

InterVISTAS

a company of Royal HaskoningDHV



Dublin Airport Economic Impact Study

Final Report
April 2017

Prepared by InterVISTAS Consulting
on behalf of daa

Contents

Executive Summary	3
<hr/>	
1. Defining Economic Impact	5
1.1 Categories of Economic Impact	6
<hr/>	
2. Methodology for the Economic Impact Study	9
2.1 Updating the Previous Economic Impact Study	10
<hr/>	
3. Overview of Dublin Airport	12
3.1 Air Passenger Movements	13
3.2 Overview of Dublin Airport's Air Services	15
3.3 Measuring Airport Connectivity	18
<hr/>	
4. Current Economic Contribution of Dublin Airport	25
4.1 Direct, Indirect and Induced Impacts	26
4.2 Catalytic Impacts	27
4.3 Total Impacts	29
<hr/>	
Glossary of Terms and Abbreviations	32
<hr/>	
Appendix A:	34
Further Information on the Input-Output Tables and the Economic Multipliers	
<hr/>	
Appendix B:	37
Overview of Catalytic Impacts	
<hr/>	

Críochfort Terminal 2

Executive Summary

The current economic impact of Dublin Airport: combining the direct, indirect, induced and catalytic impacts, Dublin Airport currently generates or facilitates 117,300 jobs and generates €8.3 billion in Gross Value Added (GVA).¹

As a small, open economy, Ireland is crucially dependent on its air links to facilitate its economy. As a result, Dublin Airport makes a substantial contribution to the national economy. The economic impact of Dublin Airport comprises of the following:

- > **Direct Economic Impact.** The employment, income and economic output associated with the operation and management of activities at the airport, including firms on-site at the airport and airport-related businesses located elsewhere near the airport.

- > **Indirect Economic Impact.** The employment, income and economic output generated by down-stream industries that supply and support the activities at the airport, such as 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.

- > **Catalytic Impacts.** These 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 by facilitating trade, tourism, investment and productivity growth.

daa had previously commissioned a study of the economic impact of Dublin Airport based on 2013 traffic and employment levels. These economic impact estimates have been updated to reflect 2016 traffic and activity levels, and are summarised in **Figure ES-1**.

Direct employment supported by ongoing operations at Dublin Airport (e.g., daa, airlines, air traffic control, ground handlers, airport security, immigration, customs, airport retail, etc.) amounts to 19,200 jobs. Adjusting for part-time and seasonal employment, this totals 17,100 Full-Time Equivalent jobs (FTEs). The total direct GVA generated by Dublin Airport is estimated to be over €1.5 billion.

Adding in multiplier impacts (indirect and induced), the total employment supported by activities at Dublin Airport is estimated to be 45,600 jobs (or 40,500 FTEs), earning a total of €1.7 billion.






The air services at Dublin Airport allow a large number of tourists to visit Ireland, facilitate the transportation of high-value exports around the world and enable employees of Irish and multinational businesses to travel to clients, regional offices and global headquarters. Many of the businesses with regional headquarters in Ireland would not be located here without the connectivity that Dublin Airport provides. These catalytic impacts of Dublin Airport were estimated to total 71,700 jobs (63,300 FTEs) and €5.0 billion in GVA in 2016.

The total economic impact of Dublin Airport includes the activity directly related to the airport, the multiplier impacts that flow from it, and the other sectors of the economy facilitated by the airport. In total, this amounts to 117,300 jobs in Ireland, equivalent to 103,800 full-time jobs, earning a total of almost €4.3 billion. Furthermore, a total of €8.3 billion is contributed to GDP, representing 3.1% of the national economy.²

1. Gross Value Added (GVA) is the value of the operating surpluses of business linked to Dublin Airport, plus the income/wages of employees and consumption of fixed capital. Gross Domestic Product (GDP) is the sum of the GVA of all industries plus taxes less subsidies on production.

2. Based on CSO estimates of 2016 GDP:
<http://www.cso.ie/en/releasesandpublications/er/na/quarterlynationalaccountsquarter42016/>, 9 March 2017.
 Adjustments by the CSO to Ireland's GDP figures have changed the calculation of the percentage contribution of Dublin Airport to national GDP – see Section 4.3 for more details.

Figure ES-1: Total Economic Impact Generated and Facilitated by Dublin Airport (2016)

Impact	 Number of Jobs	 Full-Time Equivalents (FTEs)	 Wages (€ Millions)	 GVA (€ Millions)	 GVA as % of National GDP
Direct	19,200	17,100	784	1,540	0.6%
Indirect	11,700	10,400	456	876	0.3%
Induced	14,700	13,000	488	959	0.4%
Catalytic	71,700	63,300	2,523	4,972	1.8%
Total	117,300	103,800	4,251	8,348	3.1%

Updated figures based on 2016 traffic levels. All financial figures are in 2016 prices. Numbers sum to total due to rounding.

It should be noted that these figures are not attempting to credit Dublin Airport with creating nearly 3.1% of the economy. The Irish economy is far more complex than that. It clearly takes a wide range of players acting together to generate economic growth – Government, business, infrastructure providers, residents, etc.

For example, if it had not been decided to build hotels in Ireland, tourism would also be substantially lower. What the figures do show is that without Dublin Airport, and particularly without the extensive connectivity at the airport, the Irish economy would not be as large, affluent or diverse as it is today.

Defining Economic Impact

1. Defining Economic Impact

Economic impact is a measure of the employment, spending and economic activity associated with a business, a sector of the economy, a specific project (such as the construction of a new facility), or a change in government policy or regulation. In this case, economic impact refers to the economic contribution associated with the ongoing activities at Dublin Airport. Economic impact can be measured in a number of ways:

- > **Employment** – the number of people employed by businesses involved in activities linked to Dublin Airport.

- > **Income/Wages** – the wages and salaries earned by the people employed in activities linked to Dublin Airport.

- > **Gross Value Added (GVA)** – the income/wages of employees above plus the operating surpluses of business linked to Dublin Airport and the consumption of fixed capital. GVA is broadly equivalent to Gross Domestic Product (GDP), whereby the value-added of each industry sums to the total GDP of an economy.³

1.1 Categories of Economic Impact

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

1.1.1 Direct Economic Impact

This is the employment, income and GDP associated with the operation and management of activities at Dublin

Airport 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, air traffic control, fixed base operators (General Aviation), ground handlers, airport security, immigration and customs, aircraft maintenance, etc.

While a straight-forward definition of the direct airport economic impact would be the activities and businesses located at the airport, this would not reflect the full extent of the airport's economic base. Other businesses closely connected to airport activities are not based at the airport (or only partially based at the airport), such as aircraft maintenance, logistics operators, aircraft parts suppliers, etc. These businesses would not exist, or would be much smaller, without the activities at the airport. Therefore, off-airport businesses closely linked to airport activities were also included as part of the direct economic impact.

1.1.2 Indirect Economic Impact

The employment, income and GDP generated by downstream industries that supply and support the activities at Dublin Airport. For example, these 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.

1.1.3 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. GDP is the sum of the GVA of all industries plus taxes less subsidies on production.

1.1.4 Catalytic Economic Impacts

While the economic impact described above can be seen as down-stream impacts resulting from activities at Dublin, 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:

> **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, theatres, car rentals, etc. 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 travel agents, taxis, etc. In any case, 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.

> **Trade in Goods and Services.** Although air cargo accounts for 1% of the volume of Ireland's export shipments, it accounts for over 35% of exports by value, meaning that air cargo is high value, often perishable or time-sensitive.⁴ 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 replaced by teleconferencing or other forms of communication. A 2013 study in the UK found that a 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%.⁵ 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.

> **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 to an international airport. A study by IATA of 625 businesses in five countries (including China and the United States) found that 25% of the sales of the surveyed businesses were dependent on good air transport links. Further, 30% of Chinese firms reported that they had changed investment decisions because of constraints on air services.⁶ Another study found 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.⁷

Therefore, airports are essential assets for regions wishing to expand industrial activity. Their proximity encourages industrial development. Industries choose to locate close to airports in order to gain easy access to air transport and the associated infrastructure.

> **Productivity.** Air transportation offers access to new markets, which in turn enables businesses to achieve greater economies of scale; inward investment can enhance the productivity of the labour force (e.g., state-of-the-art manufacturing facilities); air access also enables companies to attract and retain employees of high calibre. All of these factors contribute to enhanced productivity, which in turn increases the national income. A recent study for Airports Council International (ACI) found that a 10% increase in connectivity was associated with an increase in GDP per capita of 0.6%.⁸

Additional research evidence on the link between aviation and economic development is summarised in **Appendix B**.

In effect, the catalytic impact of aviation is to increase the productive potential of the economy (in economist terms, moving the production-possibility frontier). Improvements in aviation connectivity enable economies to attract more tourists, conduct more trade and draw more foreign investment. 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

4. Source: Irish Exporters Association.

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

6. Airline Network Benefits, IATA Economic Briefing No. 3, 2006.

7. Bel, G. and Fageda, X. (2008), "Getting There Fast: Globalization, Intercontinental Flights and Location of Headquarters", *Journal of Economic Geography*, Vol. 8, No. 4.

8. InterVISTAS Consulting, "The Economic Impact of European Airports: A Critical Catalyst to Growth", ACI Europe, January 2015.

attract tourists, to conduct trade and attract investment from other countries. As a result, the country's economy and employment potential would suffer.

