Economic Impact of Luxembourg Airport

PREPARED FOR
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Executive Summary

It is clear that airports and economic activity are closely associated and in the context of a European single market and an increasingly global market, air transport is essential to economic progress. As a small, open economy, Luxembourg is crucially dependent on its air links to facilitate its economy. Société de l’Aéroport de Luxembourg commissioned a study to quantify the contribution of Luxembourg Airport (LUX) to the growth of the national economy. The key findings are presented below.

Luxembourg Airport is a vital element of national infrastructure and an important facilitator of economic development. Its economic importance is reflected in the estimated 24,170 jobs supported or facilitated by the airport and the €2.6 billion contributed to Gross Domestic Product (GDP).
Direct, indirect and induced impacts: day-to-day activity at Luxembourg Airport directly provides employment for 6,280 people. Together with the businesses that supply the goods and services to airport activity (indirect impacts) and spending of employees in the wider economy (induced impacts), a total of 14,870 jobs are supported by Luxembourg Airport.

The economic impact of airport activity is provided in Figure ES-1. Economic impact can be measured in a number of ways:

- **Employment** – the number of people employed by businesses involved in activities linked to Luxembourg Airport.
- **Wages** – the wages and salaries earned by the people employed in activities linked to Luxembourg Airport.
- **Gross Domestic Product (GDP)** – the value of the operating surpluses of business linked to Luxembourg Airport, plus the income/wages of employees and consumption of fixed capital.

Figure ES-1: Direct, Indirect, Induced Economic Impact of Luxembourg Airport

<table>
<thead>
<tr>
<th>Impact</th>
<th>Employment</th>
<th>Wages (€ Millions)</th>
<th>GDP (€ Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>6,280</td>
<td>€380</td>
<td>€590</td>
</tr>
<tr>
<td>Indirect</td>
<td>4,030</td>
<td>€200</td>
<td>€330</td>
</tr>
<tr>
<td>Induced</td>
<td>4,560</td>
<td>€210</td>
<td>€400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14,870</strong></td>
<td><strong>€790</strong></td>
<td><strong>€1,320</strong></td>
</tr>
</tbody>
</table>

Direct employment supported by ongoing operations at Luxembourg Airport (Lux-Airport, airlines, air traffic control, ground handlers, airport security, immigration, customs, airport retail, etc.) amount to 6,280 jobs. The total wages of these employees is estimated to be €380 million. The total direct GDP generated by Luxembourg Airport is estimated to be €590 million, equivalent to 1.2% of national GDP.¹

Adding in multiplier impacts (indirect and induced), the total employment supported by activities at Luxembourg Airport is estimated to be 14,870 jobs, earning a total of €790 million. Total GDP is estimated to be €1.3 billion, approximately 2.6% of national GDP.

¹ Source: Eurostat. The estimated GDP of Luxembourg in 2015 is €51.2 billion.
Catalytic impacts: the connectivity provided by Luxembourg Airport helps attract tourists, facilitates trade and investment, and contributes to the growth of the economy. These catalytic impacts total 9,300 jobs and €1.3 billion in GDP.

The economy of Luxembourg is a diversified knowledge-based economy, focusing on banking, steel, information technology and other industry and services. Adjusted for cost of living (purchasing power parity), the IMF ranks Luxembourg first in Europe and second in the world, behind Qatar, in terms of per capita GDP for 2015.²

A large number of factors have contributed to Luxembourg’s economic success – business regulations, government policy, taxation, the education and skillset of the local population, geographic location, etc. Nevertheless, the quality and range of air services available at Luxembourg Airport is a contributing factor. Luxembourg’s position as a trading and business hub would not be possible without the high degree of air connectivity provided by Luxembourg Airport. The air service at Luxembourg Airport transports high-value exports around the world and enables employees of Luxembourg and multinational businesses to travel to clients, regional offices and global headquarters. Many of the businesses with headquarters or operations in Luxembourg would not be located there without the mobility that Luxembourg Airport provides.

