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3. Local Economy: Literature Review

Airports Commission

Final report

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1.1 Background

PricewaterhouseCoopers (PwC) was commissioned by the Airports Commission to undertake research designed to provide the Commission with a better understanding of the impacts of airports and airport expansions on local economies. Our research is intended to inform the Commissioners' final decision on the preferred long-term expansion option by feeding into further work to set the baseline and assess the economic impacts of the proposed schemes (including additional surface access infrastructure) on the local area.

1.2 Aim of project

The purpose of our project is to provide the Commission with a 'road map' which links the available evidence in relation to the local economic impacts of airport development to its Appraisal Framework[1]. Specifically, we aim to:

- Identify the local economic impacts of increases in airport capacity/use in general, not just the shortlisted schemes, focusing primarily on the supply chain effects of airports, but also considering their impacts as catalysts of wider economic impacts for airport users; and
- Undertake a series of six case studies which examine these issues in specific local contexts:
  - Four of the case studies examine the historic evolution of the local economic impacts of Heathrow, Gatwick, Manchester airports and the New York system as a whole;
  - Two more focused studies look at the impacts of airport expansion/use in the context of the origin-destination market at Paris Charles de Gaulle and surface access links at Frankfurt.

The study seeks to understand the local economic impact of an airport's operation across four areas outlined in the Airports Commission's Appraisal Framework:

- **Business & services:** what type of businesses may be attracted to locate at or in the locality of an airport?
- **Labour demand:** what are the implications of an airport's operation for local labour demand, and is there sufficient supply to meet this demand?
- **Housing & social infrastructure demand:** how is an individual's decision on where to live impacted by the presence of an airport, and what impact does this have on local housing and infrastructure?
- **Land required:** what type of land is required for new commercial, residential and other development and how easily can this land be identified and developed following airport expansion?

A key issue for our research has been to understand and assess how the 'local' area has been defined in previous studies.

1.3 Approach

Our work has involved collating and exploring existing research (both theoretical and empirical) and case studies (in the UK and internationally). Its scope is limited so that it builds on existing research and does not duplicate that being undertaken as part of other modules. This means that:

- It excludes impacts such as those covered in the national economy impacts module[2], quality of life, sense of place, landscape and environmental impacts;

[1] Airports Commission, Appraisal Framework, April 2014 (see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf)

[2] We recognise that there will be some overlap with the national economic impact, to the degree that local impacts contribute to the national picture

- It does not involve modelling or secondary data analysis (beyond the literature review); and
- It builds on the literature review by SDG on aviation and the economy[3].

1.4 Key findings

The two tables below summarise our findings from a review of the literature available on the local economic impact of airports. The focus of the review has been on the operation of airports rather than their construction and/or expansion.

Our findings are structured in a way which is aligned with the Airports Commission's proposed approach to assessing the local impacts of an aiport option, as set out in its Appraisal Framework[4]. We start by considering the impact on local businesses and services attracted to the local area and then consider the implications for labour demand and how labour supply adjusts to meet this demand (see Table 1). We distinguigh between those generated:

- Through airport operation (the direct impacts);
- Through supply chain spending and the spending of direct and supply chain employees (the indirect and induced impacts); and
- By the attraction, retention or expansion of economic activity resulting from the increased connectivity facilitated by the airport (the catalytic impacts).

We then consider the impacts on demand for housing and social infrastructure arising directly and indirectly from airport operation, and the land required for commercial, residential and infrastructure development (see Table 2).

Table 1: Key findings from literature review in relation to business & services and labour demand & supply

	Business & services attracted	Labour demand & supply
Questions to analyse	• How has the nature of the local business environment been affected by local airport development? • What businesses have been attracted to/ deterred from the local area?	• What employment has been generated: direct on- and off-site, indirect, induced and catalytic? • Could the jobs be met by the local and wider area? What was the remaining 'net additional labour demand'?
Direct impacts	• The majority of the direct business activity generated at airports is seen through passenger or freight airlines, although the sectoral breakdown of impacts is more commonly expressed in employment terms than business activity, and the definition of relevant industry groups varies between studies. • In addition, in the case of both London Heathrow and Manchester, nearly 90% of the total was direct activity on the airport site • The scale of additional business activity generated by expansion of airport capacity (measured in terms of additional passengers handled) depends on several factors including: - The share of air traffic movements which are long-haul flights (rather than low cost carriers) - How developed non-aviation activity is on the	• Our review of airport economic impact studies suggests that just over half of direct jobs created at airports are in airlines or other aviation industry firms: other major employment groups include government & security (9-18%) and ground transportation (6-15%) • The average number of direct jobs generated for each million passengers handled ranges from under 500 to over 1,500 • In the UK and USA, transport industry jobs are more skilled and more productive than the national average whereas jobs in the storage, trade and retail sectors tend on average to be relatively lower skilled • The commuting patterns of direct employees (airport workers) are relatively consistent across those airports where information is

