Acknowledgements

Oxford Economics gratefully acknowledge the help that we received from the International Air Transport Association (IATA) in preparation of this report.

Through a survey conducted by IATA many organisations across the aviation industry supplied us with data that has formed an integral part of our analysis. We would like to thank all these organisations for their generosity in supplying this data, without which this report could not have been written.

A note on the data reported in the report

Unless otherwise stated, the numbers reported in this report relate to the calendar year 2009.

Oxford Economics 2011
# Luxembourg Country Report

## Contents

**Facts & figures** ........................................................................................................... 3

1 Consumer benefits for passengers and shippers ......................... 6
   1.1 Consumer benefits .......................................................................................... 6
   1.2 Estimated consumer benefits ....................................................................... 7

2 Enabling long-term economic growth ........................................ 8
   2.1 Connectivity and the cost of air transport services .................................. 8
   2.2 How aviation enhances economic performance ...................................... 9
   2.3 Connectivity and long-term growth ............................................................ 10

3 Economic footprint.............................................................................. 12
   3.1 The aviation sector and its economic footprint ....................................... 12
   3.2 The aviation sector .................................................................................... 15
   3.3 Tax contribution .......................................................................................... 16
   3.4 Investment and productivity ....................................................................... 16
   3.5 Catalytic effects .......................................................................................... 17
      3.5.1 Benefits to Luxembourg tourism .................................................... 17
      3.5.2 Benefits to Luxembourg trade .......................................................... 18

4 Conclusion ................................................................................................. 20

**Annex: Our methods** ...................................................................................... 21

Benefits to passengers and shippers ......................................................... 21
Connectivity Index ....................................................................................... 21
Benefits to tourism ....................................................................................... 21
Economic footprint ...................................................................................... 22
Passenger and freight volumes ................................................................. 23
Facts & figures

Luxembourg aviation’s economic benefits

Air transport to, from and via Luxembourg creates three distinct types of economic benefit. Typically, studies such as this focus on the ‘economic footprint’ of the industry, measured by its contribution to GDP, jobs and tax revenues generated by the sector and its supply chain. But the economic value created by the industry is more than that. The principal benefits are created for the customer, the passenger or shipper using the air transport service. In addition, the connections created between cities and markets represent an important infrastructure asset that generates benefits through enabling foreign direct investment, business clusters, specialization and other spill-over impacts on an economy’s productive capacity.

1. Aviation’s economic footprint

Contribution to Luxembourg GDP

The aviation sector contributes €986 million (2.6%) to Luxembourg GDP. This total comprises:

- €636 million directly contributed through the output of the aviation sector (airlines, airports and ground services);
- €155 million indirectly contributed through the aviation sector’s supply chain; and
- €195 million contributed through the spending by the employees of the aviation sector and its supply chain.

In addition there is €362 million in ‘catalytic’ benefits through tourism which raise the overall contribution to €1,348 billion or 3.6% of GDP.

Major employer

The aviation sector supports 11,000 jobs in Luxembourg. This total comprises:

- 8,700 jobs directly supported by the aviation sector;
- 1,100 jobs indirectly supported through the aviation sector’s supply chain; and
- 1,100 jobs supported through the spending by the employees of the aviation sector and its supply chain.

In addition there are a further 3,500 people employed through the catalytic (tourism) effects of aviation.

High productivity jobs

The average air transport services employee generates €108,488 in GVA annually, which is over 10% more productive than the average in Luxembourg.

Contribution to public finances

Taxes paid by aviation firms and employees contribute around €165 million in government revenues. It is estimated that an additional €65 million of government revenue is raised via the aviation sector’s supply chain and €82 million through taxation of the activities supported by the spending of employees of both the aviation sector and its supply chain.
2. Consumer benefits for passengers and shippers

From visiting family and friends to shipping high value products, 1.55 million passengers and 628,000 tonnes of freight travelled to, from and via Luxembourg. More than 21,500 scheduled international flights depart Luxembourg annually, destined for 61 airports in 20 countries.

Air passengers resident in Luxembourg comprise approximately 775 thousand of the passenger total. For the 1.55 million passenger flights in total, passengers paid €545 million (inclusive of tax) for air travel, with Luxembourg residents paying around €273 million. This expenditure is likely to significantly understate the value passengers actually attach to the flights they use (see Section 1). Calculations by Oxford Economics suggest the value of the benefit to travellers from flying, in excess of their expenditure, is worth €270 million a year (€135 million for Luxembourg residents).

Air transport is crucial for the distribution of high value to weight products and Luxembourg is an important air freight hub. Air freight may only account for less than one percent of the tonnage of EU trade with the rest of the world, but in value terms it makes up around 22% of the total.

Shippers pay airlines €1.5 billion annually to carry 628,000 tonnes of freight to, from and via Luxembourg. The benefit to shippers, in excess of this expenditure, is estimated as €623 million. Based on the share of exports in total merchandise trade, we estimate that Luxembourg shippers receive less than half of this benefit (€274 million). The bulk of the benefit accrues to shippers based in other countries who make use of the connectivity to markets provided by the Luxembourg hub.

3. Enabling long-term economic growth

In 2010 there were 22 routes connecting Luxembourg Airport to urban agglomerations around the world. On average there were 1.8 outbound flights per day along these routes. A total of 3 of these routes were connecting Luxembourg to cities of more than 10 million inhabitants, with an average of just over 3 outbound flights per day available to passengers. Frequencies are higher to the most economically important destinations. For example, passengers benefited from more than 5 outbound flights per day from Luxembourg to London City Airport, and from 4 flights per day from Luxembourg to Frankfurt, providing high speed access for business and leisure purposes throughout the day. Many of these city-pair connections are only possible because of the traffic density provided by hub airports. Luxembourg’s integration into the global air transport network transforms the possibilities for the Luxembourg economy by:

- Opening up foreign markets to Luxembourg exports;
- Lowering transport costs, particularly over long distances, helping to increase competition because suppliers can service a wider area and potentially reduce average costs, through increased economies of scale;
- Increasing the flexibility of labour supply, which should enhance allocative efficiency and bring down the natural rate of unemployment;
- Encouraging Luxembourg businesses to invest and specialise in areas that play to the economy’s strengths;
- Speeding the adoption of new business practices, such as just-in-time-inventory management that relies on quick and reliable delivery of essential supplies;
- Raising productivity and hence the economy’s long-run supply capacity. It is estimated that a 10% improvement in connectivity relative to GDP would see a €24 million per annum increase in long-run GDP for the Luxembourg economy.
This report describes these channels in more detail.

