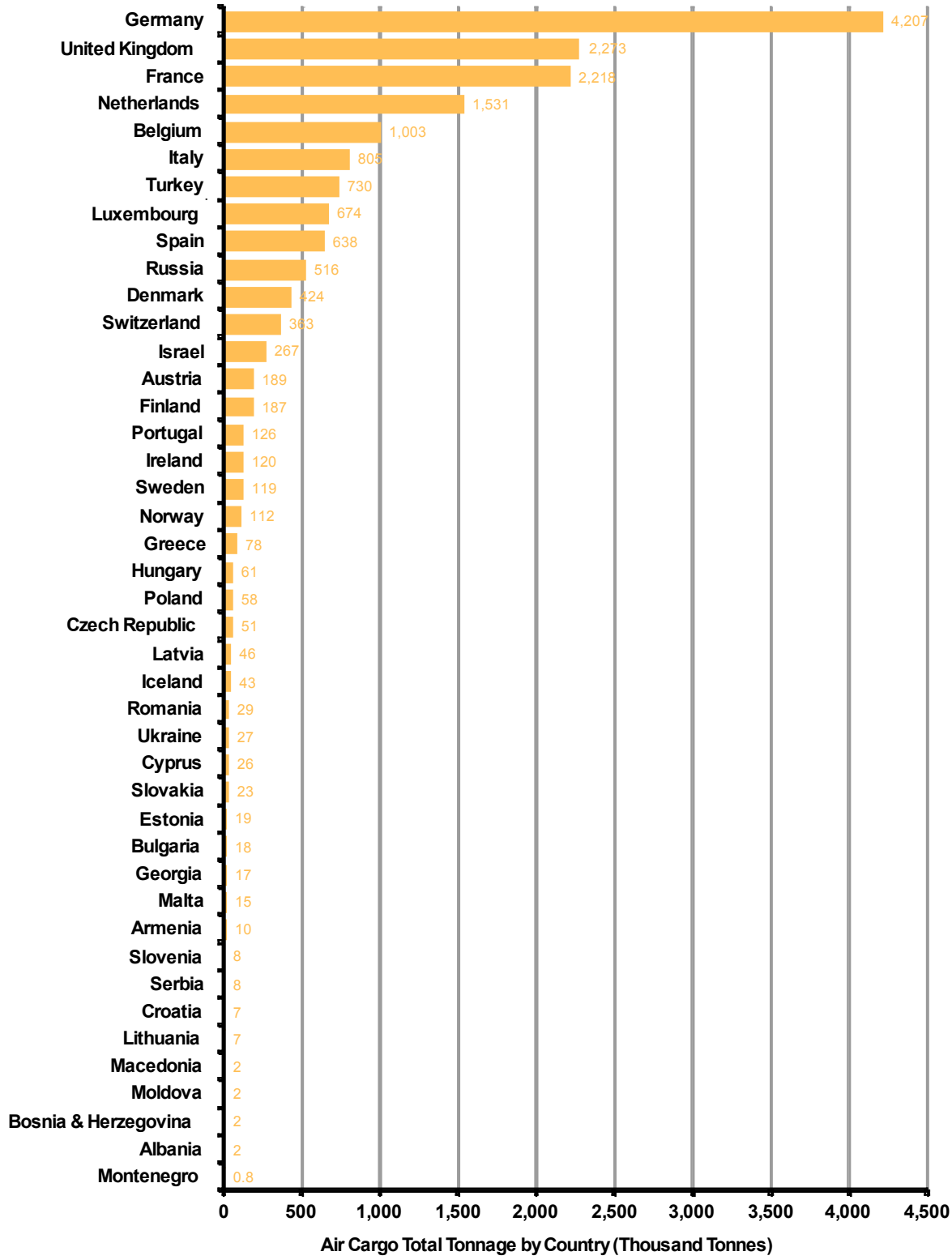
Total commercial aircraft movements in Europe totalled 20.8 million in 2013. Movements in Europe decreased in 2013 by 1.2%, for the second year in a row (-2.6% in 2012 compared to 2011). Thus, average passengers per aircraft have actually increased over the last two years in Europe. **Figure A-3** shows the total commercial aircraft movements in 2013 by country. Over half of the total commercial aircraft movements in Europe in 2013 were in the top five countries: the United Kingdom, Germany, France, Spain, and Italy.

Figure A-1: Passenger Traffic by Country, ACI EUROPE, 2013



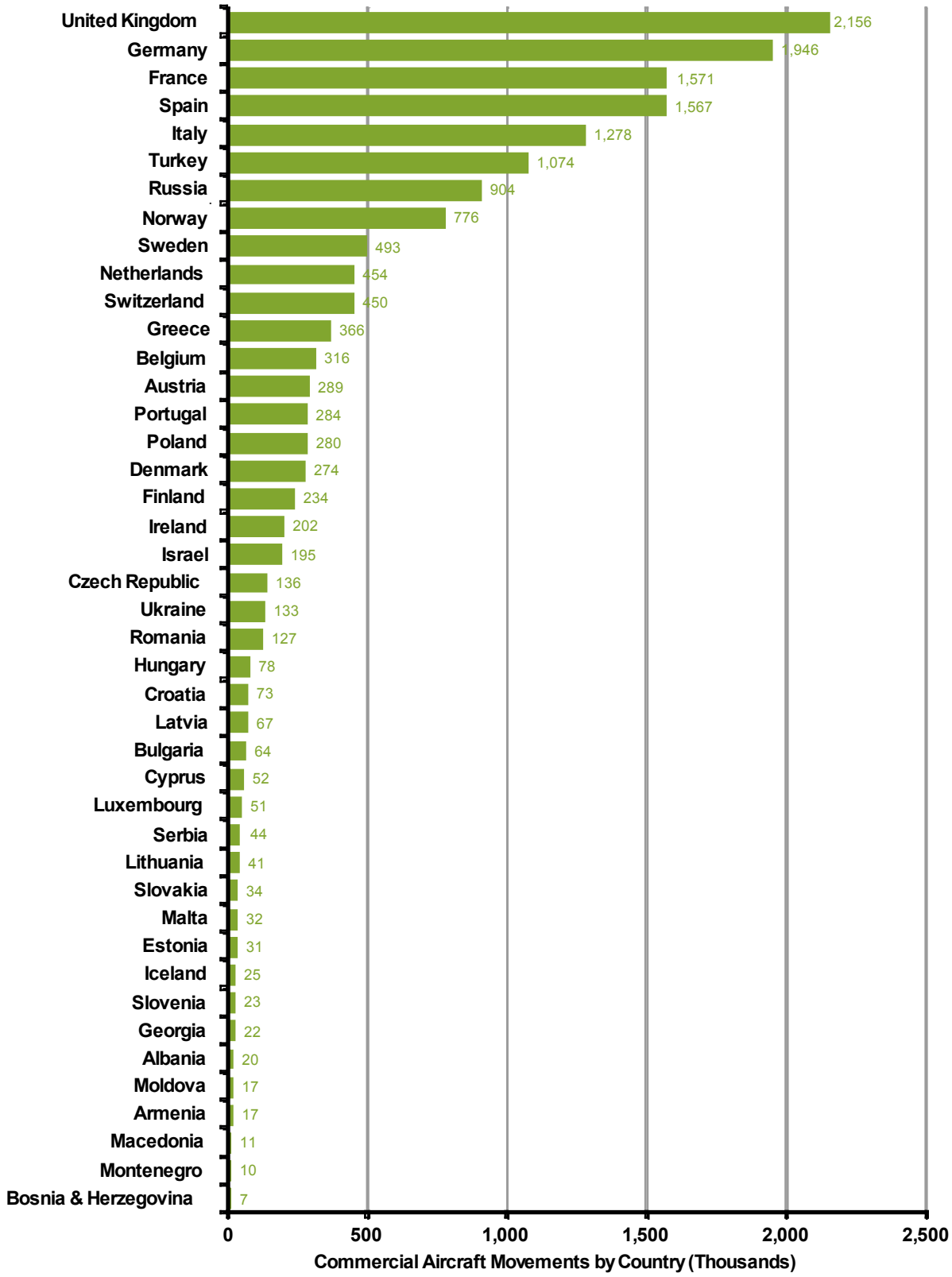
Source: ACI EUROPE Traffic Statistics, 2013.

Figure A-2: Air Cargo by Country, ACI EUROPE, 2013



Source: ACI EUROPE Traffic Statistics, 2013.

Figure A-3: Commercial Aircraft Movements by Country, ACI EUROPE, 2013



Source: ACI EUROPE Traffic Statistics, 2013.

Appendix B: Considerations in the Use of Economic Impact Analysis

When considering the economic impact of any sector, care must be taken. Economic impact assessments are a powerful tool in communicating the importance of an industry or sector to the economy and society more generally. They can stimulate new policy initiatives and inform strategies to boost economic growth. However, they are also easily abused.

This had led to a degree of scepticism in such work, which has in turn led to careful scrutiny by decision makers, academics and community groups of these studies. To be effective, studies must utilise correct and precise methodology, to be fully documented, and to withstand common sense tests. 'Black box' approaches, whereby results are presented without details of the underlying methodological approach are no longer sufficient.

However there is a responsibility also upon critics of economic impact studies. Expectations must be realistic. It must be accepted that there is no 'silver bullet' approach which will produce an indisputably set of figures which fully and indisputably quantify the net economic benefits of aviation, or any other sector. In reality there are a range of different methodological approaches, which if employed correctly and transparently, are valid. Like any decision which must be made, the choice of a specific approach will bring with it both advantages and disadvantages. The onus is on the practitioner of economic impact studies to choose a methodology which is best suited to the specific context. The methodological approach must not only be fit to deliver upon the objectives of the project in question, but must also make best use of what quality data is available.

In recent times, much of the debate has centred around the relative merits of Input-Output models (i.e. economic impact analysis) and Cost Benefit Analysis. While there is considerable value in the discussion, in reality the assumption that there is a black and white choice between two opposing methodologies is in fact a false premise. The reality is that these are two different approaches, which take different perspectives and which therefore measure different impacts, and which consequently produce results which serve different purposes. They are not contradictory, but if used correctly, complementary.

A full comparison and contrast of these two approaches is beyond the scope of this study, but the below table considers as a high level some of the respective strengths and weaknesses of both approaches.

Input-Output Models

Advantages

- Input-Output tables are based on real data. As models of individual national economies, they are grounded in actual historical financial flows between sectors.
- The methodology is well established, well recognised and can be readily interrogated if necessary.
- The outputs (number of jobs, contribution to Gross Domestic Product) are real concrete impacts which can directly be felt by citizens. This makes the results accessible and understandable to those who are not necessarily technical experts.

Disadvantages

- Not all costs and benefits associated with an industry or sector are captured. For example time savings to leisure travellers or the environmental impact on citizens are not quantified.
- Care must be taken when discussing the results, as the number of jobs supported directly and indirectly are in some respects a measure of the sector's efficiency.

Cost Benefit Analysis

Advantages

- Cost Benefit Analysis results, if performed correctly, are truly additive, i.e. the impact would not have happened via other means in the absence of the project being examined.
- The focus on net welfare gains allows some additional impacts to be quantified, such as commuter travel time, some elements of the environmental impact such as CO^2 emissions, etc.

Disadvantages

- Capturing the full range of costs and benefits is not straightforward and sometime impossible. Issues such as the health impact of noise are difficult to quantify, and some of the wider agglomeration and clustering impact which produce innovation and increased productivity are not captured at all. The removal of lead from petrol has been cited as a policy initiative which would have failed a conventional cost-benefit analysis.[73]
- The approach is focused on considering specific alternatives in terms of policy choices, investment decision, etc. and may not be readily transferrable to quantifying the current status quo economic impact of an existing sector or industry.

[73] '*Applying Cost-Benefit Analysis to Past Decisions: Was Environmental Protection Ever a Good Idea?*', Ackerman F, Heinzerling L, Massey, R, Georgetown Law Faculty Publications, 2010

This study uses Input-Output models to assess the indirect and induced impact of European airports and associated aviation activity. A detailed explanation as to the nature and usage of these models is provided in **Section 4.3**. Even further extensive explanations are provided in **Appendix F**.

This approach was chosen with reference to some of the strengths and weaknesses of the above approaches detailed in the table. The results of this analysis are presented in a manner which reflects the characteristics of this approach, and no attempt is made to claim that these figures represent anything more than their actual significance.

In light of the scepticism which does surround economic impact studies, and given the confusion which exists concerning the characteristics of the various approaches, the following principles underpin the work of this study:

- A well-established and widely accepted methodology is employed, which produces readily understood and comparable results.
- Numbers are based on hard data sources, either via direct employment surveys of airports or national economy information via Input-Output models and the calculation of the correlation between GDP per capita and air connectivity. Where numbers must be extrapolated (e.g. to account for the airports which did not respond to the survey) this is acknowledged and details of the extrapolation method are made clear.
- Care is taken to ensure that results are not overstated, nor over-interpreted. Where there is nuance or significant counter-arguments (e.g. the economic inflow and outflow catalytic impacts associated with tourism) these are acknowledged and addressed in the text.

Significant effort is made to ensure that details of the methodology are available on the various appendices, and presented in an accessible and transparent manner.

Appendix C:
Employment Survey Questionnaire

Survey questionnaires in Adobe PDF format were sent out by email to all airport members of ACI EUROPE. The document was set up so that respondents could enter information directly into the form and automatically email it back.