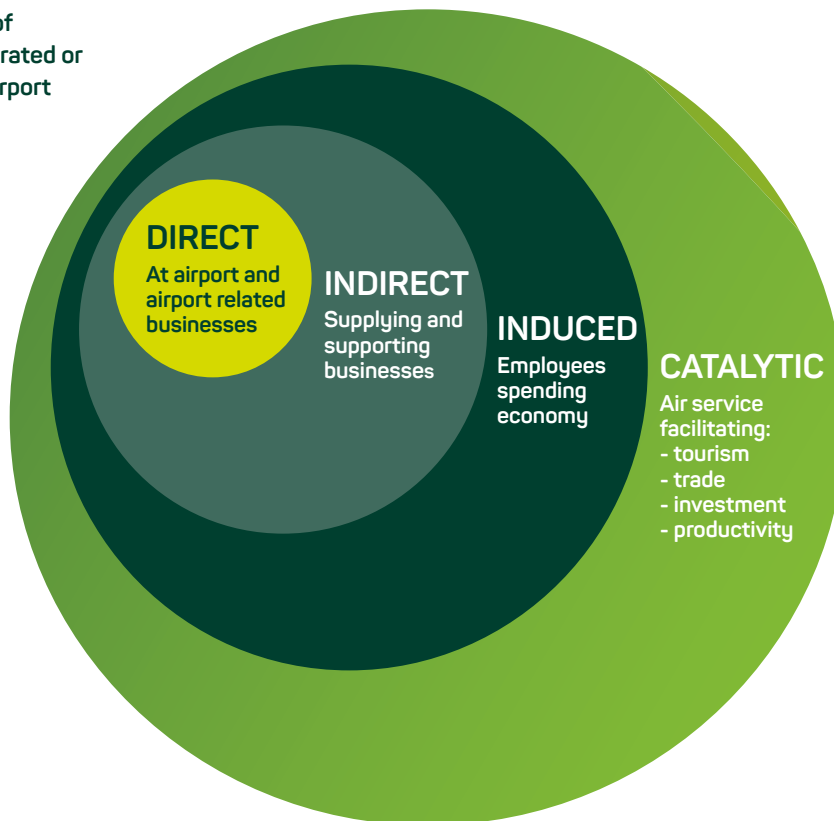
It should be noted that catalytic impacts are not simply a matter of the airport generating employment and economic activity in the same way that direct, indirect and induced impacts arise. National economies are far more complex than that. It clearly takes a wide range of players acting together to generate economic growth – government, business, infrastructure providers, residents, etc. For example, providing air connectivity alone does not guarantee large volumes of tourists. Hotels, restaurants, retail and entertainment etc. are also required. Nevertheless, without convenient air services, a destination will find it more difficult to attract tourists.

What the catalytic impacts capture is that without efficient 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 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.⁹

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. Economic growth stimulates demand for air services while at the same time, these air services open up new opportunities for tourism, trade, business development, etc. This in turn can stimulate further demand for air services, and so on, in a "virtuous cycle". The analysis in this study uses parameters that control for this two-way relationship. These four categories of impacts are summarised in **Figure 1-1**.

Figure 1-1: Categories of Economic Impact Generated or Facilitated by Dublin Airport



9. In many parts of the world, airports are also the contributors of some of the other necessary elements for catalytic growth. Various airports have developed their own economic and urban hubs, which can comprise of hotels, offices, entertainment, and other commercial developments, which benefit from the adjacent air connectivity provided by the airport.

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Methodology for the Economic Impact Study

2. Methodology for the Economic Impact Study

This chapter describes the methodology and sources that were used to measure the economic impact of Dublin Airport.

2.1 Updating the Previous Economic Impact Study

In 2014, daa commissioned InterVISTAS to complete an economic impact study on the operation of Dublin Airport, which was completed in early 2015.¹⁰ The study involved a detailed survey of businesses in and around the airport, covering passenger and cargo airlines, courier/integrators, ground handlers, government agencies, aircraft maintenance firms, air cargo, warehousing and logistics, car rental firms, hotels and airport retailers. This survey provided a detailed and robust profile of the employment and economic activity, and formed the basis for the direct economic impacts of Dublin Airport. The surveys captured information on the employment levels in 2013.

The indirect and induced effects were estimated using economic multipliers, as is common practice for economic impact studies. These multipliers were based on the Input-Output model of the Irish economy maintained by the Central Statistics Office (CSO) Ireland. 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. By tracing these linkages between sectors, I-O models can estimate indirect and induced impacts. The I-O models are described in more detail in **Appendix A**.

The catalytic impacts of Dublin Airport were calculated using 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 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 impact of Dublin Airport was estimated in this way, using findings from recent research. The catalytic parameter was taken from a study undertaken by InterVISTAS on behalf of ACI Europe,¹¹ which was selected because it is the mostly recently completed study of this sort and is based on data from 40 European countries including Ireland. The parameter captures the aggregate net effect of a range of catalytic impacts, including tourism, trade, investment, business location, etc., which manifest themselves as greater per capita GDP.

The previous economic impact study for Dublin Airport estimated the airport's economic contribution in 2013. These figures have been updated to reflect the airport's economic contribution in 2016, taking into account the traffic growth at Dublin Airport between 2013 and 2016 and adjusting for inflation.

As traffic grows at Dublin Airport, employment at the airport is also expected to increase. This includes employees at the airlines operating and supporting additional flights, as well as third party suppliers

10. A copy of the study report is available at: <http://www.daainternational.ie/wp-content/uploads/2015/06/Dublin-Airport-Economic-Impact-Study-April-2015.pdf>.

11. "The Economic Impact of European Airports: A Critical Catalyst to Growth", ACI Europe, January 2015.

supporting the airline's operations. This would include additional ground handling services to supply, fuel and clean the increased number of aircraft and to handle the baggage of hub passengers. Government services such as security, customs, air traffic control, etc. would also require additional employment resources to handle greater passenger and aircraft traffic.

While increased air traffic is expected to result in increased employment, the growth in employment is not always in proportion to the growth in traffic. For example, if passenger traffic grows by 5%, aviation employment is expected to increase by less than 5% due to productivity and economies of scale effects which mean that increases in traffic can be handled with a less than proportional increase in resources.

Employment elasticities were applied reflecting the anticipated relationship between traffic growth and employment growth. To account for productivity gains and economies of scale, the direct employment impacts were estimated assuming an economic impact elasticity of 0.67, i.e., each 1% increase in traffic results in a 0.67%

increase in airport activity. This elasticity was based on previous research on European airports for ACI Europe, which found evidence of economies of scale in airport employment.¹² The multiplier impacts (indirect and induced) were estimated from the direct impacts, using the same multiplier ratios used to estimate the current economic impact.

The estimates of catalytic impacts were based on the growth in connectivity between 2013 and 2016, using the connectivity measure described in Section 3.3. To be conservative, it was assumed that the catalytic impacts would grow at a slower rate than connectivity, such that the connectivity contribution was scaled down by 25% (e.g., a 10% connectivity increase is scaled down to a 7.5% catalytic increase). In addition, the financial figures were increased in line with inflation, based on the increase in the Consumer Price Index (CPI) between June 2013 and June 2016.¹³

¹² "The Economic Impact of European Airports: A Critical Catalyst to Growth", ACI Europe, January 2015. Similar approaches have also been used in the regulatory analysis of airports. For example, in the regulatory approval for Heathrow Terminal 5, an employment elasticity of 0.74 was used for passenger traffic ("Proof of Evidence: Forecasting – Heathrow Terminal 5 Enquiry", 1995). The analysis in this report uses a more conservative elasticity, based on recent research.

¹³ <http://www.cso.ie/en/interactivezone/interactivetools/cpiinflationcalculator/>.



Overview

3. Overview of Dublin Airport

Key Points

- > Passenger traffic at Dublin Airport reached almost 28 million in 2016, an 11% increase over 2015.
- > Dublin Airport has direct service to over 180 destinations in 42 countries on five continents.
- > It is the home base for two major carriers – Ryanair and Aer Lingus.
- > The airport is a primary contributor to Ireland having one of the highest connectivity levels on the continent relative to the size of its economy.
- > This connectivity is critical to the economic development of Ireland, including trade, tourism, FDI and business location decisions.

Dublin Airport (DUB) is the largest airport in the Republic of Ireland (and the largest on the island of Ireland). The airport acts as a point of entry for those travelling to and from Ireland, but also services connecting flights from other international destinations. There are two major airlines which use Dublin Airport as a base for their operations: Aer Lingus and Ryanair.

3.1 Air Passenger Movements

As shown in **Figure 3-1**, 2016 marked the busiest year in the history of the airport, with nearly 28 million passengers travelling through Dublin Airport, an 11% increase over 2015, following a 15% increase between 2014 and 2015.

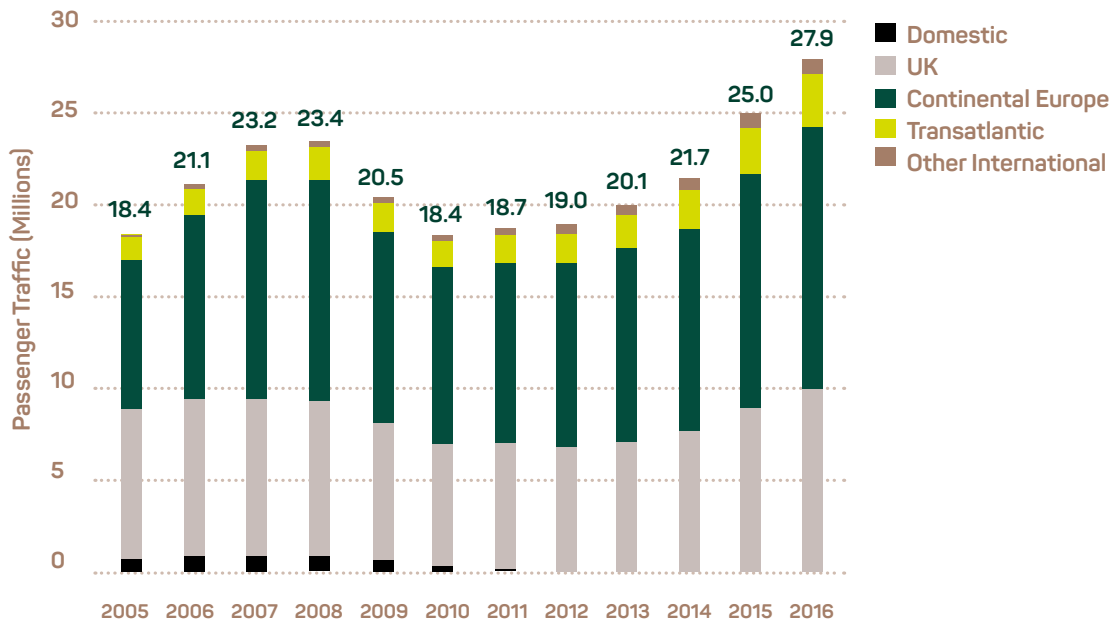
Following a long period of growth between 2000 and 2008, with an average growth rate of 6.9%, the airport experienced significant declines in air travel in 2009 and 2010 due to the global economic downturn.¹⁴ However, since 2010, traffic growth has averaged 7.2% per annum, reaching nearly 28 million in 2016.