Section 1 quantifies the benefits of air travel for air passengers and air freight shippers.

Section 2 examines the way in which the aviation sector supports long-run prosperity: by delivering supply-side benefits through a variety of different channels, which help to increase the economy’s level of productivity, and hence its long-term sustainable rate of growth.

Section 3 analyses the economic footprint of the aviation sector - the airlines, the ground-based infrastructure and spillover effects on tourism and trade - to quantify the value of its output and the jobs it supports in Luxembourg.
1 Consumer benefits for passengers and shippers

The aviation sector – comprising the airlines together with the airports, air navigation and other essential
grounds services that make up the air transport infrastructure - carries around 1.55 million passengers1 and
nearly 628,000 tonnes of air freight to, from and via Luxembourg. More than 21,500 scheduled international
flights depart Luxembourg annually, destined for 61 airports in 20 countries2.

Among the many reasons that people and businesses use air transport, people rely on it for holidays and
visiting friends and family; while businesses use air transport for meeting clients and for the speedy and
reliable delivery of mail and goods often over great distances. For this reason, the air transport network
has been called the Real World Wide Web3.

The most important economic benefit generated by air transport is the value generated for its consumers,
passengers and shippers. Passengers spent €545 million (inclusive of tax) on air travel in 2009 and
shippers spent €1.5 billion on the transportation of air cargo4. With its speed, reliability and reach there is
no close alternative to air transport for many of its customers. This means that many are likely to value air
services higher than what might be suggested by their expenditure on these services. But this economic
value will vary from flight to flight, and from consumer to consumer, making it difficult to measure.

1.1 Consumer benefits

The value of consumer benefit varies because as you fly more often, the value you attach to each
additional flight will in general fall. As frequent flyers know, the more they fly, the less excited they get
when they step on a plane. There comes a point when the fare exceeds the value we place on taking an
additional flight, and we choose instead to spend our money on other things. For this reason the air fares
that we are willing-to-pay do not reflect the value we place on air transport so much as the value we place
on the last flight we have flown. Much the same applies to the market as a whole. Air fares reflect the
value placed on the service by the marginal passengers - those who would forgo the flight were prices to
rise - and not the value that passengers as a whole place on air transport services.

For this reason, valuing the consumer benefits for air passengers and air freight shippers can not be
inferred simply from observed fares and shipping charges. In addition to the fares paid, we need an idea of
how the passengers and shippers value air transport other than at the margin. Unfortunately there is no
readily available data on this, and so we must rely instead on judgement, informed by economic theory, to
guide us. Economics tells us that the estimated benefits hinge on the sensitivity of demand to changes in
fares – the price elasticity of demand. Estimates of prices elasticities are available from previous research.
Economic theory also tells us that price elasticities will fall as we move away from the margin, but it offers
less guidance on how much they may fall by. This matters, because lower the price elasticity – the less
sensitive passengers are to a change in price – the higher the consumer benefit.

It follows that taxation of air travel or cargo directly reduces the economic benefit of all passengers and
shippers, as well as, at the margin, stopping a number of people travelling and stopping a number of
shippers using air cargo services.

---

1 This is a count of passengers on domestic flights as well as passengers arriving and departing on international flights. Each
   passenger connecting to another flight at a Luxembourg airport is counted once on their arriving flight and again on their departing
   flight.
2 Annual estimate of international and domestic operations for 2010 based on airline schedules published by SRSAnalyzer.
4 Passenger spending based on fares from IATA’s PaxIS database plus estimates for taxes and surcharges paid. Cargo spending
   based on freight rates from IATA’s CargoIS database.
1.2 Estimated consumer benefits

Given its sensitivity to our assumption about how price elasticities vary, we have taken a very conservative assumption that probably understates the true benefits (see Annex). With this in mind, we calculate that air passengers and shippers valued the air transport services they used, from all airlines serving Luxembourg, at over €815 million and €2.1 billion respectively. Air passengers paid €545 million for air travel and shippers €1.5 billion for air freight. This means that the consumer benefits derived on top of that measured by expenditure on travel and shipments were about €270 million for passengers and €623 million for shippers.

The total benefits accruing to passengers using the air transport system in Luxembourg will include those related to residents and non-residents as well as passengers already being accounted for under the benefits associated with the economy at the other end of international routes. To avoid double counting and to estimate the benefits accruing to residents in Luxembourg we have assumed that 50% of passengers in the Luxembourg market are residents. This is in line with the proportion of residents in other markets and would indicate that approximately 775 thousand of the 1.55 million passengers using air transport services to and from Luxembourg were Luxembourg residents. As for the share of freight shipped by firms based in Luxembourg, data is not readily available. To give a broad indication we have used instead the share of exports in total merchandise trade. This is estimated to be 44.0% of the total trade in goods in 2009. From this we estimate that, out of the consumer benefits generated by Luxembourg air transport and on top of that measured by expenditure, Luxembourg citizens derived €135 million in value and Luxembourg shippers around €274 million in value.

---

5 Oxford Economics Global Macroeconomic Model
2 Enabling long-term economic growth

2.1 Connectivity and the cost of air transport services

The air transport network has been called the Real World Wide Web. Chart 2.1 gives an idea of how extensive the air transport network is for Luxembourg. In 2010 there were 22 routes connecting Luxembourg Airport to urban agglomerations around the world. On average there were 1.8 outbound flights per day along these routes. A total of 3 of these routes were connecting Luxembourg to cities of more than 10 million inhabitants, with an average of just over 3 outbound flights per day available to passengers. Frequencies are higher to the most economically important destinations. For example, passengers benefited from more than 5 outbound flights per day from Luxembourg to London City Airport, and from 4 flights per day from Luxembourg to Frankfurt, providing high speed access for business and leisure purposes throughout the day.