Analysis was undertaken to estimate the catalytic impacts of Luxembourg Airport. The results of this analysis are provided in Figure ES-2. It is estimated that the catalytic impacts of Luxembourg Airport amount to 9,300 jobs and €1.3 billion in GDP (equivalent to the 2.5% of national GDP).

Figure ES-2: Catalytic Impacts Facilitated by Luxembourg Airport

<table>
<thead>
<tr>
<th>Impact</th>
<th>Employment</th>
<th>Wages (€ Millions)</th>
<th>GDP (€ Millions)</th>
<th>% of National GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalytic</td>
<td>9,300</td>
<td>€580</td>
<td>€1,260</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

² International Monetary Fund, World Economic Outlook Database, October 2015.
Total Impacts: combining the direct, indirect, induced and catalytic impacts, Luxembourg Airport generates or facilitates 24,170 jobs and contributes €2.6 billion to GDP.

The total economic impact of Luxembourg Airport is summarised in Figure ES-3. Including 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, Luxembourg Airport contributes to the employment of 24,170 people in Luxembourg, earning a total of €1.4 billion. Furthermore, a total of €2.6 billion is contributed to GDP, an amount equal to 5.0% of the national economy.

It should be noted that these figures are not attempting to credit Luxembourg Airport with creating 5% of the economy. The Luxembourg 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 no one had decided to build hotels in Luxembourg, tourism would also be substantially lower. What the figures do show is that without Luxembourg Airport, and particularly without the connectivity at the airport, the Luxembourg economy would not be as large, affluent or diverse as it is today.

Figure ES-3: Total Economic Impact Generated and Facilitated by Luxembourg Airport

<table>
<thead>
<tr>
<th>Impact</th>
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Société de l'Aéroport de Luxembourg S.A. (Lux-Airport) commissioned InterVISTAS Consulting Ltd. to conduct an economic impact study of Luxembourg Airport (LUX). This report documents the methodology and findings of the study, and is structured as follows:

- Chapter 2 outlines the methodology used to estimate the economic impact of LUX.
- Chapter 3 presents an overview of the traffic activity at LUX.
- Chapter 4 provides the economic impact directly generated by the activities at LUX.
- Chapter 5 provides estimate of the down-stream multiplier impacts (indirect and induced impacts) generated by the activities at LUX.
- Chapter 6 discusses the catalytic impacts facilitated by air service at LUX and provides an estimate of the economic contribution to Luxembourg.
- Chapter 7 totalises the economic impact of Luxembourg Airport, including direct, indirect, induced and catalytic impacts.

1.1 What is 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 LUX. Economic impact can be measured in a number of ways:

- **Employment** – the number of people employed by businesses involved in activities linked to the airport.
- **Wages** – the wages and salaries earned by the people employed in activities linked to the airport.
- **Contribution to Gross Domestic Product (GDP)** – measures the money value of final goods and services produced by airport activities, and includes operating surplus of businesses, employee remuneration and capital consumption.

It should be borne in mind that these measures attempt to assess the gross level of activity or expenditure associated with the airport. As such, they are not “net” measures that weigh benefits against costs, but nevertheless these measures can be useful in demonstrating the economic contribution of the airport.
1.2 Categories of Economic Impact

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

1.2.1 Direct Economic Impact

This is the employment, wages and GDP associated with the operation and management of activities at Luxembourg 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, 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, hotels, ground transport 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.

1.2.2 Indirect Economic Impact

The employment, wages and GDP generated by downstream industries that supply and support the activities at LUX. 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.

1.2.3 Induced Economic Impact

This captures the economic activity generated by the employees of firms directly or indirectly connected to the airport spending their wages in the national economy. For example, an airline employee might spend his/her wages 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.