A copy of the questionnaire used is provided on the following pages.

ACI EUROPE
Economic Impact of European Airports
Employment and Activity Survey

InterVISTAS
a company of Royal HaskoningDHV

ACI EUROPE
AIRPORTS COUNCIL INTERNATIONAL

The figures you provide in the following sections are **strictly confidential** and will be viewed only by Inter*VISTAS* Consulting Ltd. and ACI EUROPE. Only aggregate survey totals will be published in the final report - no individual airport data will be released.

For the purposes of this study, it is important that the figures you provide are as accurate as possible. However, where it is not possible to provide precise information, we would appreciate realistic estimates by informed parties (e.g., human resources, finance departments, unit directors, department heads, etc.), rather than no response at all.

Please complete this survey electronically by responding directly into the form. Alternatively, you can print out the form and complete by hand. Wherever possible, please state figures for calendar year 2013 (please indicate where this is not the case).

Name of Airport: _____

Contact Person: _____ Phone number: _____

Email: _____

Q1. About Your Airport

Please complete the following information for your airport for 2013, or closest possible year:

	Year: _____
Total E/D passenger traffic	
Total transfer/transit passenger traffic	
Total air cargo volumes	
Total aircraft movements	

Is your airport a hub or significant base for any airlines?

☑ No ☐ Yes, please state their names: _____

Q2. Existing Economic Impact Study

Has your airport commissioned, conducted or been the subject of an economic impact study?

☐ Yes ☑ No

If yes, please could you email a copy to acieurope.survey@intervistas.com
or fax to +44-1225-330-209, Attention: Ian Kincaid. Any information in the study will be kept confidential and only aggregate totals will be published.

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Q3. Employment at the Airport

Please attempt to complete this question even if you have provided an economic impact study.

Please complete the table on the next two pages, indicating the employment on the airport grounds for the airport activities or functions listed (**please state only the employment located at the airport**). Please estimate the employment at the airport company *and* the employment associated with other businesses located at the airport (third party providers). For example, some functions may be carried out by the airport while others are carried out by third parties, and some may be provided by a combination of the two.

While you may not have detailed information on the employment at the third party providers, please provide your best estimate of their employment levels at your airport. Please also state the name of the major third party providers (e.g., the name of the companies providing ground handling services or the name of the government agencies).

Function If these figures are not for 2013, please state the year here: _____	**Total Headcount**	
	Airport Company	**Third Party**
Airlines (passenger and cargo)		
Outsourced In-Terminal Airline Services (e.g., ticketing and check-in) Major Third Party Providers: _____		
Ground Handling / Apron & Ramp Services (e.g., loading/unloading aircraft fueling, catering and cleaning) Major Third Party Providers: _____		
Airport Management and Overhead Major Third Party Providers: _____		
Airport Cleaning and Maintenance Major Third Party Providers: _____		
Air Navigation (Route & Terminal Navigation) Major Third Party Providers: _____		

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Function	Total Headcount	
	Airport Company	Third Party
Passenger Screening and Other Security Major Third Party Providers: _____		
Customs and Immigration Major Third Party Providers: _____		
Fire and Emergency Services Major Third Party Providers: _____		
Other Government Agencies Major Third Party Providers: _____		
Car Parking and Ground Transport Major Third Party Providers: _____		
Food & Beverage and Retail Major Third Party Providers: _____		
Aircraft Maintenance, Repair and Overhaul Major Third Party Providers: _____		
Fixed Base Operators / General Aviation Major Third Party Providers: _____		
Other (Not Covered Above) Major Third Party Providers: _____		

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Q4. Employment for Other Airports

Does any of the **Airport Management and Overhead** employment listed above relate to the management of other airports? For example, if your airport is part of a larger airport group (e.g., Aena Aeropuertos, FINAVIA), some of this employment might be involved in the management of airports located elsewhere.

☐ No

☐ Yes, please estimate the approximate percentage of this employment associated with the other airports and provide the airport names:

	Airport Company	Third Party
% of Airport Management and Overhead Associated with Other Airports:		
Names (or codes) of the Other Airports:		

Q5. Total Employment at the Airport

If you have been unable to provide complete information for Question 3, please can you provide an approximate estimate of the total employment at your airport, broken down in employment at the airport company and at other businesses at the airport (third party providers).

If these figures are not for 2013, please state the year here: _____	Airport Company	Third Party
Total Employment in 2013 (Head Count)		

Q6. Number of Security Passes Issued

As a cross-check of the employment at the airport, please can you state the approximate number of active/valid restricted area security passes issued by the airport as of December 2013. This information will only be used as a cross-check and will not be published in any form.

If these figures are not for 2013, please state the year here: _____	Passes Issued as of December 2013
Restricted Area Security Passes	

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Q7. Salaries and Benefits

Please state the total payroll expenses (i.e., salaries and benefits) of your airport in 2013 (or closest available year)

Year:	
Currency:	
Total payroll (salaries and benefits):	

Alternatively, if you are unable to answer this question, please provide an approximate estimate of the average annual salary and benefits **per airport company employee**.

Average Salary/Wage: _____ per annum.

Q8. Off-Airport Employment

Is there any employment located outside of the airport that is directly related to airport activities? If so, please provide estimates in the table below.

For example, there may be hotels, cargo facilities, logistics centres, offices, etc. located adjacent to the airport that are closely linked to the airport (sometimes characterised as airport city or aerotropolis).

Similarly, there may be corporate offices for your airport group located elsewhere in the country (if the corporate office are located adjacent to the airport, include this employment in the adjacent employment below).

Total Headcount:	**Airport Company**	**Third Party**
Adjacent – within the same town/city/area		
Elsewhere in the country		

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Addition Comments/Information:

If you have any additional comments or information you want to provide, please enter it in the box below.

Thank you for your assistance in completing this survey.

Please complete and return this survey by the 28th February, 2014.

Please return the completed survey electronically by clicking the [Submit Form] icon on the top right hand corner, or by email / fax to:

Email: acieurope.survey@intervistas.com

Fax: +44-1225-330-209, Attention: Ian Kincaid

If you have any questions, please call
Ian Kincaid at the following number: +44-208-144-1835

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Appendix D: Airports Providing Employment Data

Employment data was obtained for 125 airports in Europe, either through direct surveys or from publically available economic impact studies. The 125 airports are listed in **Figure D-1** below.

Figure D-1: List of Airports

Airport Name	Country
Tirana	Albania
Graz	Austria
Salzburg	Austria
Vienna	Austria
Brussels	Belgium
Brussels South Charleroi	Belgium
Liege	Belgium
Dubrovnik	Croatia
Split	Croatia
Prague Ruzyne	Czech Republic
Copenhagen Kastrup	Denmark
Tallinn	Estonia
Helsinki	Finland
Biarritz	France
Bordeaux Merignac	France
Lyon St-Exupery	France
Marseille Provence	France
Nice	France
Nimes	France
Paris Charles de Gaulle	France
Paris Le Bourget	France
Paris Orly	France
Toulouse	France
Berlin Schoenefeld	Germany
Berlin Tegel	Germany
Cologne/Bonn	Germany

Airport Name	Country
Duesseldorf	Germany
Frankfurt	Germany
Frankfurt Hahn	Germany
Friedrichshafen	Germany
Hamburg	Germany
Kassel	Germany
Leipzig/Halle	Germany
Munich	Germany
Stuttgart	Germany
Athens	Greece
Thessaloniki	Greece
Budapest	Hungary
Reykjavik Keflavik	Iceland
Cork	Ireland
Dublin	Ireland
Knock	Ireland
Bologna	Italy
Milan Malpensa	Italy
Milan Parma	Italy
Naples Capodichino	Italy
Turin Caselle	Italy
Vilnius	Lithuania
Luxembourg	Luxembourg
Malta	Malta
Amsterdam	Netherlands
Alesund	Norway
Alta	Norway
Bardufoss	Norway
Bergen	Norway
Bodo	Norway
Bronnoysund	Norway
Floro	Norway
Hammerfest	Norway

Airport Name	Country
Harstad-Narvik	Norway
Haugesund	Norway
Kirkenes	Norway
Kristiansand Kjevik	Norway
Kristiansund	Norway
Leknes	Norway
Longyearbyen	Norway
Mo I Rana	Norway
Molde	Norway
Orsta/Volda	Norway
Oslo Gardermoen	Norway
Sandnessjoen	Norway
Stavanger	Norway
Stokmarknes	Norway
Tromso	Norway
Trondheim Vaernes	Norway
Warsaw	Poland
Faro	Portugal
Funchal	Portugal
Lisbon	Portugal
Porto	Portugal
Santa Maria Island	Portugal
Arad	Romania
Bacau	Romania
Baia Mare	Romania
Bucharest Henri Coanda	Romania
Cluj-Napoca	Romania
Constanta	Romania
Craiova	Romania
Iasi	Romania
Oradea	Romania
Satu Mare	Romania
Sibiu	Romania

Airport Name	Country
Suceava	Romania
Timisoara	Romania
Moscow Domodedovo	Russia
Moscow Sheremetyevo	Russia
Bratislava	Slovakia
Ljubljana	Slovenia
Barcelona	Spain
Beja	Spain
Madrid Barajas	Spain
Valencia	Spain
Zaragoza	Spain
Stockholm Arlanda	Sweden
Geneva	Switzerland
Zurich	Switzerland
Gazipasa	Turkey
Istanbul Ataturk	Turkey
Aberdeen	United Kingdom
Belfast International	United Kingdom
Birmingham	United Kingdom
Bristol	United Kingdom
Edinburgh	United Kingdom
Glasgow	United Kingdom
Leeds Bradford	United Kingdom
Liverpool	United Kingdom
London City	United Kingdom
London Gatwick	United Kingdom
London Heathrow	United Kingdom
London Luton	United Kingdom
London Stansted	United Kingdom
Manchester	United Kingdom
Newcastle	United Kingdom
Nottingham East Midlands	United Kingdom
Southampton	United Kingdom

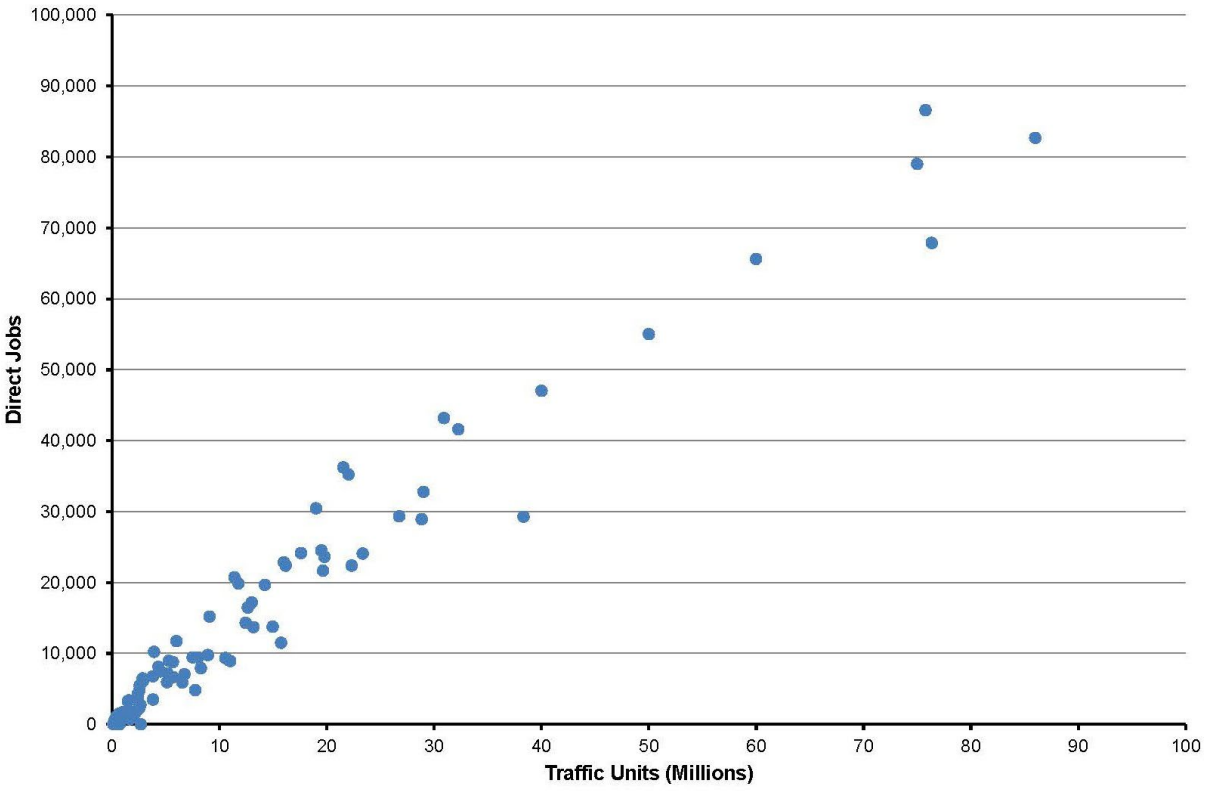
Appendix E: Inferring the Economic Impact of Non-Responding Airports

In total, employment information was collected on 125 airports, representing approximately 71% of air traffic in Europe. However, not all airports had been able to respond to the survey.

It was therefore necessary to estimate or infer the employment at the non-responding airports. In addition, it was required that the study cover European airports that were not ACI EUROPE members – the employment at these airports was also inferred, where no other information was available.