[3] Steer Davies Gleave, 'Aviation and the economy – Framework and Evidence', 2014 (see https://www.gov.uk/government/publications/airports-commission-interim-report)

[4] Airports Commission (2014); Appraisal Framework; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf

	Business & services attracted	Labour demand & supply
	airport site - How much freight is handled • Also, the scope of airport impact studies often differs significantly which means comparisons require careful interpretation	available: over 75% live within a 30-minute drive of the airport, and the majority travels by car • This pattern of commuting provides some indication of the geographic scale of the local labour market • It is also relevant for considering the effectiveness and efficiency with which labour supply adjusts to changes in labour demand as a result of airport development
Indirect & induced impacts	• The economic impact studies reviewed use a broad range of multipliers to estimate the local indirect and induced impacts on value added of airport operation: a multiplier of 1.45 was used for Edinburgh Airport and one of 2.9 at Copenhagen Airport • The size of the multiplier is partly influenced by how broadly or narrowly the local area is defined: multipliers tend to be larger when the impact is being assessed at a regional level (e.g. North West England in the context of Manchester Airport and the Ile de France in the case of the Paris airports) because the areas are more self-contained • The attractiveness of the locality of an airport as a location for firms also affects the level of indirect and, to a lesser extent, the induced business activity	• The evidence on the share of national indirect and induced employment impacts which are felt locally and regionally is less than that for the direct impacts • A key factor influencing the employment multipliers is the size of the local area being considered: all other things being equal, multipliers will be larger in larger areas because leakages from the 'local' economy will tend to be smaller • Evidence from Sydney Airport suggests that the nature of the local labour market will need to adjust to accommodate the increase in supply • Similar evidence is seen from the Joseph Rowntree Foundation who highlight that new unskilled workers have moved into local communities, while the existing workers have taken on higher skilled jobs • These adjustment mechanisms determine how labour costs and pressure on social infrastructure will change with labour demand changes • They can only be fully assessed through general equilibrium modelling.
Catalytic impacts	• The catalytic impacts are rarely quantified, and often not discussed, within the literature around the economic impact of individual airports	
Investment and productivity	• The existing literature highlights the positive influence of (good) transport infrastructure on firms' investment location decisions • For example, a survey of UK companies shows that access to the air transport network is rated as vital or very important by more than 40% of companies, ahead of the cost of labour and business taxes • Similarly, the series of European Cities Monitors prepared by Cushman & Wakefield indicate that the most important factor influencing firms' choice of location is 'Easy access to markets, customers or clients' • The limited evidence available suggests that, in addition to companies which directly support aviation activity, occupiers of commercial space at or close to airports are typically in the technology and telecommunications (T&T) and manufacturing sectors • Businesses in the financial services, tourism, distribution and high-tech/ knowledge intensive manufacturing sectors are often cited as amongst those most influenced by connectivity: the list,	• The impact on the labour market of airport expansion depends on the nature of industries which locate in the locality • The evidence is mixed: for example, Dallas/ Fort Worth International Airport has attracted high-productivity industries, such as computing, finance and insurance whereas evidence from Memphis International and Amsterdam Schiphol airports suggests concentrations of low productivity distribution and storage firms • These differences indicate how the local economic geography and history affect the labour market demand through changing required skill mixes