1.2.4 Catalytic Economic Impacts

While the economic impact described above can be seen as downstream impacts resulting from activities at LUX, 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 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 0.5% of the volume of global trade shipments, it accounts for over 35% by value, meaning that air cargo is high value, often times perishable or time-sensitive.\(^3\) 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 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. 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 of an international airport. 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 enable 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 high quality employees. All of these factors contribute to enhanced productivity, which in turn increases the national income.

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 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 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, etc. For example, providing air connectivity alone does not guarantee large volumes of tourists. There also needs to be hotels, restaurants, retail, entertainment,

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etc. to make a destination an attractive tourism destination. Nevertheless, without convenient air services, a destination will find it more difficult to attract tourists.

What the catalytic impacts capture is that without an efficient airport and the air services it supports, 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 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. 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.

Catalytic impacts are discussed in greater detail in Chapter 6. These four categories of impacts are summarised in Figure 1-1.

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

- **DIRECT**
  - At airport and airport related businesses

- **INDIRECT**
  - Supplying and supporting businesses

- **INDUCED**
  - Employees spending economy

- **CATALYTIC**
  - Air service facilitating:
    - tourism
    - trade
    - investment
    - productivity growth
2 Methodology

A data driven methodology was applied to estimate the economic impact of LUX. Reliable and recognised data sources were used as the basis for the analysis, and established quantitative techniques used to generate the estimates.

The study methodology is summarised in Figure 2-1. The key elements are described in the sections below.

Figure 2-1: Study Methodology

2.1 Direct Impacts

The first stage in estimating the direct impact of LUX was to determine the current level of employment at the airport. This was done using data provided by Lux-Airport providing employment at the firms based at the airport. The data provided by the airport operator included employment for on-site companies such as airlines, air traffic controllers, retail/food and beverage, airport security screening, customs and immigration, cargo/logistics, general aviation and offices located on airport grounds, as well as ground transportation serving the airport and hotels located next to the airport.
2.2 Indirect and Induced Impacts

The indirect and induced impacts were estimated using economic multipliers, as is common practice for economic impact studies. In addition, the direct wage and GDP impacts were also estimated using economic multipliers.

These multipliers were based on the Input-Output model of the Luxembourg economy maintained by Eurostat. 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, remuneration, valued-added and economic output, normally expressed in terms of a unit of direct impact (e.g., per dollar of direct economic output).

The multipliers used in this study were based on the 2012 Input-Output tables (the I-O model output) maintained by Eurostat. These were the most current I-O tables available at the time of the study. The economic multipliers developed from the I-O tables have been updated to reflect current price levels, but no structural changes have been assumed.

As with any model of a complex economy, I-O models have their limitations. For example, I-O models assume constant returns to scale (i.e., no economies or diseconomies of scale) and a fixed input structure with no substitution of inputs (e.g., one fuel type cannot be substituted for another). Furthermore, due to the large amount of data collection and analysis required, the I-O data can be released several years after the period on which they are based, so may not precisely represent current conditions. Nevertheless, I-O models are the most widely accepted and well-established means for estimating multiplier impacts and are based on data unparalleled in its detail and breadth.

Further details on the I-O tables, including the derivation of the multipliers, are provided in Appendix A.

2.3 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

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air that spend money in their businesses.\textsuperscript{5} 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.

Measuring catalytic impact by direct surveys is 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.

An alternative 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 impact of LUX was estimated in this way, using findings from recent research.

The connectivity parameter was taken from a recent study undertaken by Inter VISTAS on behalf of ACI Europe.\textsuperscript{6} It was selected because it has been recently completed using the most current data and was based on data from 40 European countries including Luxembourg.

Further details on the study and the estimation of the catalytic impacts is provided in Chapter 6.

\subsection*{2.4 Total Impacts}

The total economic impact generated and facilitated by LUX was based on the sum of the direct, indirect, induced and catalytic impacts.