Passenger traffic at Dublin Airport is broken down into five categories: Domestic, United Kingdom, Continental Europe, Transatlantic and Other International. Of the five areas, the region which has seen the largest growth in passenger traffic since 2010 is Other International. Over the past six years, the passenger traffic on these routes has increased by over 190%, from a small base. Transatlantic traffic has seen a growth of 94% from increased service to the United States and Canada. European and United Kingdom passenger traffic have both increased by 48%. Domestic traffic, which makes up less than 1% of traffic, has seen a decrease in volume by 75%. This drop is attributable to the fact that the road network within Ireland has seen significant advancements over recent years. Total passenger traffic at Dublin Airport has seen an increase of nearly 51% since 2010.

Figure 3-2 shows the percentage share of passenger traffic by region. In terms of the share of passenger traffic by world region, Continental European traffic comprised 51% of all passengers in 2016. United Kingdom represented 36% of total passengers, followed by Transatlantic at 10%, Other International at 3% and Domestic passenger traffic at less than 1%.

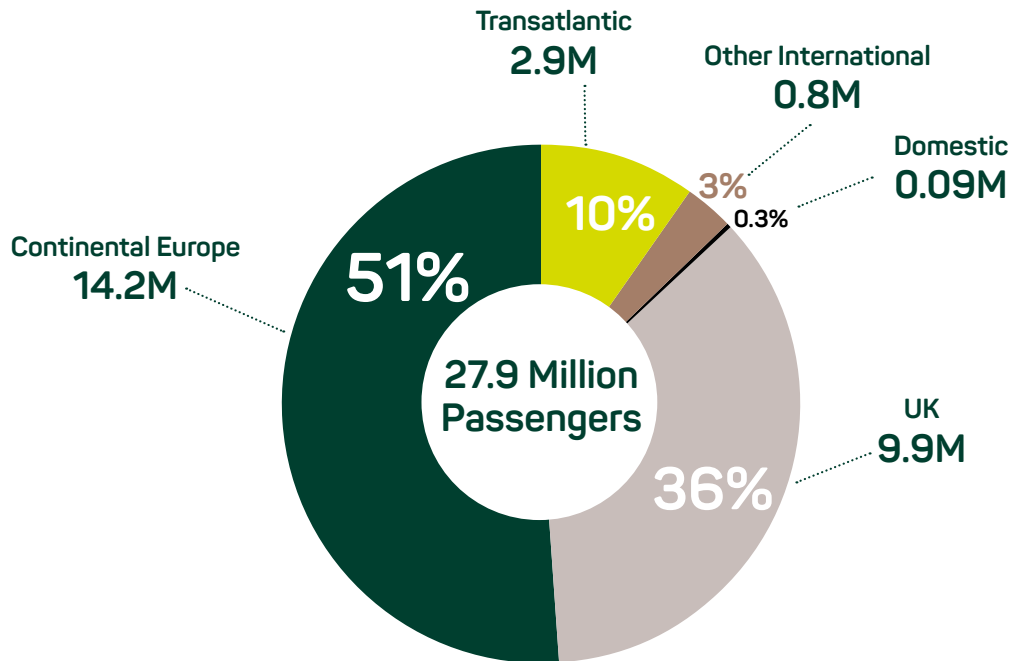
14. Based on Central Statistics Office Ireland data, the Irish economy was in recession for all of 2008 and 2009, contracting by over 10% in that period.

Figure 3-1: Passenger Movements at Dublin International Airport, 2005-2016



Source: daa

Figure 3-2: Passenger Movements by Region at Dublin Airport, 2016



Source: daa

3.2 Overview of Dublin Airport's Air Services

Based on schedule data for 2016, Dublin Airport served 42 airlines offering non-stop scheduled service to 180

destinations in 42 countries on five continents. In 2016, there were over 100,000 scheduled flights. **Figures 3-3** and **3-4** show the scheduled passenger routes operated from Dublin Airport in 2016, across Europe and other international destinations, respectively.

Figure 3-3: Dublin Airport's European Route Network (2016)



Source: Diio Schedule Data for 2016.

Figure 3-4: Dublin Airport's Global Route Network (2016)



Source: Diio Schedule Data for 2016.

Figure 3-5: Countries Directly Connected to Dublin by Air Service from Dublin Airport, 2016

Europe [33 countries]	
Austria (3)	Lithuania (2)
Belgium (2)	Luxembourg (1)
Bulgaria (2)	Malta (1)
Croatia (3)	Moldova (1)
Cyprus (1)	Netherlands (2)
Czech Republic (1)	Norway (2)
Denmark (2)	Poland (12)
Estonia (1)	Portugal (3)
Finland (2)	Romania (3)
France (19)	Russia (1)
Germany (11)	Slovakia (1)
Greece (7)	Spain (20)
Hungary (1)	Sweden (1)
Iceland (1)	Switzerland (3)
Ireland (2)	Turkey (2)
Italy (16)	United Kingdom (24)
Latvia (1)	
Africa [3 Countries]	North America [2 Countries]
Egypt (1)	Canada (5)
Ethiopia (1)	United States (12)
Morocco (2)	
Other [2 Countries]	Middle East [2 Countries]
Jamaica (1)	Israel (1)
Mexico (1)	United Arab Emirates (2)

Source: Diio Schedule Data for 2016.

Figures in parenthesis indicate the number of routes operated to that country.

The most popular country for travel to and from Ireland is the United Kingdom. In 2016, 9.9 million people travelled between the two countries through Dublin Airport. On any given day, there are more than 40 flights between Dublin and London, and over 100 between Dublin and the entire United Kingdom. Aer Lingus and Ryanair are the largest carriers servicing flights to the United Kingdom, operating 18,700 and 17,300 flights in 2016, respectively. New York is the most popular long-haul international destination with close to 2,000 flights to John F. Kennedy International (JFK) and Newark (EWR) in 2016, operated by Aer Lingus, United Airlines, Delta Air Lines and American Airlines. **Figure 3-5** lists the countries which are serviced directly from Dublin and the number of destinations within each country in 2016.

Figure 3-6 shows the total scheduled seat capacity operated by the top 15 carriers at Dublin Airport in 2016. As shown in the table, Dublin's two largest carriers, Ryanair and Aer Lingus, make up 79% of the total seat capacity. Aer Lingus increased its capacity by over 300,000 seats, a 5% increase over 2015.

In 2016, the largest capacity increases were by SWISS and Delta, each increasing their outbound seat capacity by 29% from 2015. United Airlines also saw significant growth, increasing their capacity by 14% in 2016. Overall, the services provided by North American carriers increased by 16% in 2016.

Figure 3-6: Outbound Seat Capacity by Carrier at Dublin Airport, 2016

Carrier	Outbound Seat Capacity (Thousands)	% Share of Total Seat Capacity
1. Ryanair	7,168	42.6%
2. Aer Lingus	6,176	36.7%
3. British Airways	537	3.2%
4. Emirates	292	1.7%
5. Lufthansa	266	1.6%
6. American Airlines	203	1.2%
7. Cityjet	193	1.1%
8. FlyBE	183	1.1%
9. Delta Air Lines	164	1.0%
10. Air France	163	1.0%
11. Etihad Airways	162	1.0%
12. Scandinavian Airlines	160	1.0%
13. United Airlines	156	0.9%
14. Turkish Airlines	117	0.7%
15. SWISS	105	0.6%
Other Airlines	781	4.6%
Total	16,828	100.0%

Source: Diio Schedule Data for 2016. Figures based on marketing rather than operating carrier. Notes: Numbers sum to total due to rounding.

3.3 Measuring Airport Connectivity

Connectivity is essential in the international marketplace and it is fundamentally about access to markets and destinations. A country or region that has continental and intercontinental linkages to only 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 in order for people to travel and goods to be shipped. 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 reach a range of destinations.

This is a particularly important consideration for Ireland as a small open economy positioned on the western tip of Europe. Air access is critical for Ireland's economic development. Dublin Airport's pre-eminent position in the Irish aviation sector delivers the critical mass required to attract the necessary services to key short and long-haul destinations for both business and leisure markets. Direct connections are essential for both expanding Irish export trade and growing foreign direct investment in Ireland. Dublin Airport is also a key gateway for Northern Ireland.