These linkages represent the ‘connectivity’ of Luxembourg cities with major cities and markets around the world. Connectivity reflects the range, frequency of service, the economic importance of destinations and the number of onward connections available through each country’s aviation network. Improvements in connectivity achieved in recent decades has brought benefits to users of air transport services by: reducing time spent in transit, increasing the frequency of service, allowing for shorter waiting times and better targeting of departure and arrival times; and improving the quality of service, such as reliability, punctuality and quality of the travel experience.

A number of these city-pair connections have point-to-point services, where passenger flow density is sufficient to make the economics work. However, many of the city-pair connections that make up Luxembourg’s connectivity to overseas markets can only be served by airlines aggregating flows from a number of origins through a hub airport in order to generate a sufficiently dense flow of passengers.

Improvements in connectivity have been accompanied by a steady fall in the cost of air transport services. The cost of air transport services, in real terms, has fallen by around 1% a year over the past 40 years,
Luxembourg country report

contributing to the rapid expansion in the volume of trade seen over this period. Air transport has also steadily become more competitive relative to other modes of transport. For example, it is estimated that its relative cost has been falling by around 2.5% a year since the 1990s. As its relative cost has fallen, air shipments have become increasingly important for international trade. The European Union, for instance, which reports data on the value of cargo carried by different modes of transport, has 22% of its trade with the rest of the world carried by air.

Apart from the benefits to direct users of air transport services, the largest economic benefit of increased connectivity comes through its impact on the long term performance of the wider economy.

2.2 How aviation enhances economic performance

Improvements in connectivity contribute to the economic performance of the wider economy through enhancing its overall level of productivity. This improvement in productivity in firms outside the aviation sector comes through two main channels: through the effects on domestic firms of increased access to foreign markets, and increased foreign competition in the home market, and through the freer movement of investment capital and workers between countries.

Improved connectivity gives Luxembourg-based businesses greater access to foreign markets, encouraging exports, and at the same time increases competition and choice in the home market from foreign-based producers. In this way, improved connectivity encourages firms to specialise in areas where they possess a comparative advantage. Where firms enjoy a comparative advantage, international trade provides the opportunity to better exploit economies of scale, driving down their costs and prices and thereby benefiting domestic consumers in the process. Opening domestic markets to foreign competitors can also be an important driver behind reducing unit production costs, either by forcing domestic firms to adopt best international practices in production and management methods or by encouraging innovation. Competition can also benefit domestic customers by reducing the mark-up over cost that firms charge their customers, especially where domestic firms have hitherto enjoyed some shelter from competition.

Luxembourg airport is an important freight hub with a large proportion of the goods imported and exported through Luxembourg originating from or destined to many countries in Europe. The air transport infrastructure in Luxembourg therefore supports the economic activity not only of Luxembourg and surrounding regions but also of Europe more generally.

Improved connectivity can also enhance an economy’s performance by making it easier for firms to invest outside their home country, which is known as foreign direct investment (FDI). Most obviously, the link between connectivity and FDI may come about because foreign investment necessarily entails some movement of staff: whether to transfer technical know-how or management oversight. But increased connectivity also allows firms to exploit the speed and reliability of air transport to ship components between plants in distant locations, without the need to hold expensive stocks of inventory as a buffer. Less tangibly, but possibly just as important, improved connectivity may favour inward investment as increased passenger traffic and trade that accompanies improved connectivity can lead to a more favourable environment for foreign firms to operate in. Chart 2.2 plots the total value of FDI built up in individual countries in relation to their GDP against an index of connectivity (produced by IATA), that measures the availability of flights, weighted by the importance of each of the destinations served. The chart shows that countries with higher connectivity (measured relative to their GDP), are in general more

---


successful at attracting foreign direct investment. This is emphasised by the upward sloping line that confirms the statistical relationship between greater connectivity and greater FDI.

### 2.3 Connectivity and long-term growth

A thought experiment considering the impact on trade from eliminating the air transport network suggests the economic benefit of connectivity is substantial. Moreover, the experience of businesses in many parts of Europe during the volcanic ash-induced airspace closures of 2010, as just-in-time supply chains failed, provides a more concrete illustration of how dependent modern economies are on their air transport infrastructures.

A number of recent studies have attempted to quantify the long-term impact on a country’s GDP that results from an improvement in connectivity. Measuring connectivity is not straightforward. Chart 2.3 shows one measure of Luxembourg connectivity, compared to other economies (see Annex for details). Given that the supply-side benefits of connectivity come through promoting international trade and inward investment, any impact is likely to manifest itself gradually over time. This protracted adjustment makes it very challenging to disentangle the contribution that improved connectivity has had on long-term growth, from the many of other factors that affect an economy’s performance. This issue is reflected in the wide range of estimates that studies have reached for connectivity’s impact on long-run growth. Three studies undertaken in 2005 and 2006 provide estimates of the impact that connectivity can have on long-run level of productivity (and hence GDP). The mechanisms through which connectivity generates this economic benefit are those described in Section 2.2. Two of these studies suggest that a 10% increase in connectivity (relative to GDP) will raise the level of productivity in the economy by a little under 0.5% in the long run, with there being a fair degree of uncertainty around this average estimate. The third much wider study, based on a cross-country statistical analysis of connectivity and productivity, derived a lower estimate of 0.07% for the elasticity between connectivity and long-run productivity.

Given the uncertainty about the correct elasticity, here we adopt the elasticity of 0.07 derived from the 2006 study, as the lowest estimate among the available studies it provides a conservative estimate of the impact of connectivity on long-term GDP. Based on this estimate, a 10% improvement in Luxembourg’s connectivity (relative to GDP) would see a €24 million per annum increase in long-run GDP.