\footnotesize
\begin{itemize}
\item 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.
\end{itemize}
3 Overview of Luxembourg Airport

Located outside Luxembourg City, Luxembourg Airport is the only international airport in the country, and the only airport with a paved runway. LUX has been managed and operated by Lux-Airport since 2001. With the opening of a new passenger terminal in 2008, the airport has a capacity of 3 million passengers. LUX has significant cargo operations, and is headquarters to one of the largest scheduled all-cargo airlines in Europe, Cargolux.

3.1 Air Passenger Services

LUX handled nearly 2.7 million passengers in 2015. Over the last six years, passenger traffic has grown steadily at the airport from 1.6 million passengers in 2010, increasing by 11% on average each year. Passenger traffic reached a record of over 2 million passengers in 2013, and is predicted by the airport to reach 2.9 million in 2016. Figure 3-1 shows the growth in passenger traffic at LUX from 2010-2015, as well as the forecast for 2016.

Figure 3-1: Total Passenger Traffic at Luxembourg Airport, 2010-2016

Source: Administration de la Navigation Aérienne
In 2015, LUX offered direct non-stop services to 64 destinations across 20 different countries in Europe and Africa. African countries served include Cape Verde, Morocco and Tunisia. More than 20,200 outbound flights were scheduled in 2015. Services to Germany accounted for the largest proportion of non-stop flights at 22%, followed by the United Kingdom at 14%. With almost all non-stop flights destined for European countries, services to the three African countries comprised 1% of the total non-stop flights. Of the 23 airlines that operated non-stop flights at LUX in 2015, Luxair, the flag carrier airline of Luxembourg, comprised 68% of the services. A route map of non-stop flights offered in the 2015 summer period is presented in Figure 3-2, while a route map of non-stop schedules in the winter period of the same year is presented in Figure 3-3.

Figure 3-2: Map of Non-stop Flights from Luxembourg Airport, 2015 Summer Period
3.2 Air Cargo Operations

In 2015, LUX handled over 738,100 tonnes of air cargo (including freight and post), ranking 5th busiest airport in the Europe based on cargo tonnage (exclusive of express freight).\(^7\) Air freight amounted to 737,600 tonnes (99%), while air post summed up to 500 tonnes (1%) in 2015.

The volume of air cargo transported via LUX has reported an upward trend over the last three years, increasing from 615,000 tonnes in 2012 to 738,000 tonnes in 2015 (average growth of 6.3% per annum). **Figure 3-4** illustrates the change in total air cargo handled at the airport from 2006-2015, equivalent to a 1% average growth annually.

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\(^7\) Luxembourg Airport Press Release, *Air freight continues upward trend at Luxembourg Airport*, 20 January 2016.
Figure 3-4: Total Air Cargo Tonnage at Luxembourg Airport, 2006-2015

Source: Administration de la Navigation Aérienne
4 Direct Employment Impacts of Airport Activity

This section describes the direct employment and estimated wages attributable to employees directly related to ongoing activity and operations at LUX. Employment by industry is also provided.

4.1 Direct Employment, Wages and GDP

Direct employment related to ongoing operations at LUX amounts to 6,280 direct jobs. Employees at LUX receive an estimated €380 million in wages, providing an average of approximately €60,500 per job. Employment figures are summarized in Figure 4-1. In addition, ongoing LUX airport operations generate €590 million in direct GDP.

Figure 4-1: Annual Direct Employment, Wages and GDP Generated by LUX

<table>
<thead>
<tr>
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4.2 Direct Employment by Business Type

A breakdown of direct employment at LUX by industry type provides insight into the different businesses located at the airport. The following summary details direct employment of each industry:

- **Cargo/Logistics** account for 2,910 jobs at LUX with 46% of direct employment. This includes employment of freight forwarders, storage facilities, as well as Cargolux Airlines International and Luxair cargo employees.

- **Airline & Airline Services** account for 1,420 jobs at LUX with 23% of direct employment. Employment of ground handlers is included. (Cargolux Airlines International and Luxair cargo employees are not included in this category, but included in Cargo/Logistics above).
- **Other Aviation Support** accounts for 740 jobs at LUX with 12% of direct employment. This includes air traffic control, security and screening, as well as customs, immigration and other government services.