To infer the employment for these airports, econometric analysis was conducted of the airports from which data was collected to analyse the relationship between direct employment and characteristics of the airport. Unsurprisingly, there was a strong relationship between the volumes of traffic at the airport and its direct employment. This is illustrated in **Figure E-1**, which shows the relationship between traffic and direct employment at the responding airports. Traffic is measured in traffic units (or Work Load Units), a commonly-used standardised measure of traffic at airports, which combines passenger and cargo traffic. One (1) traffic unit equals one passenger or 100kgs of cargo.

Figure E-1: Airport Traffic and Direct Jobs at the Responding Airports



As can been seen, the relationship is very pronounced. Econometric analysis was undertaken to quantify the relationship between traffic units and employment, and to examine the impact of other possible variables. These other variables included:

- Dummy indicating whether the airport was a hub or not;
- Proportion of passengers connecting at the airport;
- Proportion of passengers using Low Cost Carriers (LCCs);
- Including additional variables to examine whether the relationship between traffic units and employment varied with airport size.

We note that the definition of LCCs can vary, and the boundary between LCCs and other types of carriers is becoming increasingly blurred. However, these airlines generally have lower fares and fewer amenities than network or legacy carriers. Although there is considerable variation in the business models, low cost carriers currently typically operate a single aircraft type (to reduce training and maintenance costs), do not offer first or business class travel, do not provide in-flight services such as meals and entertainment (or offer them at additional charge), and focus on point-to-point travel offering limited connecting options. For this analysis, LCCs were defined as those carriers that are members of the European Low Fares Airline Association (ELFAA): EasyJet, Ryanair, Jet2, flybe, Norwegian Air Shuttle, Sverige Flyg, Transavia Airlines, Vueling, Volotea and Whizz.[74]

The hub dummy variable found to be statistically insignificant and was dropped from the regression (the hub impact may be picked up in the connecting passengers variable, since connecting traffic is a key characteristic of hubs). The other variables were kept in the regression.

The resulting parameters estimated are shown in **Figure E-2**. The traffic unit parameter was split into three parts:

- Less than 1 million traffic units;
- 1 million to 10 million traffic units;
- Over 10 million traffic units.

The estimated traffic unit parameters show evidence of economies of scale: each additional 1000 traffic units for an airport less than 1 million traffic units increases employment by 1.2 jobs, whereas the same traffic increase for an airport of over 10 million traffic units increases employment by 0.85 jobs (a 29% reduction in the incremental employment growth).

[74] http://www.elfaa.com/members.htm as of April 2014

Figure E-2: Direct Employment Regression Results

Variable	Coefficient Estimate	Comment
Traffic Units: Less than 1 million Traffic Units	1.196 (7.1)	For airports with less than 1 million Traffic Units - each increase of 1000 Traffic Units increases employment by 1.2 Direct Jobs
Traffic Units:1 million - 10 million Traffic Units	0.952 (11.8)	For airports with 1-10 million Traffic Units - each increase of 1000 Traffic Units increases employment by 0.95 Direct Jobs
Traffic Units: Over 10 million Traffic Units	0.854 (23.7)	For airports with over 10 million Traffic Units - each increase of 1000 Traffic Units increases employment by 0.85 Direct Jobs
Connecting passengers	-0.03 (-3.9)	Connecting passengers generate 3% less direct jobs than origin/destination passengers
LCC passengers	-0.20 (-5.6)	LCC passengers generate 20% less direct jobs than non-LCC passengers
Adjusted R-Squared: 0.972		

The results also indicate that connecting passengers have a marginally smaller direct employment impact than origin/destination passengers, and that LCC traffic has a smaller economic impact than other types of traffic. The adjusted r-squared value is provided at the bottom of the table in **Figure E-2**. The adjusted r-squared provides an indicator as to how well the estimated regression equation explained the variation in the dependent variable (sometimes referred to as the statistical fit). A value of 1 would indicate that the regression equation perfectly explained the variation in the dependent variable, while a value close to zero would indicate that the regression equation was a poor fit. The adjusted r-squared value of this regression model, 0.972, indicates a high statistical fit.

It should be noted that these ratios do not attempt to find relationships between passenger numbers and the impact on total employment – in particular the impact upon catalytic impact. For example, connecting passengers may require a lower proportion of direct workers, but if connecting passengers allows the operation of routes which would otherwise not be viable, than this leads to an increase in traffic, which would not be factored into this ratio. Similarly, although LCC passengers also require less direct workers, LCC traffic has been for many airports and areas, the major if not sole provider of growth in recent years. In such cases this traffic has contributed to the catalytic impact of airports, which is again not captured in the ratios.

Appendix F: Deriving the Economic Impact Multipliers

As described in **Section 4.3**, the economic impact multipliers (indirect and induced) impacts were based on Input-Output (I-O) models of the national economies. These were obtained from multiple sources:

- For the 28 EU Member States, the Input-Output tables (the I-O model output) were sourced from Eurostat.[75]
- For Switzerland, the I-O tables were sourced from Office fédéral de la statistique.[76]
- For Israel, the I-O tables were sourced from the Israeli Central Bureau of Statistics.[77]

The I-O model output was used to estimate the direct, indirect and induced economic effects in this study. This approach has been widely accepted as the most comprehensive approach for the study of economic impact.

The Input-Output Model

The I-O model of an economy links the gross output of an industry to the final demand for that industry and to the intermediate demands made by other sectors for its output. **Figure F-1** illustrates the basic structure of the input-output model.

Figure F-1: A Highly Simplified Input-Output Accounting Framework

	Industries (Purchases)	Final Demand	Total Output
Industries (Sales)	Z	Y	X
Value-added (primary inputs)	V		
Total output	X		

[75] http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database.
[76] http://www.bfs.admin.ch/bfs/portal/fr/index/themen/04/02/01/dos/02.html.
[77] http://147.237.248.50/reader/?MIval=cw_usr_view_SHTML&ID=966.

Analytically, we have the following basic identity for sector *i*,

$$X_i = Z_{i1} + Z_{i2} + \cdots + Z_{in} + Y_i, \quad i = 1, \cdots, n. \quad (1)$$

In **Figure F-1**,

- The first row characterizes the "purchasing sectors" (purchasers), while the first column captures the "selling sectors" (sellers);
- Each data column under "Industries" represents the sales from other sectors to sector *i*; that is, sector *i*'s purchases of the products of various producing sectors in the economy. Hence the column represents the sources and magnitudes of sector *i*'s inputs.
- On the other hand, in engaging in production, a sector also pays for other items – for example, labor and capital – and uses other inputs as well, such as inventoried items. All of these together are termed the value-added in sector *i*. In addition, imported goods may be purchased as inputs by sector *i*. All of these inputs (value added and imports) are lumped together as purchases from what is called the payments sector (V_i in **Figure F-1**).

The net final demand (Y) is the sum of the following items:

- Private consumption;
- Government consumption expenditure;
- Gross capital formation;
- Change in stocks; and
- Exports.

The total value-added (V) is the sum of the following items:

- Imports of goods and services;
- Commodity taxes;
- Other indirect taxes;
- Remuneration; and
- Gross operating surplus.

In other words, referring back to **Figure F-1**, each row for sector i=1 to n records the sales of that sector's output to other industrial sectors in the economy plus sales to private consumers, government, capital formation, inventory and overseas purchasers. Each column for sector i=1 to n records the purchases of production inputs for that sector in order to produce its total output. This includes purchases from other sectors of the economy, purchases of imports, payment for labour, payment of government taxes, and generation of profits.

Input-Output Coefficients

Input-output table becomes an economic tool when Leontief introduced an assumption of fixed-coefficient linear production functions related to input used by a sector along each column to its output flow, i.e. for one unit of every industry's output, a fixed amount of input of each kind is required.[78] That is, we define the following coefficients:

$$a_{ij} = \frac{Z_{ij}}{X_j}.$$

This ratio is termed a technical coefficient, commonly known as input-output coefficient or direct input coefficient. With this specification of production technology, the model basically assumes that the industry shows constant returns to scale, which is a reasonable approximation in short-run, but nevertheless is also a limitation of the model.

Once the notion of a set of fixed input-output coefficients is accepted, the system of equations (1) can be represented as follows:

$$X_i = a_{i1}X_1 + a_{i2}X_2 + \cdots + a_{in}X_n + Y_i, \quad i = 1,\cdots,n. \quad (2)$$

This leads to the matrix representation:

$$\boldsymbol{X} = \boldsymbol{A}\,\boldsymbol{X} + \boldsymbol{Y} \qquad (3)$$

Hence, with the net final demand vector ***Y***, we can solve for the output vector, via matrix inverse as follows:

$$\boldsymbol{X} = (\mathbf{I} - \boldsymbol{A})^{-1}\,\boldsymbol{Y} \qquad (4)$$

where **I** stands for the identity matrix. And the matrix $(\mathbf{I} - \boldsymbol{A})^{-1}$ is the Leontief inverse coefficients. These measure the total amount of output in each sector that is required to be produced in order to satisfy the direct and indirect demands produced by one unit increase in the final demand for a given sector (i.e. the direct + indirect multiplier). The economic interpretation of the Leontief inverse coefficients is consistent with the derivation of the Keynesian multipliers (e.g. expenditure multiplier) that are commonly used in macroeconomics. In other words, it can be interpreted as a result of successive rounds of iterations. An important implication of this connection with the Keynesian multiplier is that the inverse coefficients capture both direct and indirect effects of the final demand from all sectors identified in the I-O table. In practice the multipliers from I-O tables are usually expressed in values so that coefficients measure the requirements in dollars on sector i when sector j increases its final demand by one dollar.

[78] See Leontief, Wassily W. Input-Output Economics. 2nd ed., New York: Oxford University Press, 1986.

Indirect and Induced Impacts - Open System and Closed System

The economic impact multipliers are expressed as ratios that measure the impact on the total economy as a result of an initial autonomous change in any of the final demand components. The action of the multiplier can be illustrated by the sequence of events that follows after the initial autonomous change. Different kinds of multiplier can be generated depending on the purpose of analysis. The common multipliers used are output, value-added, employment, and income multipliers. For comparative purposes, multipliers are usually expressed with respect to a unit of autonomous change in final demand.

Open Model: Direct and Indirect Impacts

Each of the multipliers listed above can be generated from two different models: *open* and *closed*. The intrinsic difference between them is the treatment of household income and personal consumption expenditure. In the *open* model, all final demand components are assumed to be exogenous. Hence the *open* model captures the production-induced effects resulting from a change in final demand. The multipliers generated using the open model are also known as simple multipliers or Leontief multipliers. This kind of model is described as *open* because at each round of the multiplier process, there is leakage from the system. The leakage consists of payments for imports and primary inputs and the recipients are assumed to make no use of their receipts. Even if a small part of the receipts were spent on goods and services, there would be further multiplier repercussions. In our analysis, Leontief multipliers capture the direct and indirect effects of an autonomous change in final demand.

Closed Model: Direct, Indirect and Induced Impacts

Conversely, in the *closed* model, the household sector is treated as endogenous to the system. The household sector receiving income from the work done in the production process would spend some of this income on local products. This increase in consumption would in turn increase the level of output of the products. In other words, the *closed* model accounts for both the production-induced effects as well as the consumption-induced effects. The multipliers generated using the *closed* model are commonly known as the total multipliers or Leontief-Keynes multipliers. In our analysis, Leontief-Keynes multipliers will capture the direct, the indirect AND the induced effects.

The total multiplier from the closed model is by definition larger than the simple multiplier from open model. The difference between the two multipliers is the induced impact.

Appendix G: Additional Breakdowns of the Economic Impacts

This appendix provides a detailed breakdown of direct, indirect, induced and catalytic impacts by country for each of the ACI EUROPE member nations.

- **Figure G-1** provides GDP impacts in millions of Euros.
- **Figure G-2** provides GDP impacts as a percentage of national GDP.
- **Figure G-3** provides employment numbers.
- **Figure G-4** provides employment per capita (i.e. by dividing by national population).
- **Figure G-5** provides income from employment in millions of Euros.

Figure G-1: GDP Impacts by Country (€ Millions)

Country	Direct	Indirect	Induced	Catalytic	Total
Albania	16	15	13	170	214
Austria	1,699	1,121	1,171	6,927	10,918
Belarus	31	29	27	1,438	1,526
Belgium	1,963	1,868	1,880	8,948	14,659
Bosnia & Herzegovina	14	13	12	156	194
Bulgaria	105	98	90	1,251	1,544
Croatia	129	89	77	1,645	1,941
Cyprus	317	165	163	1,175	1,821
Czech Republic	773	638	471	3,239	5,121
Denmark	2,620	1,514	1,762	7,586	13,483
Estonia	68	77	44	220	409
Finland	1,425	1,014	967	4,726	8,133
France	12,404	7,267	10,791	51,142	81,604
Macedonia	15	14	13	237	279
Georgia	31	29	27	-	87
Germany	16,622	10,666	11,698	60,269	99,255
Greece	1,956	1,070	917	9,938	13,881
Hungary	223	162	137	1,036	1,559
Iceland	161	125	123	640	1,049
Ireland	2,203	1,147	1,156	4,893	9,400
Israel	792	411	682	5,494	7,379
Italy	6,731	6,303	4,560	39,094	56,688
Latvia	107	90	59	515	770
Lithuania	86	72	47	665	869
Luxembourg	965	568	661	1,172	3,366
Malta	208	80	82	292	662
Moldova	19	18	17	-	54
Montenegro	29	27	24	74	153
Netherlands	5,416	3,945	4,145	13,697	27,202
Norway	2,709	2,072	2,182	8,332	15,295
Poland	617	437	374	13,349	14,776
Portugal	1,221	958	935	7,464	10,578
Romania	272	183	132	4,135	4,723
Russia	5,954	4,821	3,679	22,673	37,126
Serbia	73	68	62	805	1,007
Slovakia	89	64	56	2,013	2,221
Slovenia	78	74	54	1,040	1,246
Spain	7,187	5,598	7,894	39,648	60,328
Sweden	3,498	1,976	2,338	10,397	18,210
Switzerland	4,342	3,660	3,614	10,036	21,652
Turkey	3,530	2,440	1,801	36,269	44,041
Ukraine	238	225	204	2,420	3,087
United Kingdom	14,677	8,513	11,297	41,525	76,012
Total	**101,614**	**69,724**	**76,440**	**426,745**	**674,522**

Note: Catalytic impacts for Georgia and Moldova not available. Numbers may not add up due to rounding.