---

9 This measure emphasises passenger connectivity and as such will reflect the freight connectivity associated with belly cargo capacity in passenger aircraft but may not fully capture that provided by all-cargo operations or integrator networks.

10 ‘The Economic Catalytic Effects of Air Transport in Europe’, by Oxford Economic Forecasting (2005) on behalf of the EUROCONTROL Experimental Centre and ‘The Economic Contribution of the Aviation Industry in the UK’, by Oxford Economic Forecasting (2006). These studies also allow for connectivity to increase the long-run level of GDP through increasing investment. Allowing for this additional channel raises the total impact of a 10% increase in connectivity relative to GDP on long-run GDP to over 1%.

11 ‘Measuring the Economic Rate of Return on Investment in Aviation’ by InterVISTAS Consulting Inc. (2006)
Chart 2.3: Air connectivity by country, 2009

<table>
<thead>
<tr>
<th>Country</th>
<th>Air connectivity per €million of GDP, 2009</th>
<th>Impact on GDP from a 10% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
<td>0.15</td>
<td>€24 million (0.07%)</td>
</tr>
</tbody>
</table>

Source: IATA. IMF for GDP (PPP basis)
3 Economic footprint

Sections 1 and 2 have looked at the benefits of air transport services for its customers, and the longer-term benefits that come through increasing long-term growth in the economy as a whole. In this section we turn to the domestic resources that the aviation sector currently deploys to deliver its services, together with the domestic goods and services consumed by the workers who depend on the sector for their employment. We call the value added and jobs supported by this economic activity the aviation sector’s ‘economic footprint’.

The resources deployed by the aviation sector are measured by its Gross Value Added (GVA). GVA is calculated either as the output created by the sector less the cost of purchased inputs (net output measure), or by the sum of profits and wages (before tax) generated from the sector’s economic activity (income measure). The two approaches are equivalent. Using either approach, by adding the GVA of all firms in the economy, one derives an estimate for the economy’s overall output (GDP)\(^\text{12}\). We refer to this as the sector’s direct contribution to GDP.

From this direct contribution, the sector’s economic footprint is calculated by adding to it the output (and jobs) supported through two other channels, which we refer to as the indirect and the induced contributions. The indirect contribution measures the resources deployed by the aviation sector through using domestically produced goods and services produced by other firms – i.e. the resources used through its supply chain. The GVA generated through the indirect and direct channels supports jobs both in the aviation sector and in its supply chain. The workers whose employment depends on this activity in turn spend their wages on goods and services. The induced contribution is the value of the domestic goods and services purchased by this workforce. Taken together, these three channels give the aviation sector’s economic footprint in terms of GVA and jobs.

The aviation sector contributes to the economy in two other ways. Through the taxes levied on GVA (recall that it is equal to the sum of profits and wages), the aviation sector supports the public finances, and the public services that depend on them. Second, through its investment and its use of advanced technology, the aviation sector generates more GVA per employee than the economy as a whole, raising the overall productivity of the economy. These issues are discussed at the end of this section.

3.1 The aviation sector and its economic footprint

The sector is comprised of two distinct types of activity:

- **Airlines** transporting people and freight.
- **Ground-based infrastructure** that includes the airport facilities, the services provided for passengers on-site at airports, such as baggage handling, ticketing and retail and catering services, together with essential services provided off-site, such as air navigation and air regulation.

The aviation sector supports GDP and the employment in Luxembourg through four distinct channels. These channels are:

- **Direct** – the output and employment of the firms in the aviation sector.

\(^{12}\) It is only true to an approximation that GVA is equal to the sum of profit and wages, or that the sum of GVA across firms equals GDP. The difference in each case, however, is small enough for us to proceed as if the equalities do in fact hold. The differences are explained in the Annex to this report.
- **Indirect** – the output and employment supported through the aviation sector’s Luxembourg based supply chain.

- **Induced** – employment and output supported by the spending of those directly or indirectly employed in the aviation sector.

- **Catalytic** – spillover benefits associated with the aviation sector. Some of these include the activity supported by the spending of foreign visitors travelling to Luxembourg via air, and the level of trade directly enabled by the transportation of merchandise.

**Table 3.1: Aviation’s contribution of output and jobs to Luxembourg**

<table>
<thead>
<tr>
<th>Contribution to GDP (€ million)</th>
<th>Direct</th>
<th>Indirect</th>
<th>Induced</th>
<th>Total</th>
<th>% of whole economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation (inc Airlines, Airports and Ground Services)</td>
<td>636</td>
<td>155</td>
<td>195</td>
<td>986</td>
<td>2.6%</td>
</tr>
<tr>
<td>Total</td>
<td>636</td>
<td>155</td>
<td>195</td>
<td>986</td>
<td>2.6%</td>
</tr>
<tr>
<td>Catalytic (tourism)</td>
<td>163</td>
<td>143</td>
<td>57</td>
<td>362</td>
<td>1.0%</td>
</tr>
<tr>
<td>Total including catalytic</td>
<td>799</td>
<td>298</td>
<td>251</td>
<td>1,348</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contribution to employment (’000)</th>
<th>Direct</th>
<th>Indirect</th>
<th>Induced</th>
<th>Total</th>
<th>% of whole economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation (inc Airlines, Airports and Ground Services)</td>
<td>8.7</td>
<td>1.1</td>
<td>1.1</td>
<td>11.0</td>
<td>5.0%</td>
</tr>
<tr>
<td>Total</td>
<td>8.7</td>
<td>1.1</td>
<td>1.1</td>
<td>11.0</td>
<td>5.0%</td>
</tr>
<tr>
<td>Catalytic (tourism)</td>
<td>1.3</td>
<td>1.8</td>
<td>0.3</td>
<td>3.5</td>
<td>1.6%</td>
</tr>
<tr>
<td>Total including catalytic</td>
<td>10.1</td>
<td>2.9</td>
<td>1.5</td>
<td>14.5</td>
<td>6.6%</td>
</tr>
</tbody>
</table>

Source: IATA, Oxford Economics

The table above reports the economic contribution of the airlines and airports for each of the four channels. Contributions are reported both in terms of GDP and employment. In the following pages we look in turn at the airlines, the ground-based infrastructure and catalytic spillover benefits in terms of trade and tourism, and describe their economic contribution in more detail.