To capture the importance of connectivity, 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 2016, Atlanta airport was the world's largest airport, and so was given a weighting of one. London Heathrow, which handles 73% of the number of passengers handled by Atlanta, was given a weighting of 0.73. Therefore, if an airport has 1,000 seats available to Atlanta it is given a weighted total of 1,000. But if it also has 1,000 seats available to London Heathrow, these are only given a weighted total of 730. The weighted totals are then summed for all destinations (and divided by a scalar factor of 1,000) to determine the connectivity indicator.

A higher figure for the connectivity indicator denotes a greater degree of access to the global air transport network. Figure 3-7 shows the connectivity scores of European airports in 2016. The highest ranked airports are major hubs such as Heathrow, Frankfurt and Paris CDG. Dublin Airport ranks 12th in Europe, just behind Zurich and Copenhagen and ahead of Vienna, Berlin and Gatwick. Dublin ranks ahead of Gatwick, despite the latter handling considerably more passenger traffic (43.1 million vs 27.9 million at Dublin), due to Dublin's more extensive network, especially regarding long-haul connectivity.¹⁵

Few European airports can match Dublin Airport's connections to Ireland's established markets of Britain and the United States. For example, in 2016 Dublin Airport served more routes and operated more frequencies to Britain than either Frankfurt or Paris Charles de Gaulle and

15. <http://www.gatwickairport.com/business-community/about-gatwick/performance-reports/monthly-traffic-figures/>.

The connectivity index is therefore calculated as:

[Number of destinations x Weekly Frequency x Seats per flight]
Weighted by the Size of the Destination Airport

Scalar factor of 1000

almost as many as Amsterdam.¹⁶ During summer 2016, Dublin Airport had more weekly frequencies to North America than either Munich or Zurich.¹⁷ In addition, Dublin Airport is developing its European links and expanding into the Middle East, Africa and beyond.

As shown in Figure 3-7, Dublin has achieved comparable levels of connectivity to Barcelona, Copenhagen, Berlin, and Stockholm, cities that are arguably competitors to Dublin for tourism, trade and FDI. However, to remain competitive with or overtake these cities, Dublin Airport will need to continue to enhance its connectivity. Achieving higher connectivity will require the efforts of all airport stakeholders and will be dependent on supportive and expansive aviation policy, regulation and

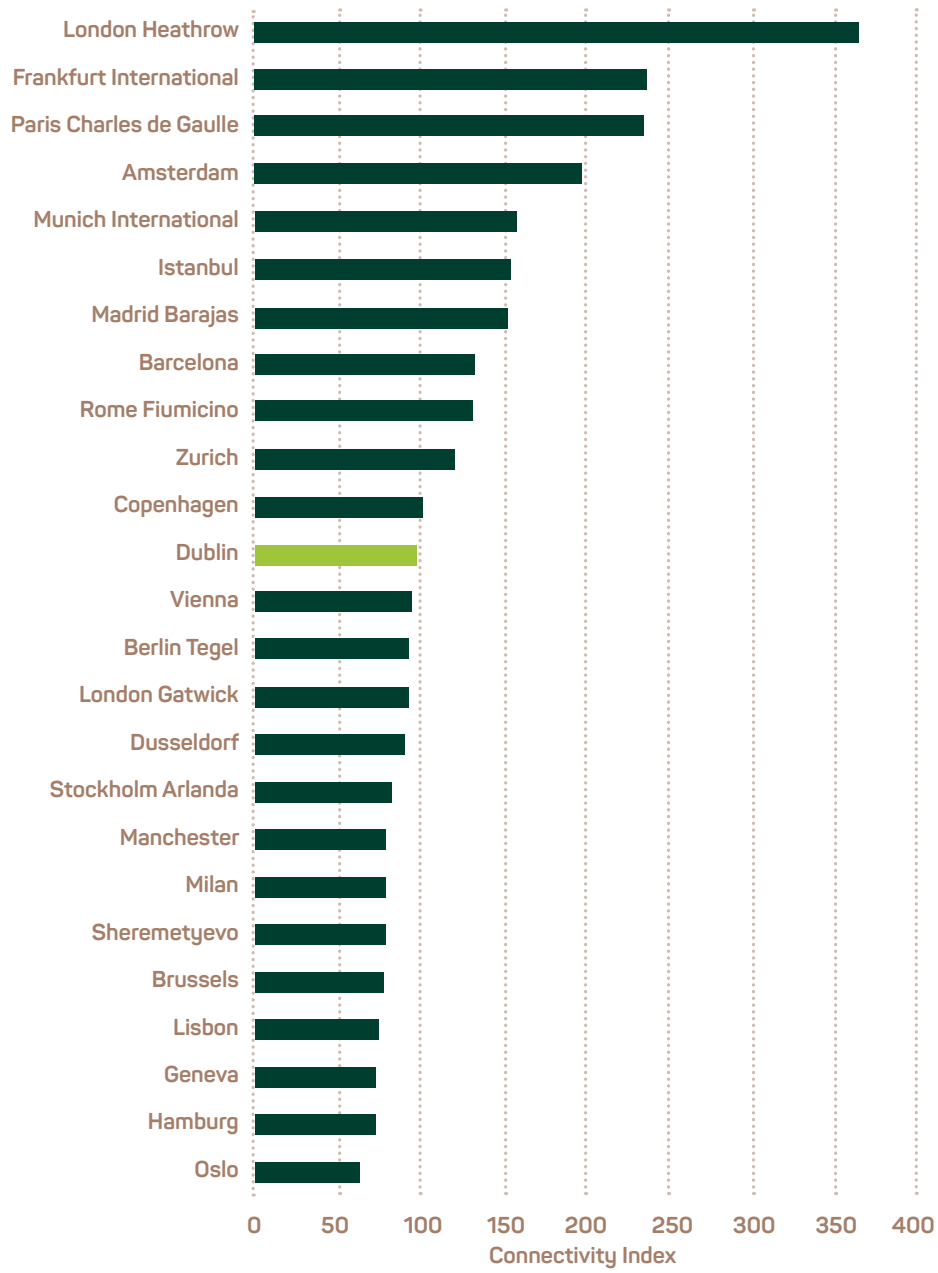
planning regimes. Dublin Airport must also be enabled to expand its facilities to meet demand. The pay-off will be even greater economic growth and development for Dublin and Ireland, as increased air connectivity facilitates increased trade, tourism, investment and economic growth (as documented in **Appendix B**). A recent report by Airbus characterised Dublin as one of 55 global “mega-cities” which provide high levels of connectivity and substantial long haul connectivity.¹⁸ The report highlighted that, without expansion, Dublin faced capacity constraints that would prevent the airport meeting future demand.

16. Source: Diio Schedule Data for 2016.

17. Source: Diio Schedule Data for Summer 2016.

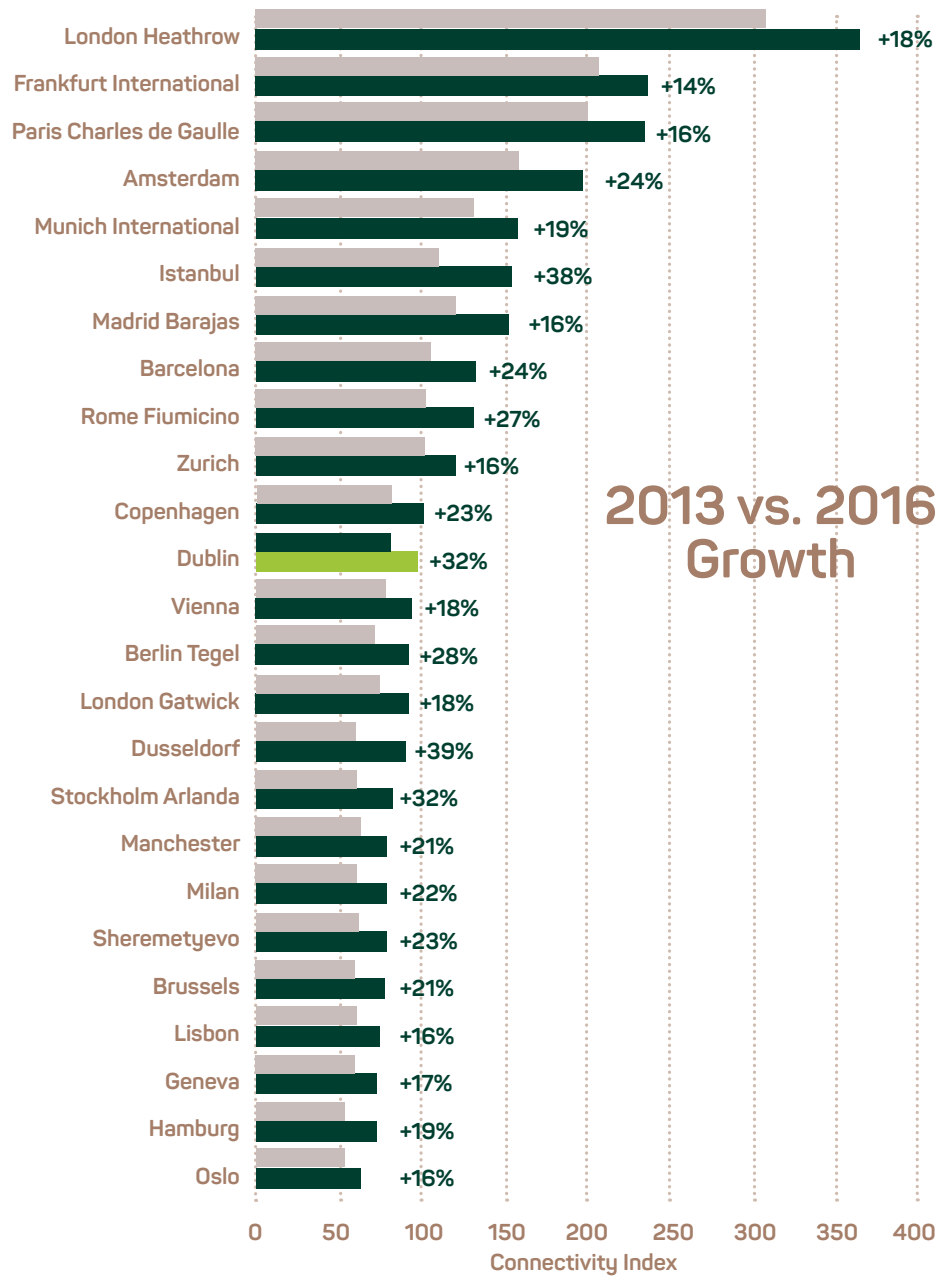
18. “Mapping Demand: Global Market Forecast 2016-35”, Airbus, <http://www.airbus.com/company/market/global-market-forecast-2016-2035/>.