Figure G-2: GDP Impacts as a Percentage of National GDP by Country

Country	Direct	Indirect	Induced	Catalytic	Total
Albania	0.2%	0.2%	0.1%	1.8%	2.2%
Austria	0.5%	0.4%	0.4%	2.2%	3.5%
Belarus	0.1%	0.1%	0.1%	3.1%	3.3%
Belgium	0.5%	0.5%	0.5%	2.3%	3.8%
Bosnia & Herzegovina	0.1%	0.1%	0.1%	1.3%	1.6%
Bulgaria	0.3%	0.2%	0.2%	3.1%	3.9%
Croatia	0.3%	0.2%	0.2%	3.8%	4.5%
Cyprus	1.9%	1.0%	1.0%	7.1%	11.0%
Czech Republic	0.5%	0.4%	0.3%	2.2%	3.4%
Denmark	1.1%	0.6%	0.7%	3.0%	5.4%
Estonia	0.4%	0.4%	0.2%	1.2%	2.2%
Finland	0.7%	0.5%	0.5%	2.4%	4.2%
France	0.6%	0.4%	0.5%	2.5%	4.0%
Macedonia	0.2%	0.2%	0.2%	3.4%	4.0%
Georgia	0.3%	0.3%	0.2%	-	0.8%
Germany	0.6%	0.4%	0.4%	2.2%	3.6%
Greece	1.1%	0.6%	0.5%	5.5%	7.6%
Hungary	0.2%	0.2%	0.1%	1.1%	1.6%
Iceland	1.5%	1.1%	1.1%	5.8%	9.5%
Ireland	1.3%	0.7%	0.7%	3.0%	5.7%
Israel	0.4%	0.2%	0.3%	2.7%	3.7%
Italy	0.4%	0.4%	0.3%	2.5%	3.6%
Latvia	0.5%	0.4%	0.3%	2.2%	3.3%
Lithuania	0.2%	0.2%	0.1%	1.9%	2.5%
Luxembourg	2.1%	1.2%	1.5%	2.6%	7.4%
Malta	2.9%	1.1%	1.1%	4.1%	9.2%
Moldova	0.4%	0.3%	0.3%	-	1.0%
Montenegro	0.9%	0.9%	0.8%	2.4%	5.0%
Netherlands	0.9%	0.7%	0.7%	2.3%	4.5%
Norway	0.7%	0.5%	0.6%	2.2%	4.0%
Poland	0.2%	0.1%	0.1%	3.4%	3.8%
Portugal	0.7%	0.6%	0.6%	4.5%	6.4%
Romania	0.2%	0.1%	0.1%	2.9%	3.3%
Russia	0.4%	0.3%	0.2%	1.4%	2.4%
Serbia	0.2%	0.2%	0.2%	2.5%	3.1%
Slovakia	0.1%	0.1%	0.1%	2.8%	3.1%
Slovenia	0.2%	0.2%	0.2%	2.9%	3.5%
Spain	0.7%	0.5%	0.8%	3.9%	5.9%
Sweden	0.8%	0.5%	0.6%	2.5%	4.3%
Switzerland	0.9%	0.7%	0.7%	2.0%	4.4%
Turkey	0.6%	0.4%	0.3%	5.9%	7.1%
Ukraine	0.2%	0.2%	0.2%	1.9%	2.4%
United Kingdom	0.8%	0.4%	0.6%	2.2%	4.0%
Total	**0.6%**	**0.4%**	**0.5%**	**2.6%**	**4.1%**

Note: Catalytic impacts for Georgia and Moldova not available. Numbers may not add up due to rounding.

Figure G-3: Employment Impacts by Country

Country	Direct	Indirect	Induced	Catalytic	Total
Albania	1,000	1,200	1,300	16,600	20,100
Austria	24,000	16,700	15,000	73,700	129,400
Belarus	2,100	2,500	2,600	69,400	76,600
Belgium	31,100	27,700	24,100	88,800	171,700
Bosnia & Herzegovina	900	1,100	1,100	10,200	13,300
Bulgaria	6,900	8,300	8,700	112,200	136,100
Croatia	4,900	3,900	4,000	53,900	66,700
Cyprus	8,000	4,800	4,900	35,000	52,700
Czech Republic	16,800	18,500	15,200	87,100	137,600
Denmark	29,600	19,700	20,200	84,200	153,700
Estonia	2,500	3,100	1,900	7,200	14,700
Finland	17,200	15,100	11,900	64,600	108,800
France	168,800	113,100	147,500	712,500	1,141,900
Macedonia	1,000	1,200	1,300	14,800	18,300
Georgia	2,100	2,500	2,600	-	7,200
Germany	220,500	147,600	153,900	745,400	1,267,400
Greece	36,500	27,100	25,100	271,700	360,400
Hungary	8,200	6,900	7,100	43,300	65,500
Iceland	3,500	2,200	2,200	11,800	19,700
Ireland	20,100	13,400	16,200	70,800	120,500
Israel	16,800	12,800	14,100	99,100	142,800
Italy	120,500	106,400	84,900	568,900	880,700
Latvia	4,200	4,200	3,500	19,600	31,500
Lithuania	3,400	3,300	2,800	24,800	34,300
Luxembourg	11,000	7,400	7,700	9,100	35,200
Malta	3,800	2,100	2,300	7,100	15,300
Moldova	1,300	1,500	1,600	-	4,400
Montenegro	1,900	2,200	2,400	6,500	13,000
Netherlands	81,000	60,300	55,400	173,800	370,500
Norway	27,700	19,000	17,100	58,800	122,600
Poland	23,100	18,800	19,200	379,300	440,400
Portugal	30,000	26,200	28,000	204,100	288,300
Romania	13,600	12,400	10,800	115,600	152,400
Russia	128,600	140,200	118,800	550,100	937,700
Serbia	4,800	5,700	6,000	52,000	68,500
Slovakia	2,500	2,300	1,800	41,100	47,700
Slovenia	1,900	2,100	1,600	27,200	32,800
Spain	146,500	113,600	178,800	895,800	1,334,700
Sweden	40,400	25,900	26,800	114,900	208,000
Switzerland	44,500	33,500	28,200	78,300	184,500
Turkey	168,600	163,100	145,300	979,900	1,456,900
Ukraine	15,200	18,600	19,900	234,600	288,300
United Kingdom	199,200	134,900	157,300	679,700	1,171,100
Total	**1,696,200**	**1,353,100**	**1,401,100**	**7,893,500**	**12,343,900**

Note: Catalytic impacts for Georgia and Moldova not available. Numbers may not add up due to rounding.

Figure G-4: Employment Impacts per 1000 Head of Population by Country

Country	Direct	Indirect	Induced	Catalytic	Total
Albania	0.4	0.4	0.5	6.0	7.2
Austria	2.8	2.0	1.8	8.7	15.3
Belarus	0.2	0.3	0.3	7.3	8.1
Belgium	2.8	2.5	2.2	7.9	15.3
Bosnia & Herzegovina	0.2	0.3	0.3	2.7	3.5
Bulgaria	0.9	1.1	1.2	15.4	18.7
Croatia	1.2	0.9	0.9	12.7	15.7
Cyprus	7.0	4.2	4.3	30.7	46.2
Czech Republic	1.6	1.8	1.4	8.3	13.1
Denmark	5.3	3.5	3.6	15.0	27.4
Estonia	1.9	2.3	1.4	5.4	11.1
Finland	3.2	2.8	2.2	11.9	20.0
France	2.6	1.7	2.2	10.8	17.3
Macedonia	0.5	0.6	0.6	7.0	8.7
Georgia	0.5	0.6	0.6	-	1.6
Germany	2.7	1.8	1.9	9.2	15.7
Greece	3.3	2.5	2.3	24.6	32.7
Hungary	0.8	0.7	0.7	4.4	6.6
Iceland	10.8	6.8	6.8	36.5	61.0
Ireland	4.4	2.9	3.5	15.4	26.2
Israel	2.1	1.6	1.7	12.3	17.7
Italy	2.0	1.8	1.4	9.5	14.7
Latvia	2.1	2.1	1.7	9.7	15.6
Lithuania	1.2	1.1	0.9	8.4	11.6
Luxembourg	20.3	13.6	14.2	16.8	64.8
Malta	9.0	5.0	5.4	16.8	36.1
Moldova	0.4	0.4	0.4	-	1.2
Montenegro	3.1	3.5	3.9	10.5	20.9
Netherlands	4.8	3.6	3.3	10.3	22.0
Norway	5.4	3.7	3.4	11.6	24.1
Poland	0.6	0.5	0.5	9.8	11.4
Portugal	2.9	2.5	2.7	19.5	27.6
Romania	0.7	0.6	0.5	5.8	7.6
Russia	0.9	1.0	0.8	3.8	6.5
Serbia	0.7	0.8	0.8	7.3	9.6
Slovakia	0.5	0.4	0.3	7.6	8.8
Slovenia	0.9	1.0	0.8	13.2	15.9
Spain	3.1	2.4	3.8	19.2	28.6
Sweden	4.2	2.7	2.8	12.0	21.7
Switzerland	5.5	4.1	3.5	9.7	22.8
Turkey	2.3	2.2	1.9	13.1	19.4
Ukraine	0.3	0.4	0.4	5.2	6.3
United Kingdom	3.1	2.1	2.5	10.6	18.3
Total	**2.1**	**1.6**	**1.7**	**9.6**	**14.9**

Note: Catalytic impacts for Georgia and Moldova not available. Numbers may not add up due to rounding.

Figure G-5: Income Impacts by Country (€ Millions)

Country	Direct	Indirect	Induced	Catalytic	Total
Albania	9	7	5	68	90
Austria	1,207	731	555	3,286	5,779
Belarus	19	14	11	573	617
Belgium	1,507	1,194	947	4,508	8,156
Bosnia & Herzegovina	8	6	5	62	81
Bulgaria	64	47	36	499	645
Croatia	110	45	37	781	974
Cyprus	230	84	73	528	915
Czech Republic	461	290	218	1,499	2,467
Denmark	1,571	863	831	3,579	6,844
Estonia	45	42	22	109	217
Finland	957	650	488	2,384	4,479
France	8,733	5,252	6,035	28,600	48,621
Macedonia	9	7	5	94	115
Georgia	19	14	11	-	43
Germany	10,552	5,478	5,465	28,158	49,653
Greece	1,145	588	438	4,743	6,914
Hungary	196	81	65	492	835
Iceland	118	65	61	316	560
Ireland	960	573	577	2,441	4,551
Israel	490	318	300	2,415	3,523
Italy	4,789	3,066	2,249	19,277	29,381
Latvia	59	36	24	210	329
Lithuania	47	29	19	270	365
Luxembourg	593	325	314	557	1,788
Malta	121	45	39	139	345
Moldova	12	9	7	-	27
Montenegro	17	13	10	29	69
Netherlands	4,039	2,209	2,018	6,670	14,936
Norway	2,445	1,255	1,046	3,994	8,739
Poland	534	221	177	6,336	7,268
Portugal	890	476	420	3,350	5,136
Romania	162	83	51	1,579	1,875
Russia	3,650	2,214	1,703	10,494	18,061
Serbia	44	32	25	321	422
Slovakia	56	28	20	718	823
Slovenia	57	44	27	528	657
Spain	5,618	3,792	5,242	26,326	40,978
Sweden	2,093	1,137	1,103	4,903	9,236
Switzerland	3,925	2,202	1,732	4,812	12,670
Turkey	2,189	1,105	678	13,643	17,614
Ukraine	146	106	81	965	1,298
United Kingdom	8,632	5,165	5,232	19,231	38,259
Total	**68,531**	**39,939**	**38,398**	**209,487**	**356,355**

Note: Catalytic impacts for Georgia and Moldova not available. Numbers may not add up due to rounding.

Appendix H: The IATA Air Connectivity Index

Chapter 8 describes econometric analysis undertaken to examine the relationship between air connectivity and economic growth in Europe, as a means to calculating the catalytic impact of airports. In order to do so, a measure of connectivity developed by IATA was used in the analysis. This is described in the section below.

Connectivity can be seen not simply as a matter of the number of routes or number of frequencies operated. Connectivity is fundamentally about access to markets and regions. A country or region that has continental and intercontinental linkages only to a limited number of destinations will be a less desirable place to do business. Travel costs for staff and for goods will be higher due to the need to purchase multiple flight legs to move people and goods. On the other hand, a community with direct access to a broad range of markets, especially the fastest growing markets, will be a lower cost place to do business. It will also enhance customer servicing and goods and support staff can easily and quickly get to a range of destinations.