The way that we build up the aviation sector’s economic footprint is also illustrated in Figure 3.1. The top panel shows the two activities that comprise the aviation sector: air transport services and the airports and ground-based infrastructure. The panel below represents their supply chains with boxes that list the most important inputs purchased by each activity. The third panel from the top describes the induced contribution that comes through the spending by workers of both the aviation sector and its supply chain – represented by the arrows that link this panel with the panels above. The bottom panel, entitled ‘economic footprint’, reports the total GVA, jobs and tax contribution. These totals are the sum of the numbers reported in the panels above.
Figure 3.1: Luxembourg aviation sector

**The Aviation Sector**
In this study is defined as -

- **Locally-based Airlines**
  - Domestic & International passenger & freight services

- **Ground-based Infrastructure**
  - All on-site activities at Airports
  - ANSP
  - Regulators

Direct Contribution of the aviation sector = GVA, employment and tax generated by the aviation sector.

= GVA= €0.64 Billion  Employment= 8,700 Jobs  Tax= €0.17 Billion

**The Aviation Sector’s Supply Chain**
Purchases by the aviation sector of domestically produced goods & services from firms outside the aviation sector.

- **Locally-based Airlines**
  - Aviation Fuel
  - Catering
  - Repair + Maintenance
  - Ticketing + Distribution (e.g. Travel Agents, CRS etc.)
  - Freight Forwarding
  - Aircraft Financing
  - Other Finance + Business Services

- **Ground-based Infrastructure**
  - Finance
  - Construction + Facilities management
  - Electricity + Water supply
  - Non-airside supply chain
    - Food + Drink
    - Business + Marketing Services
    - Computing

Indirect Contribution of the aviation sector = GVA, employment and tax generated by the aviation sector’s supply chain.

= GVA= €0.16 Billion  Employment= 1,100 Jobs  Tax= €0.07 Billion

**Induced Spending**
Spending by employees of the aviation sector & its supply chain on domestically produced goods & services.

Induced Contribution of the aviation sector = GVA, employment and tax generated by the spending of employees of the aviation sector & its supply chain.

= GVA= €0.20 Billion  Employment= 1,100 Jobs  Tax= €0.08 Billion

**Economic Footprint**
Economic footprint = Sum of Direct, Indirect and Induced Contributions.

= GVA = €0.99 Billion  Employment = 11,000 jobs  Tax = €0.31 Billion

---

For a definition of GVA please refer to the Annex
3.2 The aviation sector

Airlines registered in Luxembourg carry around 1.13 million passengers and 458,000 tonnes of freight a year to, from and via Luxembourg\(^\text{14}\). Among the many reasons that people and businesses use air transport, people rely on it for holidays and visiting friends and family; while businesses use air transport for meeting clients and for the speedy and reliable delivery of mail and goods often over great distances. The air transport network, the “Real World Wide Web”, offers practical, fast and reliable transport across the globe. The regions which travellers fly to and from underline its global reach (see Chart 3.2).

Airlines need ground-based infrastructure to operate. This infrastructure includes the facilities at Luxembourg Airport that directly serve passengers, such as baggage handling, ticketing, retail and catering outlets. Less visible are the essential services which are sometimes provided off-site, such as air navigation and air regulation, as well as the local activities of freight integrators.

Findel Airport is Luxembourg’s only international airport. In total approximately 1.55 million passengers and 628,000 tonnes of freight is handled annually at Findel Airport.

![Chart 3.2: Regional distribution of scheduled passenger trips originating in Luxembourg](image)

**Chart 3.2: Regional distribution of scheduled passenger trips originating in Luxembourg**

Europe, 86%
- Asia and Pacific Region, 2%
- North America, 3%
- Central and South America, 1%
- Africa and Middle East, 8%

**Chart 3.3: Luxembourg jobs and output supported by the aviation sector**

<table>
<thead>
<tr>
<th>Headcount (('000))</th>
<th>€ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>Indirect</td>
</tr>
<tr>
<td>Jobs</td>
<td></td>
</tr>
<tr>
<td>8.7</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>636</td>
</tr>
</tbody>
</table>

Source: IATA, Oxford Economics

The Aviation sector in Luxembourg (comprising the airlines as well as the airport and ground-based infrastructure) directly employs 8,700 people, and support through their supply chains a further 1,100 jobs. Examples of these supply-chain jobs include those in the distribution sector delivering aviation fuel; jobs in the catering sector and construction workers building or maintaining facilities at airports. A further 1,100 jobs are supported through the household spending of those employed by the sector and its supply chain.

The Aviation sector directly contributes around €636 million to the Luxembourg economy (GDP). The sector contributes indirectly another €155 million through the output it supports down its supply chain. A further €195 million comes from the spending of the employees or those firms in the sector and its supply chains.

Overall, the Aviation sector contributes €986 million to the economy (2.6% of GDP) and supports around 11,000 jobs in Luxembourg.

---

\(^{14}\) This figure relates to all passengers carried by Luxembourg airlines. Some of this total would be passengers carried on trips that originate and end outside Luxembourg.
3.3 Tax contribution

Aviation makes a substantial contribution to the public finances. In this section we estimate the corporation tax paid by aviation companies, the income tax paid by their employees, social security payments (both employer and employee contributions), and the revenue collected through aviation taxes. These estimates reflect the direct tax payments of the aviation sector. We also provide an indication of the taxes paid by the aviation sector’s supply chain and taxes raised through induced spending channels. They do not include increases in the overall Luxembourg tax base driven by aviation’s contribution to investment and productivity growth in the wider economy.