Figure 3-7: Top 25 European Airports Based on the IATA Connectivity Index (2016)



Source: Based on Diio Schedule Data 2016.

Figure 3-8: Top 25 European Airports Based on the IATA Connectivity Index (2013 vs. 2016)



Source: Based on Diio Schedule Data 2013 & 2016.

A comparison of connectivity scores from 2013 to 2016 is also provided for the top 25 European airports in **Figure 3-8**. Dublin Airport had a connectivity score of 75.1 in 2013, which grew to 97.2 in 2016, with a growth of 32%, placing Dublin Airport in the top five European airports for connectivity growth over the last three years. In 2016, Dublin Airport was ranked first in Europe for connectivity to London and ranked fifth in Europe for its connectivity to the U.S. and Canada.

The airports with the highest connectivity tend to be those serving relatively large economies with large populations, such as the UK, Germany and France. Dublin Airport's connectivity is even more pronounced when compared against the size of its economy or its population.

Figure 3-9 shows national connectivity (the aggregate of the connectivity scores of all major airports in the country) divided by the country's GDP, while **Figure 3-10** shows national connectivity divided by population.¹⁹ Ireland's connectivity index includes the combined connectivity scores of Dublin, Cork, Shannon, Knock, Kerry and other airports. However, Dublin accounted for 85% of the nation's total connectivity score in 2015. As can be seen, Ireland has one of the highest GDP-

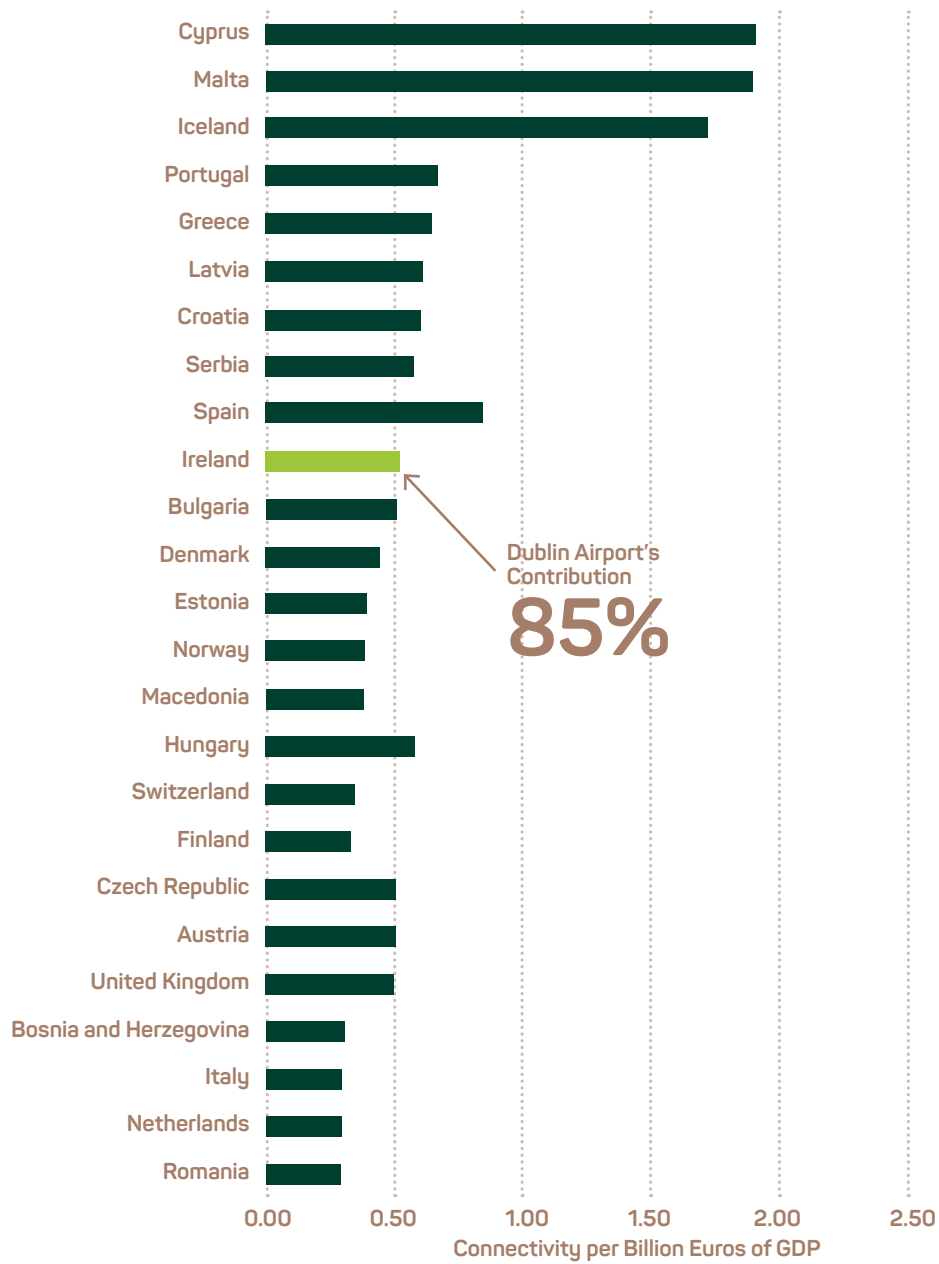
adjusted connectivity scores in Europe among major economies, 40% higher than that of the UK. Dublin Airport alone contributes higher connectivity per Euro of GDP than the UK in total.

Similarly, Ireland's connectivity per million of population is above most other European nations. With the exception of Switzerland, the most highly connected countries on a per capita basis are islands or somewhat inaccessible countries (e.g., Norway), reflecting the importance of air connectivity for these countries.

This analysis demonstrates that Dublin Airport is a major infrastructure asset for the country and a critical contributor to Ireland's connectivity with the rest of the world.

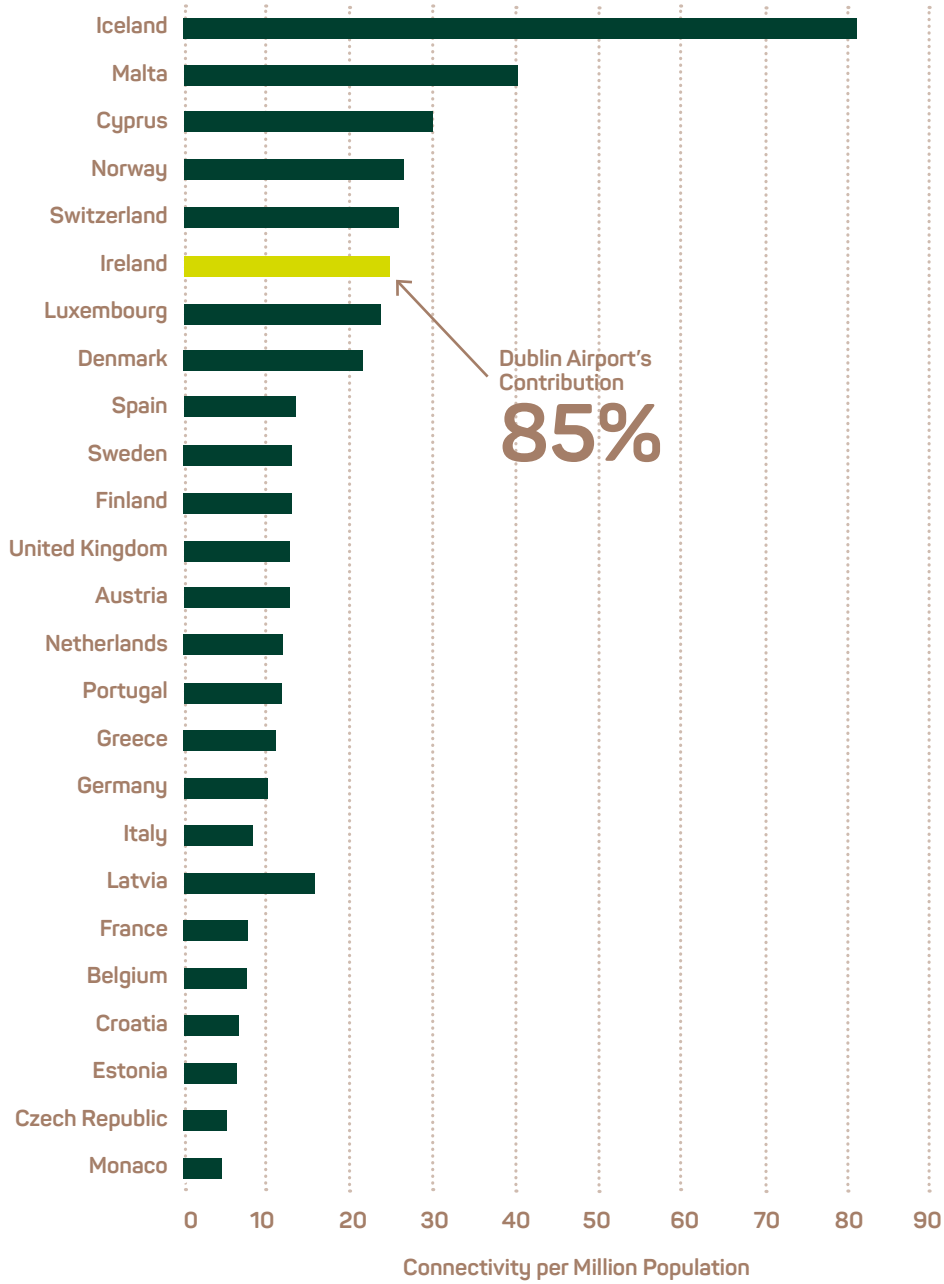
19. Figures are based on 2015 data as 2016 GDP data is not available for all countries.