To capture this, the International Air Transport Association (IATA) has developed a measure of air service connectivity which aims to measure the quality of the air transport network from the point of view of the country's economy. The IATA connectivity index seeks to measure the scope of access between an individual airport, region or country, and the global economy. The index measures the number and size (in terms of passenger air traffic) of destinations served, as well as the frequency of service to each destination and the number of onward connections available from those destinations. Thus, the index recognises that connections to major global gateways provide greater global connectivity than connections to the same number of spoke ends. For example, direct service to 40 small regional destinations does not have the same importance as direct connections to 40 major global markets.

The IATA index is calculated from airline schedule data for passenger services and is based on both domestic and international services. The connectivity index measures the number of frequencies and available seats to a particular destination. It then weights the number of available seats by the size of the destination airport (in terms of number of passengers handled in each year). This weighting reflects both the size and economic importance of the destination and the potential for convenient onward connections.

For example, in 2013, Atlanta airport was the world's largest airport and so was given a weighting of one. London Heathrow, which handles 80% of the number of passengers handled by Atlanta, was given a weighting of 0.80. Therefore, if an airport has 1,000 seats available to Atlanta it is given a weighted total of 1000. But if it also has 1,000 seats available to London Heathrow, these are only given a weighted total of 800. The weighted totals are then summed for all destinations (and divided by a scalar factor of 1,000) to determine the connectivity indicator.

The connectivity index is therefore calculated as:

$$\frac{[\text{Number of destinations} \times \text{Weekly Frequency} \times \text{Seats per flight}]\ \text{Weighted by the Size of the Destination Airport}}{\text{Scalar factor of 1000}}$$

A higher figure for the connectivity indicator denotes a greater degree of access to the global air transport network. **Figure H-1** demonstrates how the connectivity index reflects the importance of not only serving a large number of destinations, but serving destinations that are global hubs and the ability to access a large number of onward connections. London Heathrow had the highest connectivity score in 2013 despite it not serving the highest number of destinations (Frankfurt served the most, with 108 more than Heathrow; a number of other airports also served more destinations than Heathrow). Because Heathrow serves more of the major gateway destinations and with higher frequencies, its index of connectivity is higher than that of any other airport.

Figure H-1: Top 10 Airports in Europe Based on the IATA Connectivity Index (2013)

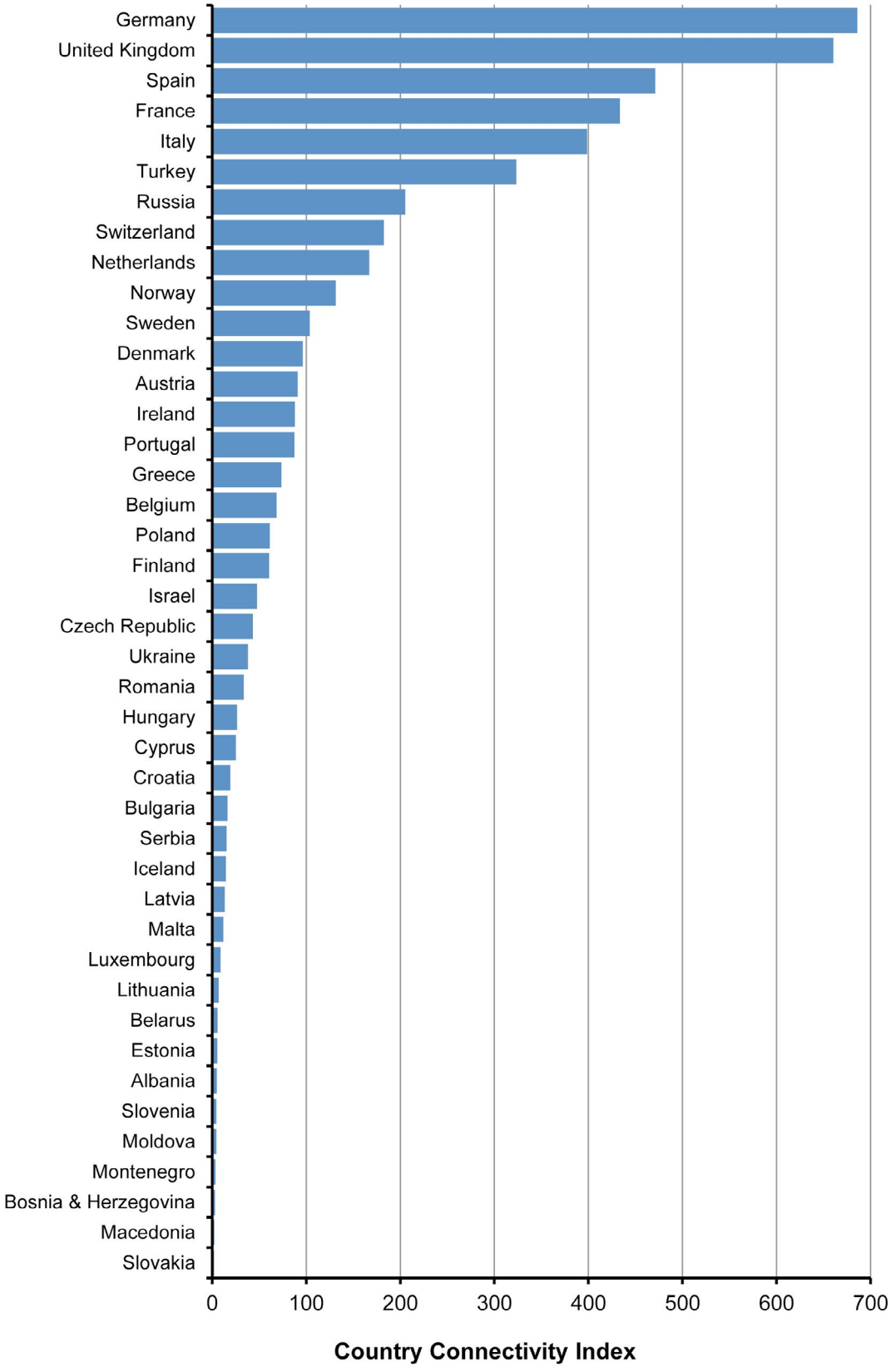
Airport	Number of Destinations Served	Total Passenger Movements (millions)	Connectivity Index
1. London Heathrow	173	72.4	306
2. Frankfurt	281	58.0	205
3. Paris CDG	249	62.3	199
4. Amsterdam	255	52.6	157
5. Munich	218	38.7	132
6. Madrid	172	39.7	120
7. Istanbul	233	51.3	110
8. Rome	197	36.2	106
9. Zurich	146	24.9	104
10. Barcelona	190	35.2	102

Source: InterVISTAS Analysis Based on Diio Mi Schedule Data.

For this study, the connectivity measure has been estimated for all the European countries from 2000 to 2013 by summing the connectivity indexes of the individual airports in each country. To illustrate the relative connectivity of these countries, **Figure H-2** presents the connectivity measures for each of these countries in 2013[79]. As can be seen, Germany has the highest connectivity score, following by the UK, Spain, France and Italy.

[79] Note that for the purposes of estimating the catalytic impact, connectivity per capita is used.

Figure H-2: Connectivity Index of Europe, 2013



Appendix I: Econometric Analysis of Catalytic Impacts

This appendix provides additional technical detail on the econometric analysis of catalytic impacts described in **Chapter 8**.

Data Sources

A list of the variables used in the econometric analysis and the underlying data sources is presented in **Figure I-1**. As much as possible, data was collected for all the countries in the study, covering the time period of 2000-2012.

Figure I-1: Data and Data Sources

Variable	Source	Original Units	Time Frequency	Summary
GDP Per Capita (Constant PPP)	The World Bank, World Development Indicators	Constant 2005 US$	Annual	GDP per capita of each country, converted to U.S. dollars
GDP (Constant Prices)	The World Bank, World Development Indicators	Constant 2005 US$	Annual	GDP of each country, converted to U.S. dollars
Connectivity Index	Diio Mi Airline Schedule Data		Annual	Derived from InterVISTAS analysis of schedule data.
Connectivity Index/GDP	Diio Mi Airline Schedule Data		Annual	Derived from InterVISTAS analysis of schedule data.
Education Spend	The World Bank, World Development Indicators	Constant 2005 US$	Annual	Calculated by multiplying education spend as a % of GDP by GDP (Constant Prices)

Variable	Source	Original Units	Time Frequency	Summary
R&D Spend	The World Bank, World Development Indicators	Constant 2005 US$	Annual	Calculated by multiplying R&D spend as a % of GDP by GDP (Constant Prices)
Gross Capital Formation per Worker	The World Bank, World Development Indicators and The Conference Board Total Economy Database	Constant 2005 US$ per Worker	Annual	Calculated by multiplying gross capital formation as a % of GDP by GDP (Constant Prices), then dividing by total number of workers
Population	The World Bank, World Development Indicators	Persons	Annual	Total population
Jet Fuel Price	U.S. Energy Information Administration	U.S. Dollars per Gallon	Annual	U.S. Gulf Coast Kerosene - Type Jet Fuel spot price
Airport Investment	OECD Statistics	Constant Euros	Annual	Total investment in airport infrastructure

Model Specification

To investigate the relationship between connectivity and Gross Domestic Product (GDP) (aviation's contribution to growth), econometric analysis of the data was undertaken. A number of different model specifications were tested. The sub-sections below describe the broad set of models employed in this analysis, as well as the results of the preferred regression for each model.

Ordinary Least Squares

Ordinary Least Squares (OLS) regression analysis is the method used to relate economic growth to connectivity and other variables that might be expected to have an impact on economic growth. The regression analysis allows the relationship between economic growth and connectivity to be isolated and quantified while controlling for other factors that may impact economic growth, such as education levels, research and development, capital spending, etc. The regression analysis, used data from 40 countries over 12 years. Various model formulations were estimated, and the final model used a log-log formulation, as follows: [80]

$$\ln(GDP\ per\ Capita) = Constant + \beta_1 \ln(Connectivity\ /\ GDP) + \beta_2 \ln(Education\ Spend) + \beta_3 \ln(R\&D\ Spend) + \beta_4 \ln(GCF\ per\ Worker) + \beta_5 \cdot Country\ Dummies + \beta_6 \cdot Time\ Dummies$$

Where:

- GDP per Capita is the dependent variable, fixed US$, converted at purchasing power parity.
- Connectivity / GDP is the calculated IATA connectivity measure divided by national GDP.
- Education Spend is the amount of public spending on all levels of education.
- R&D Spend is the amount of research and development (R&D) spending in the country.
- GCF per Worker is Gross Capital Formation (GCF) per worker. GCF is a measure of the net new investment by enterprises in the domestic economy in fixed capital assets, less disposals of fixed assets. It is measure of the flow of capital investment rather than the total stock of capital investment.[81] GCF per worker is a measure of the change in capital deepening occurring in each country.
- The country dummies capture any remaining structural reasons for economic growth differences between countries.
- The time dummies capture any remaining reasons for economic growth differences between years.

The regression analysis estimates the value of the parameters (constant, β_1, β_2, β_3, β_4, β_5, β_6) on each of the variables, which reflect the relative impact of each of the variables on economic growth. As the model is a log formulation, the parameters can be interpreted as elasticities.

[80] Log-log model formulations refer to a model specification where both the dependent (left hand side) and independent (right hand side) variables have been transformed by the natural logarithm.
[81] Measuring the total value of fixed capital stock of a country is complex and problematic. There is very little reliable data on national capital stock, and its coverage is limited to a small number of countries.

The results of the preferred regression specification are provided in **Figure I-2**. Along with the coefficient estimate, the table provides the standard error of the estimate and the t-statistic. The t-statistic is calculated as the coefficient estimate divided by the standard error, and gives an indication of whether the estimated coefficient is significantly different from zero or, in other words, whether the variable to which the coefficient applies had any measurable impact on the dependent variable. Broadly speaking, absolute t-statistics above two (2) indicate that the estimated coefficient has a measureable impact, at the 95% confidence level.

The adjusted r-squared value is provided at the bottom of the table in **Figure I-2**. The adjusted r-squared provides an indicator as to how well the estimated regression equation explained the variation in the dependent variable (sometimes referred to as the statistical fit). A value of 1 would indicate that the regression equation perfectly explained the variation in the dependent variable, while a value close to zero would indicate that the regression equation was a poor fit. The adjusted r-squared value of this regression model, 0.993, indicates a high statistical fit due, in part, to the inclusion of country and time specific dummies.

The coefficient estimate on Connectivity/GDP is positive, which indicates the relationship between connectivity and GDP is positive (as one increases, so does the other); the coefficient estimate of 0.05 is also statistically significant at the 99% confidence level. The coefficient estimate suggests that a 10% increase in connectivity (relative to GDP) increases economic growth (measured as GDP per capita) by 0.5%.

The other independent variables were also positive and statistically significant at the 99% confidence level. The coefficient on education spend indicates that a 1% increase in education spending increases economic growth by 0.13%. The coefficient on R&D spending indicates that a 1% increase in R&D spending increases economic growth by 0.07%. Lastly, the impact of increasing GCF per worker (increasing capital spending) by 1% is an increase in economic growth of 0.24%.