Table 3.2: Aviation makes a substantial contribution to Luxembourg tax

<table>
<thead>
<tr>
<th>Description</th>
<th>€ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxes on Aviation Sector’s GVA</td>
<td>165</td>
</tr>
<tr>
<td>Corporation Tax</td>
<td>32</td>
</tr>
<tr>
<td>Income Tax &amp; Social Security payments</td>
<td>132</td>
</tr>
<tr>
<td><strong>Aviation sector’s direct tax contribution</strong></td>
<td><strong>165</strong></td>
</tr>
<tr>
<td>Tax generated through the aviation sector’s indirect &amp; induced impact</td>
<td><strong>147</strong></td>
</tr>
<tr>
<td><strong>Total tax attributable to the aviation sector’s economic footprint</strong></td>
<td><strong>311</strong></td>
</tr>
</tbody>
</table>

Source: Oxford Economics, IATA, Individual company accounts

The aviation sector contributed €165 million in taxes through corporation tax and the income and social security contributions (both employee and employer contributions). This contribution is likely to increase further, as the sector recovers following a number of difficult years where many firms suffered losses. Very indicatively, it is estimated that a further €147 million of government revenue is raised via taxation through the indirect (€65 million) and induced (€82 million) channels.

3.4 Investment and productivity

Apart from these transformative effects on the wider economy, air transport services – the airlines, airports and ancillary services, such as air traffic control – form a capital intensive sector that invests heavily in aircraft systems and other advanced technology.

---

15 Indirect and Induced Tax contribution is approximated by applying an economy wide average tax figure (as a proportion of GDP) to the Indirect and Induced GVA estimates, using data from the Oxford Economics Global Macroeconomic Model.
Table 3.3: Investment by the aviation sector

<table>
<thead>
<tr>
<th>Investment as % value of output</th>
<th>Air transport services</th>
<th>5.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg Economy</td>
<td>17.3</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.4: Labour productivity in the aviation sector

<table>
<thead>
<tr>
<th>Productivity (GVA per employee)</th>
<th>Air transport services</th>
<th>€108,488</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg Economy</td>
<td>€97,802</td>
<td></td>
</tr>
</tbody>
</table>

Source: IATA, Oxford Economics

Table 3.3 reports the investment intensity of the aviation sector, as measured by its investment as a proportion of GVA. Investment in air transport services is equal to 5.2%. Table 3.4 provides an indication of the productivity of the aviation sector versus the rest of the economy. Measured as GVA per employee, the productivity of air transport services (the airlines and the ground-based infrastructure excluding retail and catering services at airports) is estimated to be €108,488. This is above that for the average productivity for the economy as a whole (€97,802). This high level of productivity implies that were the resources currently employed in the aviation sector redeployed elsewhere in the economy, this would be accompanied by a fall in overall output and income.

3.5 Catalytic effects

3.5.1 Benefits to Luxembourg tourism

Air transport lies at the heart of global business and tourism. Through its speed, convenience and affordability, air transport has expanded the possibilities of world travel for tourists and business travellers alike, allowing an ever greater number of people to experience diversity of geography, climate, culture and markets.

Tourism, both for business and leisure purposes, makes a large contribution to the Luxembourg economy, with foreign visitors spending just under €997 million in the Luxembourg economy each year\textsuperscript{16}. Nearly 40% of these visitors arrive by air, which by comparison is very similar to the average for the European Union as a whole (Chart 3.4), so that passengers who arrive by air probably spend around €380 million in Luxembourg\textsuperscript{17}.

\textsuperscript{16} Based on IMF statistics
\textsuperscript{17} Includes foreign visitors arriving on both domestic and foreign carriers
Oxford Economics estimates that in 2009 the travel and tourism industry directly employed 6,400 people and supported indirectly through its supply chain a further 6,300 jobs. A further 1,400 people were supported through the household spending of those people directly and indirectly employed by the travel and tourism sector. Of these jobs, we estimate that 1,300 (direct), 1,800 (indirect) and 300 (induced) were supported through the spending of foreign visitors who travelled by air.

The travel and tourism industry directly contributed €779 million to the Luxembourg economy (GDP), €495 million indirectly through the output it supports down its supply chain and a further €236 million through the induced effects of consumer spending. When only considering the contribution linked to the spending of foreign visitors arriving by air on Luxembourg produced goods and services, the sector contributes €163 million directly to the Luxembourg economy, €143 million indirectly and a further €57 million through induced effects.

3.5.2 Benefits to Luxembourg trade

Compared to other modes of transport, air freight is fast and reliable over great distances. However, these benefits come with a cost attached. Consequently, it is mostly used to deliver goods that are light, compact, perishable, time sensitive or that have a high unit value.

These key characteristics of air freight are most apparent in the data on the modes of transport used in world trade. For example, data on the weight (volume) and value of goods carried by air, sea and land transport is available for EU trade with the rest of the world. While air accounts for less than 1% of the tonnage of EU trade (Chart 3.6), air freight makes up over 22% of the value of EU trade with the rest of the world.
As with passenger services, air freight operations make up an essential part of the global transport network. Air freight’s global reach is clearly illustrated from Chart 3.7. Measured in terms of tonnage carried to and from Luxembourg, 34% is linked to trade with the Asia Pacific region with 25% linked to trade with the Middle East and Africa. Freight shipments to North America accounts for 21% of the total, with the rest of Europe (11%) and the Caribbean & Central/South American region (9%) occupying the remaining distribution of freight.
4 Conclusion

This study has described and quantified a number of channels through which aviation in Luxembourg generates important economic benefits for its customers and the wider Luxembourg economy.

Studies of this kind usually focus on the ‘economic footprint’ of the industry, the GDP and jobs supported by the industry and its supply chain. We provide the latest estimates for these metrics. But the economic value created by the industry is more than that. It is not just jobs that are threatened if government policies are badly designed. The welfare of voting citizens and the effectiveness of infrastructure critical to the country’s long-term success in global markets are also at risk.

The welfare of travelling citizens has been conservatively quantified in this study. Not all customers of airlines serving Luxembourg airports are Luxembourg residents, but an estimated 50% are. They currently get an economic benefit estimated to be worth €135 million. Indicatively, 73% of the shippers using air freight services are Luxembourg companies. Taxing air transport directly reduces the welfare of these Luxembourg residents and Luxembourg businesses.