Figure 3-9: Connectivity Relative to Gross Domestic Product (2015) – Top 25 Countries



Source: Based on Diio Schedule Data and World Bank Data for 2015. Figures are based on 2015 data as 2016 GDP data is not available for all countries.

Figure 3-10: Connectivity Relative to Population (2015) – Top 25 Countries



Source: Based on Diio Schedule Data and World Bank Data for 2015. Figures are based on 2015 data as 2016 population data is not available for all countries.

Current Economic Contribution of Dublin Airport



4. Current Economic Contribution of Dublin Airport

Key Points

- > In 2016, direct employment at Dublin Airport is estimated to be 19,200 jobs (17,100 FTEs).
- > Including multiplier impacts, the employment generated totals 45,600 jobs (40,500 FTEs), earning €1.7 billion in income/wages.
- > The catalytic impacts of Dublin Airport are estimated at 71,700 jobs and €5.0 billion in GVA.
- > Dublin Airport contributes to the employment of 117,300 people in the Republic of Ireland, (103,800 FTEs) and contributes a total of €8.3 billion to GDP, equivalent to 3.1% of national GDP in 2016.

The previous economic impact study for Dublin Airport estimated the airport's economic contribution in 2013.²⁰ These figures have been updated to reflect the airport's economic contribution in 2016, taking into account the traffic growth at Dublin Airport between 2013 and 2016 and adjusting for inflation, as described in Chapter 2. This chapter provides a summary of the updated economic impact of Dublin Airport, including the direct, indirect, induced and catalytic impacts.

4.1 Direct, Indirect and Induced Impacts

As described previously, the economic impact of Dublin Airport includes the direct impacts related to ongoing operations at Dublin Airport (including daa, airlines, air traffic control, ground handlers, airport security, immigration, customs, airport retail, etc.), as well as 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 income in the general economy.

As noted previously, economic impact can be measured in a number of ways:

- > **Employment** – the number of people employed by businesses involved in activities linked to Dublin Airport. This is measured in terms of jobs and full-time equivalents (FTEs), the latter of which allows for the fact that some jobs are not full-time (i.e. part-time or seasonal jobs are weighted less than full-time jobs).

- > **Income/Wages** – the wages and salaries earned by the people employed in activities linked to Dublin Airport.

- > **Gross Value Added (GVA)** – GVA is broadly equivalent to Gross Domestic Product (GDP), whereby the value-added of each industry sums to the total GDP of an economy.

²⁰ A copy of the study report is available at: <http://www.daainternational.ie/wp-content/uploads/2015/06/Dublin-Airport-Economic-Impact-Study-April-2015.pdf>.

The 2016 estimated economic impact of Dublin Airport is summarised in **Figure 4-1**. Direct employment supported by ongoing operations at Dublin Airport amounts to 19,200 jobs.

Adjusting for part-time and seasonal employment, this amounts to 17,100 Full-Time Equivalent jobs (FTEs). The

total direct GVA generated by Dublin Airport is estimated to be over €1.5 billion.

Adding in multiplier impacts (indirect and induced), the total employment supported by activities at Dublin Airport is estimated to be 45,600 jobs (or 40,500 FTEs), earning a total of €1.7 billion.

Figure 4-1: Total Economic Impact of Dublin Airport (2016)

Impact	Number of Jobs	Full-Time Equivalents (FTEs)	Income (€ Millions)	GVA (€ Millions)
Direct	19,200	17,100	€784	€1,540
Indirect	11,700	10,400	€456	€876
Induced	14,700	13,000	€488	€959
Total	45,600	40,500	€1,728	3,376

Updated figures based on 2016 traffic level. All financial figures are in 2016 prices. Numbers sum to total due to rounding.

4.2 Catalytic Impacts

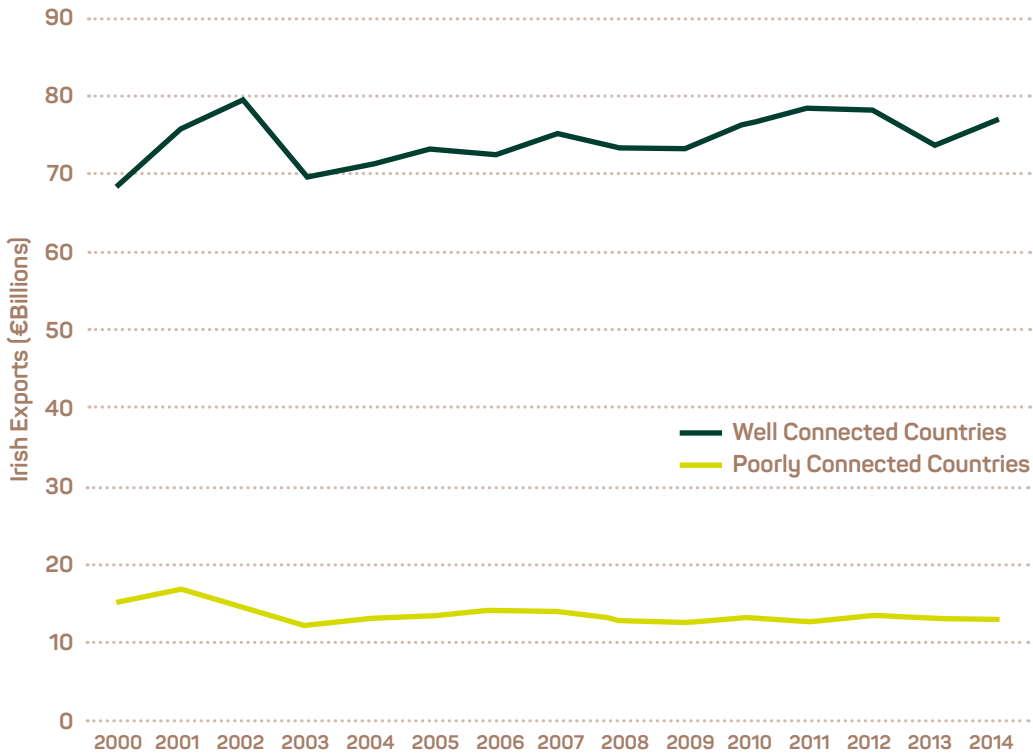
Appendix B summarises research examining the linkage between aviation connectivity and trade, investment, productivity and economic growth. Using data from the past 10-15 years, analysis was conducted that showed a clear linkage between Dublin Airport’s connectivity and trade and GDP growth.

The relationship between the connectivity of Dublin Airport and Ireland’s export trade is illustrated in **Figure 4-2**. It shows the value of merchandise exports (i.e., goods) from Ireland to countries with frequent air service from Dublin (at least five times per week on a year-round basis) and to those countries with limited or no frequencies from Dublin. The value of exports with the well-connected countries is five to six times that of trade

with poorly connected countries. While air connectivity alone cannot create trade, it is a necessary requirement for trade development. Poor air connectivity to a country will hinder the ability to develop business contracts, service clients and to compete with businesses in more connected countries.

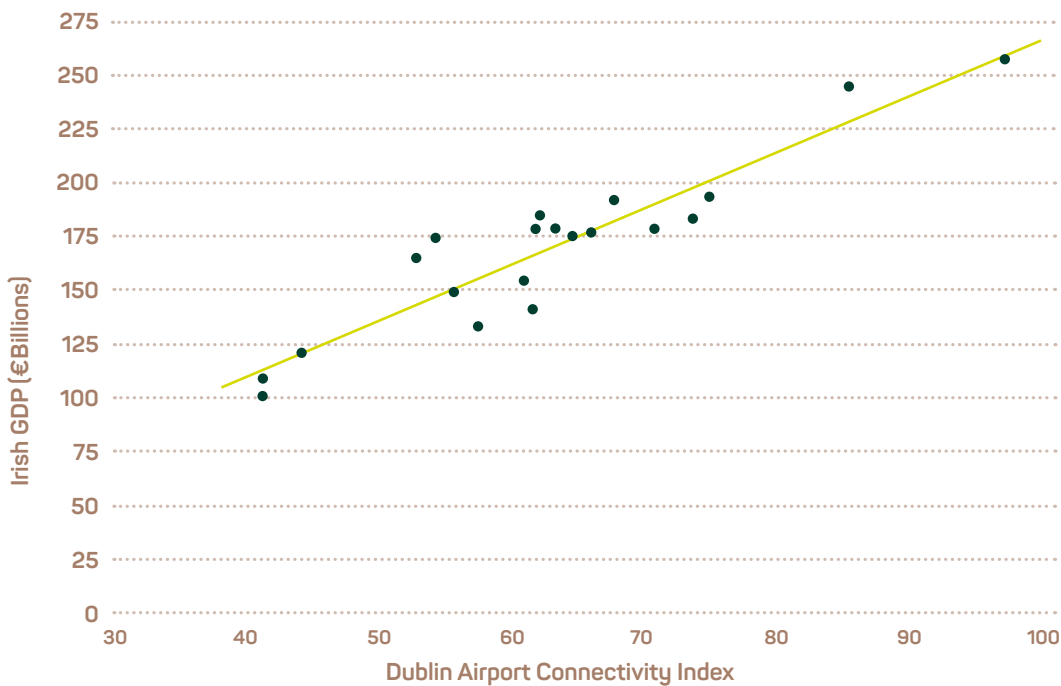
Figure 4-3 shows the relationship between Dublin Airport’s connectivity (using the IATA connectivity index) and national GDP. It shows a clear and fairly strong relationship between connectivity and GDP over time, consistent with findings in other research.