- **Hotels** account for 340 jobs at LUX with 5% of direct employment.

- The **Airport Company** accounts for 220 jobs at LUX with 4% of direct employment.

- **Other** business services (such as a consulting firm with an office at the airport and a facilities management firm) located at the airport account for 190 jobs at LUX with 3% of direct employment.

- **General Aviation** accounts for 190 jobs at LUX with 3% of direct employment.

- **Ground Transportation** firms (such as car rentals, taxis and buses) account for 150 jobs at LUX with 2% of direct employment.

- **Retail/Food & Beverage** account for 120 jobs at LUX with 2% of direct employment.

A breakdown of direct employment at LUX, by business type, is illustrated in Figure 4-2.
5 Indirect and Induced Impacts of Airport Activity

The previous section presented the direct economic impacts related to ongoing operations at LUX. However, the economic impact of the airport does not end there, as other sectors of the economy benefit from activity at the airport. This includes indirect impacts at businesses that supply 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.

5.1 Indirect Impacts

Indirect impacts are generated by suppliers to the businesses directly related to the airport. Based on the application of economic multipliers, it was estimated that 4,030 indirect jobs are related to LUX. In other words, 4,030 jobs are indirectly generated in industries that supply the businesses directly related to operations at the airport. The wages associated with the total indirect employment is estimated at €200 million per annum. The indirect GDP contribution is estimated at €330 million per year.

5.2 Induced Impacts

The induced employment is the result of demand for goods and services generated by wages earnings of those directly or indirectly linked to the airport. The induced employment attributable to LUX in 2015 is estimated at 4,560 jobs, generating €210 million per annum in wages. Induced GDP amounts to €400 million each year.

5.3 Combined Economic Impacts

Ongoing LUX airport operations generate a total of 14,870 jobs and €790 million in wages, including indirect and induced impacts. Including these multiplier effects, operations at LUX generate €1.3 billion in total GDP annually. Figure 5-1 summarizes the direct, indirect and induced impacts of ongoing operations at LUX.
**Figure 5-1: Annual Direct, Indirect and Induced at LUX**

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6 Facilitating the Wider Economy – The Catalytic Impact of Luxembourg Airport

6.1 Overview of Catalytic Impacts

As discussed in Chapter 2, 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 spending of 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 of 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 quality 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 impacts of aviation, taken from academic and industry research.
6.1.1 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.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Methodology</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warnock-Smith and Morrell (2008)&lt;sup&gt;8&lt;/sup&gt;</td>
<td>The authors examine the impact of liberalising extra-regional air services on air traffic growth and tourism growth for the region, using data from 1995 to 2003.</td>
<td>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 liberalised.</td>
</tr>
<tr>
<td>Graham and Dennis (2008)&lt;sup&gt;9&lt;/sup&gt;</td>
<td>The authors examined the effect of the Maltese government’s decision in 2006 to provide incentives to low cost carriers (LCCs) to fly to the islands. The research made use of data in Malta on passenger/tourist numbers, passenger survey results, and airline schedules.</td>
<td>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.</td>
</tr>
<tr>
<td>Dennis (2007)&lt;sup&gt;10&lt;/sup&gt;</td>
<td>Uses data from the UK on tourist arrival information, air passenger traffic, survey data and airline ticket information.</td>
<td>Concludes that air travel increases tourism abroad and that as air travel becomes a smaller portion of the vacation cost, the penalty for taking shorter, more frequent trips is reduced, stimulating air travel.</td>
</tr>
<tr>
<td>Rey (2011)&lt;sup&gt;11&lt;/sup&gt;</td>
<td>Examines tourist demand from the principal EU-15 member states to estimate the impact of low-cost airlines on Spanish tourism.</td>
<td>The findings suggest that the expansion of LCC activity had a strong positive effect on the number of tourist arrivals.</td>
</tr>
</tbody>
</table>