The study has also shown what a critical asset Luxembourg’s air transport network is, to business and the wider economy. Connectivity between cities and markets boosts productivity and provides a key infrastructure on which modern globalized businesses depend. Many of these city-pair connections are dependent on hub airports through which to generate the traffic density necessary to sustain them. All airlines supplying services at Luxembourg airports contribute to generating these wider economic benefits. These ‘supply-side’ benefits are hard to measure but are easily illustrated by the experience of the volcanic ash cloud, which closed much of European airspace for a week in early 2010. Travellers were stranded. Many globalized supply chains and just-in-time manufacturing processes were impacted.

More readily measured is the ‘economic footprint’ supported, mostly, by the activities of national airlines. Luxembourg-based airlines were responsible for carrying 73% of both passengers and freight. The wages, profits and tax revenues created by these airlines flows through the Luxembourg economy, generating multiplier effects on Luxembourg national income or GDP. The economic benefits for Luxembourg created by non-Luxembourg airlines are to be found in customer welfare and in the part these airlines play in providing the connectivity infrastructure between Luxembourg and overseas cities and markets.

Aviation has a significant footprint in Luxembourg’s economy, supporting 2.6% of Luxembourg GDP and 11,000 jobs or 5.0% of the Luxembourg workforce. Including the sector’s contribution to the tourism industry, these figures rise to 3.6% of Luxembourg GDP and 14,500 jobs or 6.6% of the workforce.

Also significant is the fact that these are high productivity jobs. The annual value added (or GVA) by each employee in air transport services in Luxembourg is €108,488, over 10% higher than the Luxembourg average of €97,802.

Tax revenues from aviation are substantial. Luxembourg-based aviation companies paid €165 million annually in direct taxes and social security payments. It is estimated that an additional €65 million of government revenue is raised via the aviation sector’s supply chain and €82 million through taxation of the activities supported by the spending of employees of both the aviation sector and its supply chain.

All together these points demonstrate that aviation provides significant economic benefits to the Luxembourg economy and its citizens, some of which are unique and essential to the operation of modern economies, as was found when volcanic ash closed large parts of European airspace for some time.
Annex: Our methods

Benefits to passengers and shippers

In Section 1, we report estimates for the monetary benefits that air transport customers receive through the services provided by the aviation sector. These estimates are based on the economic concept of consumer surplus, the difference between the passengers’ or shippers’ willingness-to-pay and the actual airfare or freight rate they face. In order to calculate the overall consumer surplus for the various fare types and for freight, we need three pieces of information: (1) data on passenger numbers, freight tonnage and their respective average fares and freight charge; (2) an estimate of how sensitive passenger numbers and freight tonnage are to changes in fares and freight, known as the elasticity of demand; and (3) an assumption about customers’ willingness to pay (airfare and freight charges), reflected through an assumption about the shape of the market demand curve.

The calculations are based on 2009 data on total passenger numbers and freight tonnage arriving and departing from domestic airports, together with the average fare and freight charge, broken down by the following market segments: first class, business class, economy, economy discount, and freight. The data are provided by IATA.

We apply an estimate for the elasticity of demand for each market segment. We draw on the findings of several recent studies that investigate elasticities of demand for air transport, to choose elasticities for each market segment that we believe are reasonable\(^\text{18}\). The elasticities that we use are: first and business class -0.55, economy -1.13, and freight -1.20. These indicate the percentage change in demand that would follow a one percent change in the average fare, or freight charge.

Based on these inputs, we calculate consumer surplus based on the approach proposed by Brons, Pels, Nijkamp, and Rietveld (2002) that assumes that the demand curve for each market segment has a constant elasticity of demand\(^\text{19}\).

Connectivity Index

The connectivity index is a measure of the quality of a country’s air transport network that reflects both the volume of passenger traffic and the importance of the destinations served. For every destination country for which there are direct services, an estimate of total passenger seat capacity is derived from data on the frequencies of service and the available seats per flight. From this underlying data, an index is constructed by attaching a weight to each destination. This weight reflects the relative importance of the destination in the global air transport network, measured by the number of seats available for passengers from that airport relative to Atlanta, the largest airport. The connectivity index will therefore have a higher value, the more destinations are served, the higher the frequency of services, the larger the number of available seats per flight and the greater the relative importance of the destinations served.

Benefits to tourism

In quantifying the benefits from Travel & Tourism (T&T) we were seeking to capture the spending by tourists and businesses on accommodation, food etc outside of their airfare (which forms part of our estimate of the direct calculation). In doing this we relied heavily on the Oxford Economics Travel & Tourism model

---


\(^\text{19}\) See http://www.ecad-aviation.de/fileadmin/documents/Konferenzbeitraege/Braun_Klophaus_Lueg-Arndt_2010_WCTR.pdf
prepared on behalf of the World Travel & Tourism Council (WTTC) which simulates Tourism Satellite Account (TSA) data across over 180 countries. From the model we obtained an estimate of the level of value-added created by foreign visitors, and assigned a share of this to the aviation industry based on the share of foreign visitor arrivals travelling by air. We then used coefficients within the model to divide this between T&T providers (direct) and their supply chain (indirect). Finally, we attributed a share of the total induced effect to the aviation industry by dividing our estimates of aviation-related direct and indirect GDP by total T&T direct and indirect GDP. It should be noted that this is a gross measure of the benefit from tourism and therefore does not account for the spending which is effectively “lost” when domestic residents travel abroad by air.

**Economic footprint**

In Section 3 we report the contribution that the aviation sector makes to the economy. The contribution is measured in terms of the value of the sector’s output and the number of people it employs. For each measure, the contribution is built up from three components: direct, indirect, and induced.