Figure I-2: OLS Regression Analysis of GDP and Connectivity

Variable	Coefficient Estimate	Standard Error	T-Statistic
Constant	1.379	0.729	1.89
Connectivity / GDP	0.054	0.011	5.07
Education Spend	0.134	0.028	4.79
R&D Spend	0.067	0.015	4.52
GCF per Worker	0.239	0.014	17.65
Country Dummies			
Albania	0.828	0.176	4.70
Austria	0.622	0.061	10.14
Belarus	0.664	0.119	5.60
Belgium	0.488	0.055	8.87
Bulgaria	0.804	0.132	6.08
Croatia	0.768	0.121	6.35
Cyprus	1.317	0.143	9.19
Czech Republic	0.733	0.089	8.23
Denmark	0.517	0.058	8.92
Estonia	1.129	0.145	7.78
Finland	0.609	0.069	8.84
France	-0.082	0.020	-4.00
Greece	0.619	0.083	7.46
Hungary	0.550	0.091	6.06
Iceland	1.354	0.136	9.99
Ireland	0.841	0.080	10.58
Israel	0.594	0.075	7.91
Italy	0.031	0.028	1.09
Latvia	0.973	0.145	6.72
Lithuania	0.987	0.128	7.72
Luxembourg	2.004	0.131	15.35
Macedonia	1.112	0.180	6.19

Variable	Coefficient Estimate	Standard Error	T-Statistic
Malta	1.620	0.173	9.35
Netherlands	0.496	0.044	11.36
Norway	0.811	0.062	13.11
Poland	0.223	0.065	3.46
Portugal	0.518	0.077	6.72
Romania	0.375	0.102	3.66
Russia	-0.060	0.046	-1.32
Serbia	0.657	0.131	5.02
Slovak Republic	0.904	0.113	8.02
Slovenia	1.108	0.116	9.51
Spain	0.089	0.039	2.30
Sweden	0.474	0.050	9.57
Switzerland	0.596	0.057	10.45
Turkey	-0.024	0.065	-0.36
UK	0.053	0.021	2.53
Ukraine	-0.031	0.092	-0.34
Year Dummies			
2001	0.013	0.011	1.17
2002	0.033	0.012	2.89
2003	0.041	0.012	3.45
2004	0.052	0.012	4.27
2005	0.054	0.013	4.26
2006	0.060	0.013	4.56
2007	0.075	0.014	5.50
2008	0.076	0.014	5.28
2009	0.087	0.015	5.99
2010	0.083	0.015	5.70
2011	0.086	0.015	5.87
2012	0.089	0.015	6.03
Adjusted R-squared: 0.993			

The OLS regression analysis above demonstrates a correlation between air connectivity and GDP per capita but it does not necessarily demonstrate causality. Does air connectivity growth increase GDP per capita or does GDP growth increase air connectivity, or do both effects arise? To some extent, dividing by GDP controls for the influence of economic growth on connectivity, therefore allowing for analysis of the contribution of connectivity to GDP growth. However, in order to address this issue more rigorously, further analysis was undertaken.

Granger Causality Analysis

Granger causality analysis is a technique used to determine whether one time-series is useful for forecasting another series. A time series X is said to Granger Cause Y if it can be shown, usually through a series of F-tests on lagged values of X (and with lagged values of Y also known), that those X values provide statistically significant information on future values of Y.

The test works by first conducting a regression of Y on lagged values of Y and lagged values of X. In this, the restriction is tested whether all the lagged values of X can be dropped from the regression. These steps are then repeated for the reverse relationship. The researcher is often looking for a clear story, such as Y granger-causes X, but not the reverse. In the real world, often, difficult results are found such as neither granger-causes the other, or that each granger-causes the other.

For example, the two models tested would be as follows:

$$Y_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=1}^{m} \beta_j X_{t-j} + D_t + \varepsilon_t$$

and

$$X_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=1}^{m} \beta_j X_{t-j} + D_t + \varepsilon_t$$

Testing for granger causality is simply testing whether or not the coefficients of the independent variables in each equation are zero, i.e. all the β_j=0 in the first equation and all the α_i=0 in the second equation.

The analysis involves the calculation of an F-test statistic based on the residual sum of squares (RSS) of the two regressions incorporating lagged values of X and Y:

$$F - Test = \frac{(RSS_0 - RSS_1)/p}{RSS_1/(T - 2p - 1)}$$

Where:

- RSS_0 is the residual sum of squares produced by a regression of Y on the lagged values of Y and the lagged values of X.
- RSS_1 is the residual sum of squares produced by a regression of X on the lagged values of Y and the lagged values of X.
- p is the number of lagged terms incorporated into the regression.
- T is the number of observations.

The null hypothesis is that there is no granger causality, so rejecting the null hypothesis implies granger causality is present.

The Granger analysis used the model formulation presented in **Chapter 8** and added lagged values of connectivity and GDP per capita. In the analysis the final two models tested used a log-log formulation, as follows:

1. $$\ln(Connectivity\ /\ GDP) = Constant + \alpha_1 \ln(GDP\ per\ Capita)_{t-1} + \beta_1 \ln(Connectivity\ /\ GDP)_{t-1} + \beta_2 \ln(Education\ Spend)_{t-1} + \beta_3 \ln(R\&D\ Spend)_{t-1} + \beta_4 \ln(GCF\ per\ Worker)_{t-1} + \beta_5 \cdot Country\ Dummies + \beta_6 \cdot Time\ Dummies$$

2. $$\ln(GDP\ per\ Capita) = Constant + \alpha_1 \ln(GDP\ per\ Capita)_{t-1} + \beta_1 \ln(Connectivity\ /\ GDP)_{t-1} + \beta_2 \ln(Education\ Spend)_{t-1} + \beta_3 \ln(R\&D\ Spend)_{t-1} + \beta_4 \ln(GCF\ per\ Worker)_{t-1} + \beta_5 \cdot Country\ Dummies + \beta_6 \cdot Time\ Dummies$$

Equation 1 regresses *Connectivity/GDP* on lagged values of GDP per Capita and Connectivity/GDP while equation 2 regresses *GDP per capita* on lagged values of GDP per Capita and Connectivity/GDP.

The output, taken from statistical software package *stata*, is provided in **Figures I-3 to I-6**. Both fixed effects and random effects models were estimated, with similar results. The critical parameter is the F-test highlighted in red at the bottom of the output (or Chi-test in the case of the random effects models).

In the case where connectivity/GDP is the dependent variable, there was weak evidence that lagged GDP per capita had explanatory power. For example, the F-test in **Figure G-4** was 2.38, indicating that the lagged GDP per capita was significant at around the 88% confidence level, slightly below the statistical standard of 90% or 95% confidence.[82] In other words, there was statistically weak evidence that GDP per capita Granger causes connectivity.

In the case where GDP per capita is the dependent variable, there was statistically robust evidence that connectivity Granger causes GDP per capita. For example, the F-test in **Figure G-5** was 6.69, indicating that the lagged connectivity was significant at around the 99% confidence level.

The Granger test is a significant but not definitive test of causality. The results point toward a two-way relationship between connectivity and economic growth, with the evidence of connectivity affecting GDP growth being particularly robust.

[82] Lagged connectivity/GDP was highly statistically significant.

Figure I-3: Granger Test, Dependent = Connectivity/GDP, Fixed Effects

```
Table 13
. xtreg lnivccongdp l.lngdpcap l.lnivccongdp lnrdspend  lneducationspend  lngrosscapitalformation d2003 d2004 d2005 d2006 d2007 d2008 d2009 d2010 d2011 d2012, fe

Fixed-effects (within) regression               Number of obs      =       468
Group variable: country1                        Number of groups   =        39

R-sq:  within  = 0.8571                         Obs per group: min =        12
       between = 0.9942                                        avg =      12.0
       overall = 0.9687                                        max =        12

                                                F(15,414)          =    165.57
corr(u_i, Xb)  =    0.8402                     Prob > F           =    0.0000

lnivccongdp       Coef.   Std. Err.      t    P>t     [95% Conf. Interval]

lngdpcap
L1.           .0307446   .0205128     1.49   0.124    -.009466    .0709521

lnivccongdp
L1.            .806684   .0263917    30.57   0.000    .7548056    .8585624

lnrdspend     -.0512399   .0362908    -1.41   0.159    -.122577    .0200973
lneducatio~d  -.0185494   .0721413    -0.26   0.797   -.1603582    .1232595
lngrosscap~n   .0826066   .035103      2.35   0.019    .0136042     .151609
d2003           .075217   .0214518     3.51   0.001     .033049     .117385
d2004          .1200675   .021823      5.50   0.000    .0771697    .1629652
d2005          .1135526   .0231981     4.89   0.000    .0679519    .1591533
d2006          .1685805   .0248802     6.78   0.000    .1196733    .2174878
d2007          .1061297   .0265782     3.99   0.000    .0538846    .1583749
d2008          .1608058   .0285215     5.64   0.000    .1047407    .2168709
d2009          .0869618   .0297714     2.92   0.004    .0284398    .1454837
d2010          .1575194   .0282739     5.57   0.000     .101941    .2130978
d2011          .1921167   .0288013     6.67   0.000    .1355017    .2487316
d2012          .1248798   .0293863     4.25   0.000    .0671148    .1826447
_cons         -5.161476   1.629783    -3.17   0.002   -8.365158   -1.9577944

sigma_u   .13230067
sigma_e   .10512824
rho   .61296496   (fraction of variance due to u_i)

F test that all u_i=0:     F(38, 414) =     2.55            Prob > F = 0.0000

.
. test l.lngdpcap

 ( 1)  L.lngdpcap = 0

       F(  1,   414)   =    2.38
       Prob > F        =    0.124
```

Figure I-4: Granger Test, Dependent = GDP per Capita, Fixed Effects

```
Table 14
. xtreg lngdpcap l.lngdpcap l.lnivccongdp lnrdspend  lneducationspend  lngrosscapitalformation d2003 d2004 d2005 d2006 d2007 d2008 d2009 d2010 d2011 d2012, fe

Fixed-effects (within) regression               Number of obs      =       468
Group variable: country1                        Number of groups   =        39

R-sq:  within  = 0.9681                         Obs per group: min =        12
       between = 0.8901                                        avg =      12.0
       overall = 0.8927                                        max =        12

                                                F(15,414)          =    837.73
corr(u_i, Xb)  = -0.2434                        Prob > F           =    0.0000

lngdpcap          Coef.   Std. Err.      t    P>t     [95% Conf. Interval]

lngdpcap
L1.           .7601523   .0187405    40.56   0.000     .723314    .7969906

lnivccongdp
L1.           .0076869   .0023311     3.29   0.001     .003118    .0012256

lnrdspend     .0208193   .0071959     2.89   0.004     .0066742   .0349643
lneducatio~d  .0189381   .0143045     1.32   0.186    -.0091804   .0470567
lngrosscap~n  .0903211   .0069604    12.98   0.000      .076639   .1040032
d2003         .0081166   .0042536     1.91   0.057    -.0002446   .0164779
d2004         .0187072   .0043272     4.32   0.000     .0102013   .0272132
d2005         .0146029   .0045998     3.17   0.002      .005561   .0236449
d2006         .0188112   .0049334     3.81   0.000     .0091136   .0285087
d2007         .0176178   .0052701     3.34   0.001     .0072584   .0279772
d2008        -.0042577   .0056554    -0.75   0.452    -.0153746   .0068591
d2009        -.0466412   .0059032    -7.90   0.000    -.0582452  -.0350372
d2010         .0086398   .0056063     1.54   0.124    -.0023806   .0196601
d2011         .0132196   .0057109     2.31   0.021     .0019937   .0244454
d2012        -.0042834   .0058269    -0.74   0.463    -.0157373   .0071705
_cons        -.4735344   .3231612    -1.47   0.144    -1.108776    .161707

sigma_u   .19837539
sigma_e   .02084533
rho   .98907874   (fraction of variance due to u_i)

F test that all u_i=0:     F(38, 414) =     7.80            Prob > F = 0.0000

.
. test l.lnivccongdp

 ( 1)  L.lnivccongdp = 0

       F(  1,   414)   =    6.69
       Prob > F        =    0.0126
```