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6.1.2 Trade

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

<table>
<thead>
<tr>
<th>Paper</th>
<th>Methodology</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cech (2004)(^{12})</td>
<td>Used a cross-section statistical comparison method to investigate how air cargo services affect the economies of 125 U.S. counties.</td>
<td>Higher levels of air cargo services contribute to increased earnings and increased employment.</td>
</tr>
<tr>
<td>EUROCONTROL (2005)(^{13})</td>
<td>The study estimated the net contribution of air transportation to trade (i.e., export minus imports).</td>
<td>Net contribution of air transportation to trade was €55.7 billion in 2003 across the 25 current EU members.</td>
</tr>
<tr>
<td>UK Institute of Directors (2008)(^{14})</td>
<td>Surveyed 500 UK businesses about their use and the importance of air transportation.</td>
<td>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.</td>
</tr>
<tr>
<td>Poole (2010)(^{15})</td>
<td>Econometric analysis of U.S. trade and travel data from 1993 to 2013.</td>
<td>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.</td>
</tr>
<tr>
<td>PWC (2013)(^{16})</td>
<td>Examined the relationship between the UK's international air seat capacity and international trade, controlling for other factors affecting trade.</td>
<td>A 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%.</td>
</tr>
</tbody>
</table>

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\(^{13}\) 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.


\(^{15}\) Poole, J. (2010), “Business Travel as an Input to International Trade”, http://www.scu.edu/business/economics/upload/Poole.pdf

### 6.1.3 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 aviation contributing to increased investment and beneficial location decision for the surrounding regions or the country.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Methodology</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hansen and Gerstein (1991)&lt;sup&gt;17&lt;/sup&gt;</td>
<td>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).</td>
<td>The amount of Japanese investment in each US state was causally linked to the air service between Japan and that state.</td>
</tr>
<tr>
<td>EUROCONTROL (2005)&lt;sup&gt;18&lt;/sup&gt;</td>
<td>Analysed the relationship between air transportation and business investment in the EU.</td>
<td>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).</td>
</tr>
<tr>
<td>IATA (2006)&lt;sup&gt;19&lt;/sup&gt;</td>
<td>IATA surveyed 625 businesses in five countries (China, Chile, United States, Czech Republic and France).</td>
<td>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.</td>
</tr>
<tr>
<td>Bel and Fageda (2008)&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Statistically analysed the relationship between international air service and the location of large firm’s headquarters across major European urban areas.</td>
<td>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.</td>
</tr>
<tr>
<td>Arndt et al. (2009)&lt;sup&gt;21&lt;/sup&gt;</td>
<td>Survey of 100 foreign-owned businesses in Germany.</td>
<td>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.</td>
</tr>
</tbody>
</table>

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18 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.
### 6.1.4 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 aviation connectivity.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Methodology</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWC (2013)</td>
<td>Econometric analysis of the UK’s air connectivity, air seat capacity and Foreign Direct Investment (FDI).</td>
<td>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.</td>
</tr>
</tbody>
</table>

#### 6.1.4.1 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 aviation connectivity.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Methodology</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Button, Lall, Stough and Trice (1999)</td>
<td>Used data from 321 US metropolitan areas in 1994 to regressed high-tech employment against a number of controlling factors including a dummy indicating that the region was served by a hub airport.</td>
<td>The analysis found that the presence of a hub airport increased high-tech employment by an average of 12,000 jobs in a region.</td>
</tr>
<tr>
<td>Button and Taylor (2000)</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>Brueckner (2002)</td>
<td>Regressed employment in 94 metropolitan areas in the US against a number of factors including measures of air service.</td>
<td>A 10 percent increase in passenger enplanements in a metropolitan area leads to an approximately 1 percent increase in employment in service-related industries.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Paper</th>
<th>Methodology</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>InterVISTAS (2006)(^{26})</td>
<td>Used data on 48 countries over nine years to examine the relationship between air connectivity (a measure of international air service) and labour productivity growth.</td>
<td>The research found that a 10% increase in a nation’s air connectivity increased GDP per labour hour by 0.068%.</td>
</tr>
<tr>
<td>Ishutkina and Hansman (2009)(^{27})</td>
<td>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).</td>
<td>Found statistical evidence of a (two-way) feedback relationship between air transport and economic activity.</td>
</tr>
<tr>
<td>PWC (2013)(^{28})</td>
<td>Estimated an Error Correction Model of UK GDP and air seat capacity between 1991 and 2010.</td>
<td>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.</td>
</tr>
<tr>
<td>ACI Europe/InterVISTAS (2015)(^{29})</td>
<td>Analysed the relationship between national air connectivity and GDP per capita using data for 40 European countries between 2000 and 2012.</td>
<td>This recent 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.</td>
</tr>
</tbody>
</table>