The direct output component is measured by Gross Value Added (GVA). GVA is measured either as the firm or industry sales revenue less purchases from other companies, or equivalently, as the sum of employee compensation and gross operating surplus, measured before the deduction of depreciation, interest charges and taxation. In this report we treat gross operating surplus as equivalent to gross operating profit, however, the two concepts differ slightly with the former including income from land and a technical adjustment for the change in stock valuation. GVA differs from Gross Domestic Product (GDP) in the price used to value goods and services. GVA is measured at producer prices that reflect the price at the ‘factory gate’ together with cost of distribution. GDP is measured at market prices that reflect the price paid by the consumer. The two prices differ by the taxes less subsidies levied on the goods or services.

The indirect output component is measured using an Input-Output table that reports how industries use the output of other industries in the process of production, and how their final output is used, e.g. in final domestic consumption, changes in stocks or exports. For many countries, Input-Output tables are available as part of the national accounts. As Input-Output tables describe how an industry uses the output of other industries as inputs in the production of its goods or service, they describe its full supply chain – its direct suppliers, those industries that supply its direct suppliers, and so on. This is reported as the indirect output component.

The Input-Output table reports how much of final output is sold in the domestic economy. Using similar methods as that used to derive the indirect output component, the Input-Output table can be used to estimate how much spending on completed goods (known as final domestic consumption) is supported through the employees of the industry and its full supply chain. This is reported as the induced output component. Based on analysis at Oxford Economics, the ratio of induced output to the sum of direct and indirect output is capped at 30%.

We also calculate the contribution of freight integrator activity in countries where they have significant presence. Where reported, their contribution appears under airport and ground based infrastructure as a component of both the direct benefit (on-airport activity) and indirect benefit (off-airport activity), with the induced benefit adjusted accordingly. Our estimates are based on employment and market share information supplied by freight integrators (either directly or from company websites), and labour productivity estimates derived from Oxford Economics’ 2009 global express delivery industry study.

---

The three output components – direct, indirect, and induced – are converted to their respective employment components, using an estimate for the average labour productivity (GVA per employee) for the economy.

Passenger and freight volumes

Passenger and freight traffic is accounted for in different ways across the industry supply chain, depending on the focus of the operator and the purpose of analysis. For example, airlines generally count the number of passengers who board their aircraft, whereas airports often count the number of passengers arriving or departing their airport – which in some cases can lead to totals significantly larger than those reported by airlines, despite referring to the same inherent volume of passengers. The table below outlines the main passenger and freight volumes referred to in this report. In particular, it shows how the numbers used in the calculation of consumer benefit and the economic footprint were derived.

<table>
<thead>
<tr>
<th>Passenger numbers 2009</th>
<th>Thousands</th>
<th>Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of passengers arriving or departing Luxembourgian airports (A)</td>
<td>1,551</td>
<td></td>
</tr>
<tr>
<td>Less domestic arrivals at Luxembourgian airports (due double counting)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Number of passengers on aircraft flying to and from Luxembourg (B)</td>
<td>1,551</td>
<td>1,132 Carried by Luxembourgian airlines (C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>775 Luxembourgian residents (D)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Freight tonnes 2009</th>
<th>Thousands</th>
<th>Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes of freight carried on aircraft flying through Luxembourg (E)</td>
<td>628</td>
<td>458 Carried by Luxembourgian airlines (F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>170 Carried by non-Luxembourgian airlines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Passenger measure</th>
<th>Thousands</th>
<th>Use in report</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Number of passengers arriving or departing Luxembourgian airports</td>
<td>1,551</td>
<td>Overall indicator of passenger arrivals and departures handled by airports in Luxembourg.</td>
<td>Luxembourg Gouvernment Statistics</td>
</tr>
<tr>
<td>B Number of passengers on aircraft flying to and from Luxembourg</td>
<td>1,551</td>
<td>Overall indicator of airline passenger traffic associated with the Luxembourgian market.</td>
<td>Luxembourg Gouvernment Statistics</td>
</tr>
<tr>
<td>C Passengers carried by Luxembourgian registered airlines</td>
<td>1,132</td>
<td>Overall indicator of passenger output ‘performed’ by airlines in the scope of the economic footprint analysis in Section 3 of this report.</td>
<td>Estimate based on 50% of 1,551 thousand passengers (B)</td>
</tr>
<tr>
<td>D Number of Luxembourgian residents on flights flying to and from within Luxembourg</td>
<td>775</td>
<td>Basis for calculation of passenger consumer surplus accruing to Luxembourgian economy.</td>
<td>73% of Luxembourgian market scheduled capacity is operated by Luxembourgian airlines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Freight measure</th>
<th>Thousands</th>
<th>Use in report</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>E Tonnes of freight carried on aircraft flying through Luxembourg</td>
<td>628</td>
<td>Overall indicator of freight loaded and unloaded at airports in Luxembourg.</td>
<td>Luxembourg Gouvernment Statistics</td>
</tr>
<tr>
<td>F Tonnes of freight uplifted by Luxembourgian registered airlines</td>
<td>458</td>
<td>Overall indicator of freight output ‘performed’ by airlines in the scope of the economic footprint analysis in Section 3 of this report.</td>
<td>73% of Luxembourgian market scheduled capacity is operated by Luxembourgian airlines</td>
</tr>
</tbody>
</table>
OXFORD
Abbey House, 121 St Aldates
Oxford, OX1 1HB, UK
Tel: +44 1865 268900

LONDON
Broadwall House, 21 Broadwall
London, SE1 9PL, UK
Tel: +44 207 803 1400

BELFAST
Lagan House, Sackville Street
Lisburn, BT27 4AB, UK
Tel: +44 28 9266 0669

NEW YORK
817 Broadway, 10th Floor
New York, NY 10003, USA
Tel: +1 646 786 1863

PHILADELPHIA
303 Lancaster Avenue, Suite 1b
Wayne PA 19087, USA
Tel: +1 610 995 9600

SINGAPORE
No.1 North Bridge Road
High Street Centre #22-07
Singapore 179094
Tel: +65 6338 1235

PARIS
9 rue Huysmans
75006 Paris, France
Tel: + 33 6 79 900 846

email: mailbox@oxfordeconomics.com

www.oxfordeconomics.com