Figure I-5: Granger Test, Dependent = Connectivity/GDP, Random Effects

```
Table 15

Random-effects GLS regression                   Number of obs      =       468
Group variable: country1                        Number of groups   =        39

R-sq:  within  = 0.8571                         Obs per group: min =        12
between        = 1.0000                                        avg =      12.0
overall        = 0.9793                                        max =        12

Random effects u_i ~ Gaussian                   Wald chi2(53)      =  19577.23
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000


lnivccongdp       Coef.   Std. Err.      z    P>z     [95% Conf. Interval]

lngdpcap
L1.           .0307446    .020513     1.49   0.122    -.009124    .0691871

lnivccongdp
L1.            .806684   .0263917    30.57   0.000     .7549573    .8584107

lnrdspend      .0512399   .0362908    -1.41   0.158    -.1223685    .0198887
lneducatio~d  -.0185494   .0721413    -0.26   0.797    -.1599437     .122845
lngrosscap~n   .0826066    .035103     2.35   0.019      .013806    .1514073
albania        .0552103   .4382934     0.13   0.900    -.8038289    .9142495
austria        .0353265     .16807     0.21   0.834    -.2940846    .3647377
belgium       -.0735896   .1484974    -0.50   0.620    -.3646391    .2174599
bulgaria       .1294027   .3334821     0.39   0.698    -.5242101    .7830156
bosniaandh~a  (omitted)
belarus       -.1867184   .2953709    -0.63   0.527    -.7656346    .3921979
cyprus         .3146228    .387783     0.81   0.417    -.4454178    1.074663
czechrepub~c    .051824   .2298275     0.23   0.822    -.3986298    .5022777
denmark        .1259073    .162373     0.78   0.438     -.192338    .4441525
spain          .1086734    .092063     1.18   0.238    -.0717667    .2891136
estonia        .0921175    .377224     0.24   0.807    -.6472279    .8314628
finland        .0905851   .1871605     0.48   0.628    -.2762428    .4574131
france        -.0362071   .0458529    -0.79   0.430    -.1260772     .053663
uk             .030803   .0501039     0.61   0.539    -.0673988    .1290049
greece         .032187   .2132644     0.15   0.880    -.3858036    .4501776
croatia       .0670505    .306869     0.22   0.827    -.5344016    .6685027
hungary       .0286915   .2304607     0.12   0.901    -.4230033    .4803862
ireland       .1178051   .2199318     0.54   0.592    -.3132532    .5488635
iceland       .2684952   .3772035     0.71   0.477      -.47081     1.0078
israel        .1057918   .2005248     0.53   0.598    -.2872296    .4988132
italy        -.0229525   .0650438    -0.35   0.724    -.1504361    .1045311
lithuania     .0065777   .3329054     0.02   0.984     -.645905    .6590604
luxembourg   -.0588682    .397446    -0.15   0.882    -.8378481    .7201116
latvia         .1990512   .3702048     0.54   0.591    -.5265369    .9246393
macedoniafyr  -.0902591   .4575712    -0.20   0.844    -.9870822    .8065641
malta          .391718   .4707739     0.83   0.405    -.5309819    1.314418
montenegro    (omitted)
netherlands    .009878   .1226646     0.08   0.936    -.2305402    .2502962
norway         .060482   .1833787     0.33   0.742    -.2989337    .4198978
poland        -.1082315   .1580164    -0.68   0.493     -.417938     .201475
portugal       .1306727   .1983305     0.66   0.510    -.2580479    .5193932
romania        .0072633   .2494828     0.03   0.977    -.4817141    .4962407
russia         -.079448   .1088808    -0.73   0.466    -.2928505    .1339545
serbia         .1805978   .3294279     0.55   0.584     -.465069    .8262646
slovakrepu~c  -.3556387   .2887885    -1.23   0.218    -.9216538    .2103765
slovenia      -.0825195   .3142712    -0.26   0.793    -.6984797    .5334408
sweden         .0507184    .13924     0.36   0.716     -.222187    .3236238
switzerland    .1215826    .157386     0.77   0.440    -.1868883    .4300535
turkey         .0218651   .1551908     0.14   0.888    -.2823033    .3260334
ukraine        .1085263   .2240264     0.48   0.628    -.3305573    .5476099
d2003           .075217   .0214518     3.51   0.000     .0331723    .1172617
d2004          .1200675    .021823     5.50   0.000     .0772952    .1628398
d2005          .1135526   .0231981     4.89   0.000     .0680852     .15902
d2006          .1685805   .0248802     6.78   0.000     .1198163    .2173448
d2007          .1061297   .0265782     3.99   0.000     .0540374    .1582221
d2008          .1608058   .0285215     5.64   0.000     .1049046     .216707
d2009          .0869618   .0297714     2.92   0.003     .0286109    .1453126
d2010          .1575194   .0282739     5.57   0.000     .1021035    .2129353
d2011          .1921167   .0288013     6.67   0.000     .1356672    .2485661
d2012          .1248798   .0293863     4.25   0.000     .0672837    .1824758
_cons         -5.208886   1.818499    -2.86   0.004    -8.773078   -1.644694

sigma_u            0
sigma_e   .10512824
rho                0   (fraction of variance due to u_i)


.
. test l.lngdpcap

( 1)  L.lngdpcap = 0

chi2(  1)       =       2.42
Prob > chi2     =     0.1202
```

Figure I-6: Granger Test, Dependent = GDP per Capita, Random Effects

```
Table 16

Random-effects GLS regression                   Number of obs      =       468
Group variable: country1                        Number of groups   =        39

R-sq:  within  = 0.9681                         Obs per group: min =        12
       between = 1.0000                                        avg =      12.0
       overall = 0.9989                                        max =        12

Random effects u_i ~ Gaussian                   Wald chi2(53)      = 365396.75
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000


lngdpcap          Coef.   Std. Err.      z    P>z     [95% Conf. Interval]

lngdpcap
L1.            .7601523   .0187405    40.56   0.000     .7234217    .7968829

lnivccongdp
L1.            .0076869   .0023311     3.29   0.001     .003044     .0010578

lnrdspend      .0208193   .0071959     2.89   0.004     .0067156     .034923
lneducatio~d   .0189381   .0143045     1.32   0.186    -.0090982    .0469745
lngrosscap~n   .0903211   .0069604    12.98   0.000      .076679    .1039632
albania        .4274077   .0869069     4.92   0.000     .2570733     .597742
austria        .2791344   .0333257     8.38   0.000     .2138172    .3444516
belgium        .2439622   .0294448     8.29   0.000     .1862515    .3016728
bulgaria       .3452555   .0661244     5.22   0.000      .215654     .474857
bosniaandh~a  (omitted)
belarus        .3151799   .0585675     5.38   0.000     .2003896    .4299701
cyprus         .5992568   .0768914     7.79   0.000     .4485524    .7499613
czechrepub~c   .2916611   .0455713     6.40   0.000      .202343    .3809793
denmark        .2866242   .0321961     8.90   0.000      .223521    .3497273
spain          .0494838   .0182547     2.71   0.007     .0137052    .0852623
estonia        .5230111   .0747978     6.99   0.000     .3764102    .6696121
finland        .3112084   .0371111     8.39   0.000      .238472    .3839448
france         .0013252   .0090919     0.15   0.884    -.0164947    .0191451
uk             .0400233   .0099348     4.03   0.000     .0205513    .0594952
greece         .2594846   .0422871     6.14   0.000     .1766034    .3423657
croatia        .3645966   .0608474     5.99   0.000     .2453378    .4838554
hungary        .2675608   .0456969     5.86   0.000     .1779966     .357125
ireland        .3782682   .0436091     8.67   0.000     .2927959    .4637405
iceland        .6533828   .0747937     8.74   0.000     .5067898    .7999757
israel         .3017715    .039761     7.59   0.000     .2238414    .3797017
italy          .0197317   .0128972     1.53   0.126    -.0055463    .0450098
lithuania      .4649399   .0660101     7.04   0.000     .3355625    .5943172
luxembourg     .7347705   .0788075     9.32   0.000     .5803107    .8892304
latvia         .4729142    .073406     6.44   0.000     .3290411    .6167873
macedoniafyr   .5059497   .0907294     5.58   0.000     .3281233    .6837761
malta          .7251987   .0933473     7.77   0.000     .5422414     .908156
montenegro    (omitted)
netherlands    .2098805   .0243225     8.63   0.000     .1622092    .2575517
norway         .3581911   .0363612     9.85   0.000     .2869244    .4294577
poland         .1334437   .0313322     4.26   0.000     .0720337    .1948538
portugal       .2368048   .0393259     6.02   0.000     .1597274    .3138821
romania        .1810813   .0494686     3.66   0.000     .0841245     .278038
russia        -.0289183   .0215894    -1.34   0.180    -.0712328    .0133961
serbia         .3267048   .0653205     5.00   0.000     .1986789    .4547307
slovakrepu~c   .3839798   .0572624     6.71   0.000     .2717476    .4962119
slovenia       .4763376   .0623152     7.64   0.000     .3542021    .5984731
sweden         .2526153   .0276092     9.15   0.000     .1985023    .3067283
switzerland    .2662199   .0312072     8.53   0.000     .2050548     .327385
turkey         .0273816    .030772     0.89   0.374    -.0329304    .0876935
ukraine        .0628064    .044421     1.41   0.157    -.0242572    .1498699
d2003          .0081166   .0042536     1.91   0.056    -.0002202    .0164535
d2004          .0187072   .0043272     4.32   0.000     .0102261    .0271883
d2005          .0146029   .0045998     3.17   0.002     .0055875    .0236184
d2006          .0188112   .0049334     3.81   0.000      .009142    .0284804
d2007          .0176178   .0052701     3.34   0.001     .0072887     .027947
d2008         -.0042577   .0056554    -0.75   0.452    -.0153421    .0068266
d2009         -.0466412   .0059032    -7.90   0.000    -.0582113   -.0350711
d2010          .0086398   .0056063     1.54   0.123    -.0023483    .0196279
d2011          .0132196   .0057109     2.31   0.021     .0020265    .0244126
d2012         -.0042834   .0058269    -0.74   0.462    -.0157038     .007137
_cons         -.7747813   .3605806    -2.15   0.032    -1.481506   -.0680564

sigma_u            0
sigma_e    .02084533
rho                0   (fraction of variance due to u_i)


.
. test l.lnivccongdp

( 1)  L.lnivccongdp = 0

chi2(  1)       =    10.31
Prob > chi2     =    0.00132
```

Appendix J: Estimating the Future Economic Impact of Europe's Airports

EUROCONTROL Forecasts

As part of its *Challenges of Growth* series, in 2013 EUROCONTROL released a report forecasting air traffic in Europe in 2035.[83] The report contains forecasts of unconstrained traffic air traffic levels under four economic and political scenarios:[84]

Scenario A: Global Growth
"Strong economic growth in an increasingly globalised World, with technology used successfully to mitigate the effects of sustainability challenges such as the environment or resources availability." [85]

Scenario C: Regulated Growth (Most Likely)
"Moderate economic growth, with regulation reconciling the environmental, social and economic demands to address the growing global sustainability concerns. This scenario has been constructed as the 'most-likely' of the four, most closely following the current trends." [86]

This scenario is considered to EUROCONTROL to be the most likely.

Scenario C': Happy Localism
"With European economies being more and more fragile, increasing pressure on costs, stricter environmental constraints, air travel in Europe would adapt to new global environment but taking an inwards perspective. There would be less globalization, more trade inside EU (e.g., Turkey joining Europe is important in this scenario). Also, slow growth of leisure travel to outside Europe, however certainly more inside EU. More point-to-point traffic within Europe. It does not mean that Europe does not grow or does not adapt to new technologies and innovation but its main focus is 'local'."[87]

Scenario D: Fragmented World
"A World of increasing tensions between regions, with more security threats, higher fuel prices, reduced trade and transport integration and knock-on effects of weaker economies." [88] Within each of these scenarios, EUROCONTROL also examined the current capacity expansion plans at European airports, and projected that not all future demand could be accommodated (i.e., there was a significant gap between unconstrained demand and capacity in 2035 under all four scenarios).

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[83] https://www.eurocontrol.int/sites/default/files/article/content/documents/official-documents/reports/201306-challenges-of-growth-2013-task-4.pdf.
[84] The forecasts are unconstrained in the sense that they reflect underlying passenger demand before any possible constraints due to airport or airspace capacity.
[85] EUROCONTROL, "Challenges of Growth 2013 Task 4: European Air Traffic in 2035", Page 11.
[86] Ibid.
[87] Ibid.
[88] Ibid.

The EUROCONTROL forecasts are summarised in **Figure J-1**. In 2012, there were approximately 0.7 billion passenger departures in the EUROCONTROL countries (which does not include Russia and Israel). In Scenario C (the most likely forecast), unconstrained passenger demand is forecast to reach over 1.5 billion departures in 2035. However, due to projected capacity constraints at European airports, only 1.3 billion departures are anticipated to be accommodated, leaving a gap (unfulfilled demand) of nearly 225 million departures. The size of the gap varies by scenario due to the difference in forecast demand and forecast capacity development.

Figure J-1: EUROCONTROL Forecasts of Passenger Departures, 2012-2035

Scenario	2012 Passengers	2035 Passengers		
		Unconstrained	Constrained	Gap
Scenario A: Global Growth	0.7 Billion	2.0 Billion	1.5 Billion	492 Million
Scenario C: Regulated Growth	0.7 Billion	1.5 Billion	1.3 Billion	225 Million
Scenario C': Happy Localism	0.7 Billion	1.3 Billion	1.2 Billion	109 Million
Scenario D: Fragmented World	0.7 Billion	1.0 Billion	0.98 Billion	20 Million

Source: Forecast Data from the Challenges of Growth 2013 forecasts, provided by EUROCONTROL. The geographic area covered in the forecasts is slightly different to ACI Europe, and does not include Russia or Israel.

Estimating the Foregone Economic Impact

The analysis considered the economic impact associated with the gap between constrained and unconstrained demand (the unfulfilled demand). This economic impact would be foregone if airport capacity is unable to match demand.

The future economic impact was estimated for each of the scenarios for both the constrained and unconstrained forecasts and the difference taken between them. To do this, it was assumed that the economic impact (employment, income, GDP) associated with the airports would increase as traffic at the airport increased. However, our experience has been that the aviation sector achieves productivity gains and economies of scale, handling increasing

numbers of passengers per employee as traffic increases. Therefore, the increases would not be linear, i.e. a 1% increase in traffic would lead to a less than 1% in the economic impact.