6.1.5 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 simply economic growth leading to increased air transport levels.

6.2 Estimating the Catalytic Impact of Luxembourg Airport

As described in Chapter 2, the catalytic impact of LUX was estimated using findings from recent research. The connectivity parameter was taken from a recent study undertaken by InterVISTAS on behalf of ACI Europe. This study was previously referenced in Section 6.1.4. It was selected because it has been recently completed using the most current data and was based on data from 40 European countries including Luxembourg.

The parameter from that study found that a 10% increase in air connectivity increased GDP per capita by 0.5%. While the outcome from the parameter is expressed in terms of GDP per capita, it 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.

Consistent with the ACI Europe study, connectivity was measured using the IATA connectivity index. This 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 are provides greater global connectivity than connections to the same number of spoke ends. Further information on the IATA connectivity index is provided in Appendix B.

To estimate the catalytic impact of LUX, the analysis was based on the growth in air connectivity at LUX over the last 22 years – 1993 to 2015. The year 1993 was selected as it ties in with the completion of the European Union’s de-regulation 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. Using the results from the ACI Europe study, the analysis estimated the GDP per capita that has been facilitated by the growth in connectivity at LUX since 1993. In other words, it is that the amount of GDP that would have been foregone if air connectivity at LUX had been unchanged since 1993. Arguably, this is a

31 1993 was also the base year used in the ACI Europe study.
conservative approach to estimating the catalytic impacts, as it does not consider connectivity changes prior to 1993.

Between 1993 and 2015, Luxembourg Airport’s connectivity index (divided by GDP) increased by 88%. Applying the catalytic parameter, this suggests that the contribution to per capita GDP growth was 0.05 x 88% = 4.4%. In other words, without the connectivity provided at Luxembourg Airport since 1993, the GDP per capita of Luxembourg would be 4.4% lower (due to less trade and tourism, less investment, fewer companies based in Luxembourg, etc.).

This percentage was applied to the GDP per capita of Luxembourg in 1993 (inflated to 2015 prices) and multiplied by the estimated 2015 population of Luxembourg to estimate the overall GDP impact:

\[ \€51,005 \times 4.4\% \times 562,960 = \€1.26 \text{ billion} \]

The GDP attributable to the catalytic impacts of Luxembourg Airport is the result of incremental economic activity supported and stimulated by air connectivity – increased tourism visits and spending, greater trade, new investment, etc. This activity supports additional jobs in the economy, which were estimated by dividing the GDP estimate by the average GDP per worker in Luxembourg. Similarly, the wage impacts were based on the average wage figures.