Figure 4-2: Ireland's Exports and Direct Services from Dublin Airport, 2000-2014



Source: Diio Schedule Data, Central Statistics Office Ireland and U.N. Comtrade Database. 2014 is the most recent data available.

Figure 4-3: National GDP and Dublin Airport Connectivity, 1997-2016



Source: Diio Schedule Data and Central Statistics Office Ireland.

The plots presented are indicative of the underlying relationship between Dublin Airport’s connectivity and economic development. More detailed analysis would be required to control for other factors affecting the economic indicators (e.g., government policy, general economic environment, etc.) and to establish the nature of the causal relationship between connectivity and the economic indicators. For example, air connectivity alone cannot create trade – a new air service to a country will not guarantee a surge in trade with that country. That said, it is also the case that poor air connectivity to a country will hinder the ability to develop business contracts, service clients and to compete with businesses in better connected countries.

As described in Section 2.2, use has been made of the results from a larger European study in order to estimate the catalytic impact of Dublin Airport, which are presented below.

The employment, income and GDP associated with the catalytic impacts of Dublin Airport are based on the previous economic impact study, updated to reflect 2016 traffic levels. These are presented in **Figure 4-4**. It is estimated that a total of 71,700 jobs are associated with the catalytic impacts of Dublin Airport, earning €2.5 billion in income and wages. The catalytic impacts of Dublin Airport facilitated nearly €5.0 billion in GDP.

Figure 4-4: The Catalytic Impacts of Dublin Airport (2016)

Impact	Number of Jobs	Full-Time Equivalents (FTEs)	Income (€ Millions)	GVA (€ Millions)
Direct	71,700	63,300	€2,523	€4,972

Updated figures based on 2016 traffic level. All financial figures are in 2016 prices. Numbers sum to total due to rounding.

4.3 Total Impacts






The total economic impacts of Dublin Airport - activity directly related to the airport, the multiplier impacts that flow from it and the other sectors of the economy facilitated by the airport (also referred to as “catalytic impacts”) – are shown in **Figure 4-5**. Dublin Airport contributes to the employment of 117,300 people in the Republic of Ireland, equivalent to 103,800 full-time jobs, earning a total of €4.3 billion. Furthermore, a total of €8.3 billion is contributed to GDP, an amount equal to 3.1% of the national economy.²¹

While these figures are substantial, it is worth considering how Ireland’s economy might look if the country did not have a hub airport the size of Dublin

Airport offering the scope of air services currently provided. At the most extreme, Ireland could have no commercial airports, instead relying on sea access to airports in the UK, or Dublin could have smaller regional airports acting as spokes for other hubs in the UK and the rest of Europe, so that passengers would have to travel via these hubs to get to many parts of the world. In such scenarios, it is easy to imagine that tourism in Ireland would be much lower, that Dublin would not be able to attract as many carriers to operate services (or to have aircraft maintained and repaired in Ireland), that the overall volume of trade would be substantially lower, and that some companies would choose not to locate or expand in Ireland. The net effect of this would be a smaller, slower-growing economy.

21. Based on CSO estimates of 2016 GDP: <http://www.cso.ie/en/releasesandpublications/er/na/quarterlynationalaccountsquarter42016/>, 9 March 2017. The CSO increased Ireland’s GDP by 26.3% in 2015 due to a number of one-off factors such as corporate inversion deals (companies moving residence to Ireland), transfer of patents and relocation of aircraft leasing assets. As a result of this financial inflation of the GDP figures, Dublin Airport’s contribution to national GDP is now 3.1% rather than 4.0% reported in the 2015 economic impact report. This reduced percentage does not mean that Dublin Airport’s contribution to the economy has declined – without the 2015 adjustment to the GDP figures, Dublin Airport’s percentage contribution to GDP would have maintained or increased.

Figure 4-5: Total Economic Impact Generated and Facilitated by Dublin Airport (2016)

Impact	 Number of Jobs	 Full-Time Equivalents (FTEs)	 Wages (€ Millions)	 GVA (€ Millions)	 GVA as % of National GDP
Direct	19,200	17,100	784	1,540	0.6%
Indirect	11,700	10,400	456	876	0.3%
Induced	14,700	13,000	488	959	0.4%
Catalytic	71,700	63,300	2,523	4,972	1.8%
Total	117,300	103,800	4,251	8,348	3.1%

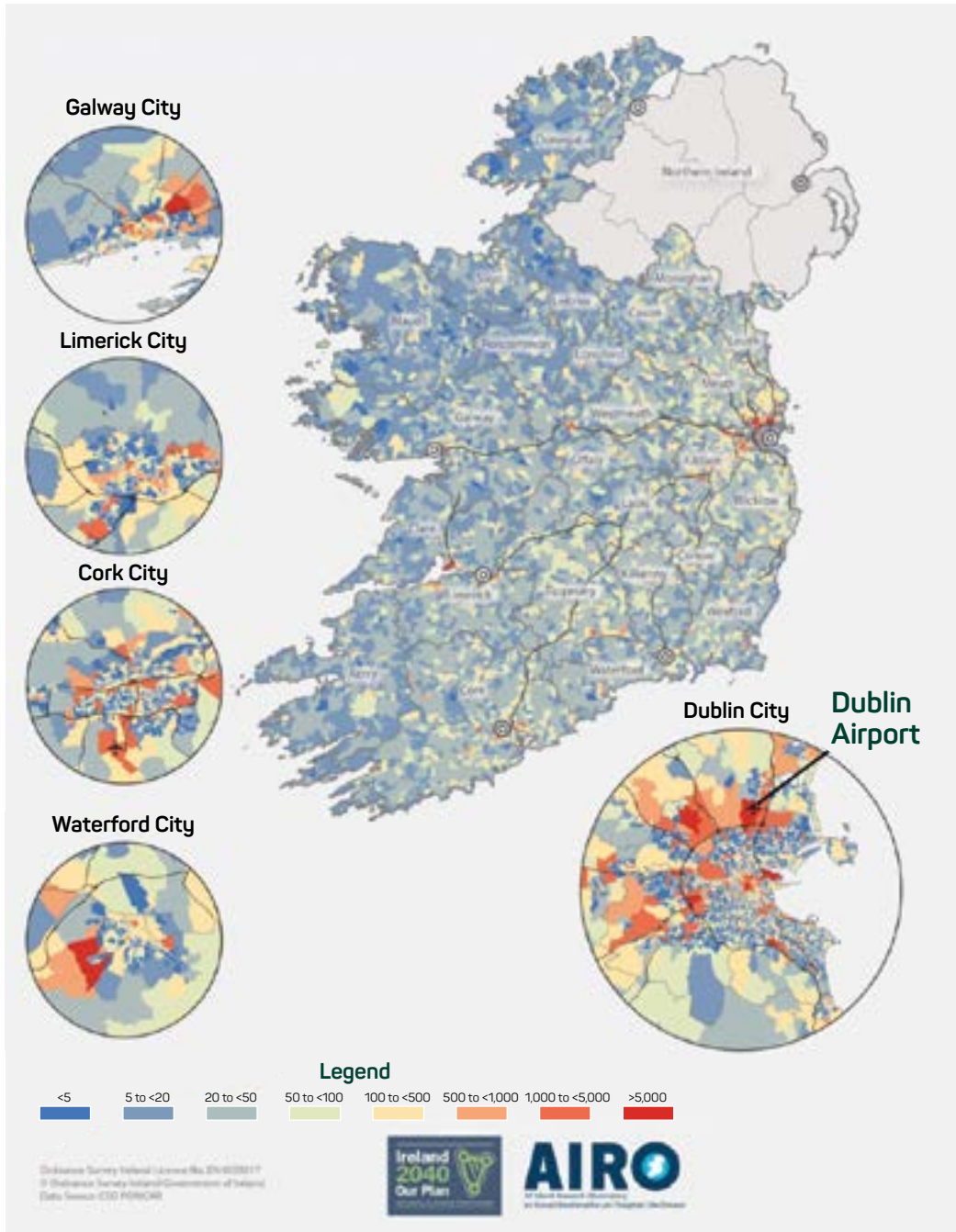
Updated figures based on 2016 traffic level. All financial figures are in 2016 prices. Numbers sum to total due to rounding.

The previous economic impact study of Dublin Airport found that 89% of the direct employment generated by Dublin Airport occurred in Fingal and that 26% of the total employment associated with the airport (direct, indirect, induced and catalytic impacts) occurred in Fingal.²²

The clustering of employment around Dublin Airport is further illustrated in **Figure 4-6**, which shows the location of jobs around Ireland. As can be seen, the area around Dublin Airport is amongst the areas of highest employment density in Ireland..

22. <http://www.daairport.ie/wp-content/uploads/2015/06/Dublin-Airport-Economic-Impact-Study-April-2015.pdf>.