To estimate the forgone economic impact, the following assumptions were made:

- The economic impacts were estimated based on EUROCONTROL forecasts for individual countries or groups of countries and then totalized for the entire region.
- The direct employment impacts were estimated based on the analysis described in **Appendix E**, which found that each 1 million traffic units (equal to 1 million passengers), increased employment by 854 for large airports.[89] Furthermore, to account for future gains in productivity associated with technological advances, competition-induced efficiency gains, etc. **this parameter was reduced by 33%.**
- The indirect and induced impacts were estimated from the direct impacts, using the 2013 economic impact multipliers.
- To be conservative, it was assumed that air connectivity would increase at a slower rate than passenger traffic, such that **each 1% increase in passengers would result in only a 0.75% increase in connectivity**. The connectivity parameter was then applied to projected increase in connectivity to estimate the catalytic impacts.

The resulting estimates of the economic impact forgone under the most likely forecast are provided in **Figure J-2**. For reference, the table also shows the 2013 economic impact of the EUROCONTROL countries (i.e. excluding Russia and Israel).

In Scenario C: Regulated Growth, EUROCONTROL's most likely forecast, the forgone economic impact associated with this unmet demand is estimated to be 2.0 million jobs, € 47.0 billion in income and € 96.7 billion in GDP, including direct activity at the airport, multiplier impacts, and the lost tourism, trade and investment due to low connectivity growth. This is roughly one sixth of the 2013 economic impact of airports in the EUROCONTROL countries.

The projected forgone economic impact is greater in Scenario A (Global Growth) due to the higher traffic volumes forecast and lower in Scenarios C' and D (Happy Localism and Fragmented World).

[89] The analysis found that the impact per million traffic units was greater for smaller airports. However, to be conservative, and due to the fact that capacity constraints will be felt at larger airports, the lower parameter value was used.

Figure J-2: Foregone Economic Impact Due to Capacity Constraints at European Airports, 2035

	Jobs	Income (€ Billions)	GDP (€ Billions)
Total 2013 Economic Impact in the EUROCONTROL Countries			
Direct	1,550,800	64.4	94.9
Indirect	1,200,100	37.4	64.5
Induced	1,268,200	36.4	72.1
Catalytic	7,244,300	196.6	398.6
Total	**11,263,400**	**334.8**	**630.0**
Foregone Economic Impact in Scenario A: Global Growth			
Direct	674,000	20.9	31.6
Indirect	570,000	11.8	21.2
Induced	558,000	10.6	22.4
Catalytic	2,308,000	55.5	123.6
Total	**4,110,000**	**98.8**	**198.9**
Foregone Economic Impact in Scenario C: Regulated Growth (Most Likely)			
Direct	313,000	9.3	14.3
Indirect	266,000	5.3	9.5
Induced	259,000	4.7	10.0
Catalytic	1,197,000	27.8	62.8
Total	**2,035,000**	**47.0**	**96.7**
Foregone Economic Impact in Scenario C': Happy Localism			
Direct	154,000	4.0	6.2
Indirect	136,000	2.2	4.1
Induced	129,000	1.9	4.2
Catalytic	484,000	9.4	21.7
Total	**903,000**	**17.5**	**36.3**
Foregone Economic Impact in Scenario D: Fragmented World			
Direct	28,000	0.8	1.2
Indirect	24,000	0.4	0.8
Induced	23,000	0.4	0.8
Catalytic	89,000	1.5	3.7
Total	**164,000**	**3.1**	**6.6**

All financial figures are in 2013 prices. Numbers may not add up due to rounding.

Appendix K: Economic Impact Model

The analysis described in this report, and particularly **Appendix E**, provides a means for modelling and estimating the economic impact of airports based on their traffic characteristics. The parameters and economic impact multipliers estimated in the economic impact analysis were built into an easy-to-use economic impact model. This model allows airports to approximately estimate the economic impact associated with specific traffic levels and traffic mixes. The appendix provides a guide to using the model.

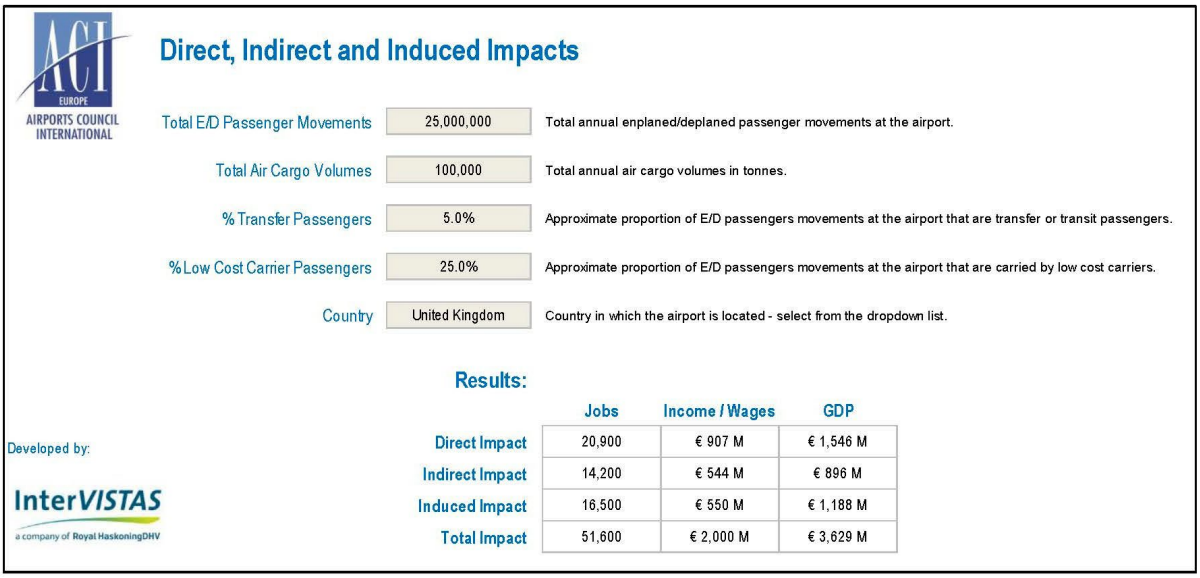
The model has been developed in Microsoft Excel in xlsx format, which is compatible with most modern version of Excel. The file can be loaded into Excel in the standard manner and does not require the use of macros (or Visual Basic).

The inputs and outputs are provided on a two worksheets: [Direct+Indirect+Induced Impacts] and [Catalytic Impacts], which described below.

Direct+Indirect+Induced Impacts

A screenshot of this worksheet is provided in **Figure K-1**. On this worksheet, the user can specify characteristics of the airport, and the model then provides an estimate of the direct, indirect and induced economic impacts for that airport.

Figure K-1: Screenshot of the Direct+Indirect+Induced Impacts Worksheet



The airport characteristics of the airport that can be specified are:

- **Total E/D Passenger Movements**. The total annual passenger movements handled by the airport. Generally speaking, the more passengers the airport handles, the larger the economic impact of the airport.
- **Total Air Cargo Volumes**. The total annual air cargo (both dedicated freighter and bellyhold) that the airport handled in metric tonnes. Again, the greater tonnage handled, the larger the economic impact.
- **% Transfer Passengers.** The approximate proportion of E/D passengers movements at the airport that are transfer or transit passengers. Transfer passengers were found have a marginally lower economic impact than originating or terminating passengers, so increasing the percentage will reduce the economic impact, all else being equal.
- **% LCC Passengers.** The approximate proportion of E/D passengers movements at the airport that were carried by low cost carriers. LCC passengers were found have a lower economic impact than originating or terminating passengers, so increasing the percentage will reduce the economic impact, all else being equal.
- **Country**. Country in which the airport is located, which can be selected from a drop-down list of ACI EUROPE countries. This parameter determines the economic multipliers used, and so affects only the indirect and induced impacts.

The resulting economic impact estimate is provided in the table labelled results, and includes projects of the jobs, incomes (wages, salaries, bonuses and other remuneration) and Gross Domestic Product (GDP) generated by the airport broken down into the following categories:

- **Direct Impact**. The employment, income and GDP associated with the operation and management of activities at the airports including firms on-site at the airport and airport-related businesses located elsewhere near the airport. This includes activities by the airport operator, the airlines, airport air traffic control, general aviation, ground handlers, airport security, immigration and customs, aircraft maintenance, and other activities at the airport.
- **Indirect Impact**. The employment, income and GDP generated by down-stream industries that supply and support the activities at the airport. For example, these could include: wholesalers providing food for inflight catering, oil refining activities for jet fuel, companies providing accounting and legal services to airlines, travel agents booking flights, etc.
- **Induced Impact**. The economic activity generated by the employees of firms directly or indirectly connected to the airport spending their income in the national economy. For example, an airline employee might spend his/her income on groceries, restaurants, child care, dental services, home renovations and other items which, in turn, generate employment in a wide range of sectors of the general economy.
- **Total Impact**. The sum of the direct, induced and indirect impacts.

It should be cautioned that the estimated figures from the model are approximate estimates based the airport characteristics specified. They are not a replacement for a detailed economic impact study. The actual economic impact of the airport could differ substantially due to factors not specified in the generalised model.

Appendix L: Glossary of Terms and Abbreviations

ACI EUROPE	ACI EUROPE is a non-profit organisation based in Brussels which represents over 450 airports in 45 European countries, covering over 90% of commercial European air traffic. The countries in ACI EUROPE comprise East and West Europe, including Russia, Turkey and Israel.
Airport air traffic control	Airport air traffic control includes air traffic control activities associated with aircraft approach, landing and take-off and ground movements. It does not include Area Control Centres that control aircraft in flight between airports (i.e. enroute).
Catalytic Impacts	*Catalytic Impacts*, also known as Wider Economic Benefits, captures the way in which specific economic activities facilitates further economic or business impacts in other sectors of the economy. Air transport creates catalytic impacts through increased connectivity and improves national economic performance through the following mechanisms; tourism, trade in goods and services, investment, and increased productivity.
Connecting Passengers	Also known as transfer passengers, connecting passengers are those changing planes (or remaining on the same aircraft) at an airport enroute to their final destination.
Connectivity	In this report, connectivity (or air connectivity) refers to the extent to which a country is connected to other countries by air services. The more air service between two countries (in terms of the number of routes, frequencies and seat capacity), the better connected those countries are.
Direct impacts	*Direct impacts* arise immediately from the conduct of those entities performing the examined activity in question. For an airport, the "direct impacts" would include the activities of the airport itself, airlines, forwarders, ground handling agents, and other firms whose principal business involves commercial aviation.
E/D Passengers	Enplaned/deplaned passengers. A measure of passenger volume that counts each passenger who enplanes (boards) or deplanes (disembarks) an aircraft at an airport. E/D passengers = the sum of O/D and connecting passengers.

EFTA	European Free Trade Association (EFTA) is a free trade organisation between four European countries that operates in parallel with – and is linked to – the European Union. The four countries are Iceland, Liechtenstein, Norway and Switzerland.
EU	European Union, an economic and political union of 28 Member States, located in Europe. It was established by the Treaty of Maastricht in November 1993, replacing the previous European Economic Community which dates back to 1957. There are currently 28 Member States of the EU: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.
Europe	The collection of countries covered by ACI EUROPE.
European Airports	In this report, *European airports* refers to airports within the countries covered by ACI EUROPE.
GDP	Gross Domestic Product, a measure of the total output of an economy.
I-O Model	Input-Output (I-O) model. A representation of the flows of economic activity within a region or country. An I-O model captures what each business or sector must purchase from every other sector in order to produce a dollar's worth of goods or services.
Indirect impacts	*Indirect impacts* involve the supply chain of the businesses or entities conducting the primary activity (i.e. those included in the direct impact). For example, the airlines at an airport purchase fuel which has been refined at a plant and transported to the airport by pipe or truck. Catering companies at the airport buy food from wholesalers. The items purchased can be used for many purposes besides commercial aviation, and would usually occur off site. The materials support the primary aviation activity, although they could be used for many purposes.
Induced impacts	*Induced impacts* capture the economic activity generated by the employees of firms directly or indirectly connected to the airport spending their income in the national economy. For example, an airline employee might spend his/her income on groceries, restaurants, child care, dental services, home renovations and other items which, in turn, generate employment in a wide range of sectors of the general economy.

Low Cost Carrier (LCC)	Also known as low fares, no-frills or budget carriers. These are airlines that generally have lower fares and fewer amenities than network or legacy carriers. Although there is considerable variation in the business models, low cost carriers typically operate a single aircraft type (to reduce training and maintenance costs), do not offer first or business class travel, do not provide in-flight services such as meals and entertainment (or offer them at additional charge), and focus on point-to-point travel offering limited connecting options. Examples in Europe include EasyJet, Ryanair, Wizz Air, Norwegian Air Shuttle and Vueling.
Member State	A sovereign nation state of the European Union (EU).
Multiplier Impacts	A method of estimating economic impacts as a multiple of a known impact, based on an estimated multiplier effect derived from an Input-Output model. See Section 4.3 and Appendix F for detailed information on how multiplier impacts were derived in this study.
O/D Passengers	O/D passengers at an airport refers to air passengers that either started or ended their air journey at that airport, but does not include passengers connecting at that airport enroute to their final destination. O/D passengers = E/D passengers minus connecting passengers.
Wider Economic Benefits	See *Catalytic Impacts*.
Traffic Unit	Also known as Work Load Unit (WLU). A standardised measure of traffic at airports, which combines passenger and cargo traffic. One traffic unit equals one passenger or 100kgs of cargo.

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