These employment and economic estimates are presented in Figure 6-1. It is estimated that a total of 9,300 jobs are associated with the catalytic impacts of Luxembourg Airport, earning €580 million in wages. The catalytic impacts of LUX facilitated €1.3 billion in GDP, which is equivalent to approximately 2.5% of the total GDP of Luxembourg in 2015.\(^{32}\)

**Figure 6-1: Catalytic Impacts of Luxembourg Airport**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Employment</th>
<th>Wages (€ Millions)</th>
<th>GDP (€ Millions)</th>
<th>% of National GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalytic</td>
<td>9,300</td>
<td>€580</td>
<td>€1,260</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

\(^{32}\) Source: Eurostat. The estimated GDP of Luxembourg in 2015 is €51.2 billion.
7 Summary: The Total Impact of Luxembourg Airport

The total economic impact both generated and facilitated by Luxembourg Airport is shown in Figure 7-1. Including 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, Luxembourg Airport contributes to the employment of 24,170 people in Luxembourg, earning a total of €1.4 billion. A total of €2.6 billion is contributed to GDP, equal to 5.0% of national GDP.

**Figure 7-1: Total Economic Impact Generated and Facilitated by LUX (Direct+Indirect+Induced+Catalytic)**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Employment</th>
<th>Wages (€ Millions)</th>
<th>GDP (€ Millions)</th>
<th>% of National GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>6,280</td>
<td>€380</td>
<td>€590</td>
<td>1.2%</td>
</tr>
<tr>
<td>Indirect</td>
<td>4,030</td>
<td>€200</td>
<td>€330</td>
<td>0.6%</td>
</tr>
<tr>
<td>Induced</td>
<td>4,560</td>
<td>€210</td>
<td>€400</td>
<td>0.8%</td>
</tr>
<tr>
<td>Catalytic</td>
<td>9,300</td>
<td>€580</td>
<td>€1,260</td>
<td>2.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24,170</strong></td>
<td><strong>€1,370</strong></td>
<td><strong>€2,580</strong></td>
<td><strong>5.0%</strong></td>
</tr>
</tbody>
</table>

While these figures are substantial, it is worth considering how Luxembourg’s economy might look if the country did not have an airport of the size of Luxembourg Airport, offering the scope of air services currently provided. At the most extreme, Luxembourg could have no commercial airports, instead relying on other airports in Europe, or Luxembourg could have a small regional airport with limited services. In such scenarios, it is easy to imagine that tourism to Luxembourg would be much lower, that Luxembourg would not be able to attract as many carriers to operate services, that the overall volume of trade would be substantially lower, and that some companies would choose not to locate or expand in Luxembourg. The net effect of this would be a smaller, slower-growing economy.
Appendix A: Further Information on the Input-Output Tables and the Economic Multipliers

As described in Chapter 2, the economic impact multipliers (indirect and induced) impacts were based on an Input-Output (I-O) table of the economy of Luxembourg maintained by Eurostat. The I-O tables can be found here: http://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/data/workbooks. The I-O table was used to estimate elements of the direct, indirect and induced economic impacts 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.

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

<table>
<thead>
<tr>
<th></th>
<th>Industries (Purchases)</th>
<th>Final Demand</th>
<th>Total Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industries (Sales)</td>
<td>Z</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>Value-added (primary inputs)</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total output</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 E-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 (Vi in Figure A-1).

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

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

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

- Compensation of employees;
- Net taxes on production;
- Consumption of fixed capital;
- Gross Operating surplus.

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**

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. 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:

\[ X_i = a_{i1}X_1 + a_{i2}X_2 + \cdots + a_{in}X_n + Y, \quad i = 1, \ldots, n. \]  

(2)

This leads to the matrix representation:

\[ X = AX + Y \]  

(3)

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

\[ X = (I - A)^{-1}Y \]  

(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 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, valued-added, employment, and wages/income multipliers. For comparative purposes, multipliers use 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: IATA Connectivity Index

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 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 2015, Atlanta airport was the world’s largest airport and so was given a weighting of one. London Heathrow, which handles 76.3% of the number of passengers handled by Atlanta, was given a weighting of 0.763. 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 763. 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:

\[
\text{Connectivity Indicator} = \frac{\text{Number of destinations} \times \text{Weekly Frequency} \times \text{Seats per flight}}{\text{Weighted by the Size of the Destination Airport}} \times 1000
\]

A higher figure for the connectivity indicator denotes a greater degree of access to the global air transport network.