Figure 4-6: Locations of Jobs by Small Area, 2011



Source: Ireland 2040 Our Plan, National Planning Framework, February 2017

Glossary of Terms and Abbreviations

Catalytic Impacts	<p>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.</p> <p>Air transport creates catalytic impacts primarily through increased connectivity and improves national economic performance through the following mechanisms: tourism, trade in goods and services, investment, and increased productivity.</p>
CSO	Central Statistics Office, Ireland.
daa	State owned corporation responsible for the operation and management of Dublin and Cork airports, and ARI and daa International.
Direct Impacts	Direct Impacts arise immediately from the conduct of those entities performing the activity in question. For an airport, the “direct impacts” would include the activities of airlines, the airport itself, 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 or deplanes an aircraft.
Economic Impact	Economic Impact is a measure of the employment, spending and economic activity associated with a business, a sector of the economy, a specific project (such as the construction of a new facility), or a change in government policy or regulation.
FDI	Foreign Direct Investment. Investment from one country into another (normally by companies rather than governments) that involves establishing operations or acquiring tangible assets, including stakes in other businesses.
FTE	A full-time equivalent (FTE) year of employment is equivalent to the number of hours that an individual would work on a full-time basis for one year (also known as a person year). FTEs are useful because part-time and seasonal workers do not account for one full-time job.
GDP	Gross Domestic Product, a measure of the total output of an economy.
GVA	Gross Value Added (GVA) – the value of the operating surpluses of business linked to Dublin Airport, plus the income/wages of employees and consumption of fixed capital. GVA is broadly equivalent to Gross Domestic Product (GDP), whereby the value- added of each industry sums to the total GDP 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). 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.
Multiplier Impacts	Economic multipliers are used to infer indirect and induced effects from a particular sector of the economy. These are typically derived from an Input-Output model.
Wider Economic Benefits	See Catalytic Impacts.

Appendix A: Further Information on the Input-Output Tables and the Economic Multipliers

As described in Chapter 3, the economic impact multipliers (indirect and induced) impacts were based on an Input-Output (I-O) model of the economy of the Republic of Ireland maintained by the Irish Central Statistics Office, updated in 2016.

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 A-1** illustrates the basic structure of the input-output model.

In **Figure A-1**,

- > The first row characterises 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, labour 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 grouped together as purchases from what is called the payments sector (Vi in Figure A- 1).

Figure A-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		

Analytically, we have the following basic identity for sector i
 $X_i = Z_{i1} + Z_{i2} + \dots + Z_{in} + Y_i, i = 1, \dots, n. (1)$

In the case of Ireland, the net final demand (Y) is the sum of the following items:

- > Final consumption of households;

- > Government consumption expenditure;

- > Gross capital formation;

- > Change in inventory; and

- > Exports.

For Ireland, the total value-added (V) is the sum of the following items:

- > Imports of goods and services;

- > Operating surplus;

- > Compensation of employees;

- > Consumption of fixed capital;

- > Product and other indirect taxes less subsidies.

In other words, referring back to Figure A-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

The 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.²³ 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:

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

This leads to the matrix representation:

$$X = A X + Y \quad (3)$$

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

$$X = (I - A)^{-1} Y \quad (4)$$

where **I** stands for the identity matrix. And the matrix $(I - A)^{-1}$ 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.

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

23. Leontief, Wassily W. Input-Output Economics. 2nd ed., New York: Oxford University Press, 1986.

demand components. The action of the multiplier can be illustrated by the sequence of events that follow 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 B: Overview of Catalytic Impacts

As discussed in Chapter 1, catalytic impacts capture the way in which aviation facilitates the business of other sectors of the economy. This comprises:

- > **Tourism** – air service facilitates the arrival of larger numbers of tourists to a country. This includes business as well as leisure tourists. The financial gain from these tourists can support a wide range of tourism-related businesses: hotels, restaurants, entertainment and recreation, car rentals, and others.

- > **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 is the proximity to an international airport.

- > **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 calibre employees.

A number of studies have demonstrated that air transportation plays an important role in trade, investment and business location decisions, while additional studies have uncovered empirical evidence demonstrating a strong linkage between air service and employment and economic growth. Provided below is a summary of this research examining the catalytic impact of aviation, taken from academic and industry research.

Trade

A number of research papers have produced evidence that aviation positively contributes to the trade of both goods and services.

Paper	Methodology	Key Findings
Cech (2004) ²⁴	Used a cross-section statistical comparison method to investigate how air cargo services affect the economies of 125 U.S. counties.	Higher levels of air cargo services contribute to increased earnings and increased employment.
EUROCONTROL (2005) ²⁵	The study estimated the net contribution of air transportation to trade (i.e., export minus imports).	Net contribution of air transportation to trade was €55.7 billion in 2003 across the 25 current EU members.
UK Institute of Directors (2008) ²⁶	Surveyed 500 UK businesses about their use and the importance of air transportation.	The use of air travel strongly linked to business trade and sales. 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.

24. Cech P. (2004), "The Catalytic Effect of the Accessibility to Air Cargo Services", TIACA Graduate Research Paper Competition.

25. Cooper, A. and Smith, P. (2005), "The Economic Catalytic Effects of Air Transport in Europe," Commissioned by EUROCONTROL. EUROCONTROL is a civil and military organisation established in 1963 to facilitate a safe, seamless pan-European Air Traffic Management (ATM) system.

26. 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

Paper	Methodology	Key Findings
Poole (2010) ²⁷	Econometric analysis of U.S. trade and travel data from 1993 to 2013.	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. The effect was strongest for travel from non-English speaking countries, suggesting that business travel help overcome language barriers in trade relationships.
PWC (2013) ²⁸	Examined the relationship between the UK's international air seat capacity and international trade, controlling for other factors affecting trade.	A 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%.

Investment and Business Location

The impact of aviation on investment and business location decisions has been the subject of a number of papers. These papers have found evidence of air connectivity contributing to increased investment and beneficial location decision for the surrounding regions or the country.

Hansen and Gerstein (1991) ²⁹	Used data from 1982 to 1987, the analysis related the amount of Japanese investment in each US state to measures of level of air service operated between Japan and that state (and other background factors).	The amount of Japanese investment in each US state was causally linked to the air service between Japan and that state.
EUROCONTROL (2005) ³⁰	Analysed the relationship between air transportation and business investment in the EU.	A 10% increase in air transportation usage increases business investment by 1.6% in the long run (the impact takes approximately five years to fully manifest).
IATA (2005) ³¹	IATA surveyed 625 businesses in five countries (China, Chile, United States, Czech Republic and France).	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.
Bel and Fageda (2008) ³²	Statistically analysed the relationship between international air service and the location of large firm's headquarters across major European urban areas.	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.

27. Poole, J. (2010), "Business Travel as an Input to International Trade", <http://www.scu.edu/business/economics/upload/Poole.pdf>

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

29. Hansen, M. and R. Gerstein "Capital in Flight: Japanese Investment and Japanese Air Service in the United States During the 1980s," *Logistics and Transportation Review*, 1991, Vol. 27, No. 3, pp. 257-276.

30. Cooper, A. and Smith, P. (2005), "The Economic Catalytic Effects of Air Transport in Europe," Commissioned by EUROCONTROL. EUROCONTROL is a civil and military organisation established in 1963 to facilitate a safe, seamless pan-European Air Traffic Management (ATM) system.

31. Airline Network Benefits, IATA Economic Briefing No. 3, 2006.

32. Bel, G. and Fageda, X. (2008), "Getting There Fast: Globalization, Intercontinental Flights and Location of Headquarters", *Journal of Economic Geography*, Vol. 8, No. 4.

Paper	Methodology	Key Findings
Arndt et al. (2009) ³³	Survey of 100 foreign-owned businesses in Germany.	Air connectivity was one of the four most important factors affecting location decisions, and that 57% of businesses would have chosen another location had connectivity been less good.
PWC (2013) ³⁴	Econometric analysis of the UK's air connectivity, air seat capacity and Foreign Direct Investment (FDI).	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.

Impact on Employment, Economic Growth and Productivity

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

Button, Lall, Stough and Trice (1999) ³⁵	Used data from 321 US metropolitan areas in 1994 to regress high-tech employment against a number of controlling factors including a dummy indicating that the region was served by a hub airport.	The analysis found that the presence of a hub airport increased high-tech employment by an average of 12,000 jobs in a region.
Button and Taylor (2000) ³⁶	Used data for 41 metropolitan areas in the US to regress "new economy" employment against a number of control factors including the number of direct routes to Europe offered by airports in the region.	Increasing the number of routes between the US and Europe from 3 to 4 at an airport generated approximately 2,900 "new economy" jobs in the surrounding region.
Brueckner (2002) ³⁷	Regressed employment in 94 metropolitan areas in the US against a number of factors including measures of air service.	A 10% increase in passenger enplanements in a metropolitan area leads to an approximately 1% increase in employment in service-related industries.
Ishutkina and Hansman (2009) ³⁸	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).	Found statistical evidence of a (two-way) feedback relationship between air transport and economic activity.

33. 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.

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

35. 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.

36. Button, K. and Taylor, S. (2000), "International air transportation and economic development", *Journal of Air Transport Management*, Vol. 6, Issue 4, October 2000.

37. Brueckner, J. (2002), "Airline Traffic and Urban Economic Development".

38. 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.

Paper	Methodology	Key Findings
PWC (2013) ³⁹	Estimated an Error Correction Model of UK GDP and air seat capacity between 1991 and 2010.	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.
ACI Europe/ InterVISTAS	Analysed the relationship between national air connectivity and GDP per capita using data for 40 European countries between 2000 and 2012.	This recently completed analysis found that a 10% increase in connectivity was associated with an increase in GDP per capita of 0.6%. 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 appears to also be the case that growth in air transport supports economic growth.

Conclusions

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 and economic growth.

Through the use of different empirical methods and data sets, this research has consistently found a significant and positive relationship between aviation and economic growth.

Furthermore, much of the research has established that air transport growth has been the cause of economic growth, rather than economic growth alone leading to increased air transport levels.

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

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