	Business & services attracted	Labour demand & supply
	however, varies significantly depending on the local context • This means that findings from airports outside the London system do not readily transfer to London because the local economic context is quite different	
Tourism	• The impact of tourism on local business and services will predominantly be determined by the definition of the 'locality' which is assumed. While there may be limited benefit of close proximity to the airport, beyond the direct and induced impacts, there may be a more significant impact when the nearest metropolitan area or region is considered[5] • For a given number of passengers visiting the local area, the value added by tourism varies greatly: the shares of international and long-haul flights are key factors which can increase the level of impact[6] • In the UK, tourism value-added is 40% of visitor spending and average visitor spending is more than twice as high for non-European visitors as it is for European visitors (£1,027 vs £451) • In addition, £24.2bn of expenditure was generated through outbound tourism from the UK. This is a further source of value added, facilitated by the airport[7]	• The value added by tourism is associated with additional jobs in tourism intensive sectors, notably accommodation and transport • The proportion of these jobs which is local to the airport depends on the travel patterns of airport users in relation to their final destinations: for example, some are closer to the final visitor destination than others • Further jobs will also be created through outbound tourism: the majority of these (60%) are in the air transport industry (i.e. direct or indirect jobs), with additional employment in areas such as retail (25%) and travel agencies (7%) • Outbound tourism could also reduce value-added by facilitating the substitution of local expenditure for expenditure in other regions or abroad: local economic welfare may be enhanced by changes in the opportunity for travel • How far an increase in airport capacity will lead to increased outbound travel depends on levels of demand and price adjustments in the air transport market: this is being analysed through the DfT's transport modelling, which should be applied in this module
Clustering & agglomeration economies	• The emergence of airport city models reflects a belief that airports can drive the development of (local) industry-specific concentrations of economic activity. These are enabled by improvements in connectivity and access to related services. They, therefore, typically comprise a far broader range of firms than just those directly in the aviation industry • Research shows that firms' motivation to locate with logistics clusters proximate to airports is more strongly motivated by the opportunities to realise agglomeration benefits than a desire simply to be near to the airport • The local context, including governments' economic priorities (and incentives), strongly influence the industries which cluster around airports, with only aviation clusters consistently present at all airports	• There is very little evidence in the existing literature regarding on the impact of industry clustering around airports on the level and nature of labour demand • A wide range of industry clusters (including, transportation, telecommunications, publishing and distribution) have developed around airports, and these have very different implications for productivity, skill mix and employee numbers

[5] See Hakfoort et al (2001)

[6] This can be seen, for example, in comparing Deloitte (2013) and BERL (2008)

[7] For more detail, please refer to the Tourism Satellite Account (ONS, 2013)

Table 2: Key findings in relation to housing, social infrastructure and land

	Housing and social infrastructure demand	Land required
Questions to analyse	• How much of the 'net additional labour demand' will add pressure to the local housing market and associated services? • How much housing demand could there be from other sources, such as people wishing to live close to the airport for connectivity reasons?	• How much land is required for commercial and residential development to meet additional labour and housing demand? • Is the land available and could it plausibly be developed?
Airport impact	• To the extent that airport expansion increases direct and indirect employment in the local area, this will create pressure in the local housing market • The extent of this pressure depends in part on the scale of the local area (geographically and in terms of the economically active population) • Changes in commuting patterns are also an important adjustment mechanism • Evidence from the Joseph Rowntree Foundation in relation to Heathrow suggests that proximity to employment opportunities has affected the location decision of many residents • How airport expansion affects local housing markets is ambiguous: on the one hand, it directly stimulates housing demand as more airport workers are needed, and indirectly, as improved connectivity attract mobile firms and/or enables existing firms to become more competitive (thus boosting their demand for labour). On the other hand, negative externalities associated with airport expansion (e.g. noise, congestion) can make the area less attractive so reducing housing demand • McMillen (2004), for example, finds that the impact of 'severe noise' in reducing demand lowers house prices by 9.2%. The impact of additional airport capacity on noise is considered in Module 5 of the Appraisal Framework • Demand for housing is shown to be increased by Lipscomb (2003) through the improved connectivity brought by an airport	• The evidence demonstrates that the amount of land which is required in the locality of an airport varies greatly according to the local context • For example, Dallas/ Fort Worth airport covers 18,000 acres, or which 6,000 are for non-aviation activity but the majority of other airports are considerably smaller • Baker et al (2012) suggest that the nature of the land used by airports has changed with their recent development, stating that "large international airports in Europe, North America and Asia have varied functions beyond airport traffic and operate as metropolitan hubs with a diverse range of land uses" • Similarly, CBRE research demonstrates how the role of land used by the airport has changed, showing that occupiers of office space at airports are dominated by the technology and telecommunications (T&T) and manufacturing sectors • The result of this has been to increase land rents on airports sites, to the extent that land at Amsterdam Schiphol is now more expensive than in the Amsterdam CBD. This type of adjustment mechanism with regards to an increase in demand will have a significant impact on the nature and level of land use in the vicinity of an airport

Each impact has been considered at the 'local' level. In practice, the way in which the local area is defined varies from study to study (and from location to location). An important aspect of the research, therefore, has been to assess how the local area has been identified and what, if any, lessons can be learned.

Our review suggests that the nature of the 'local' impact varies by type of impact:

- The extent of the direct local impacts is reflected in direct employees' commuting patterns, which are primarily within a 30-minute travel time: this suggests that travel to work areas (or similar labour market measures) define the geographic scope of the main local impacts;
- By definition, the supply chain (indirect) and knock-on employee spending (induced) effects will tend to be more widely distributed spatially, recognising that some suppliers have less need for close physical

proximity to the airport to be competitive: many studies have expanded their geographical scope to consider metropolitan or regional areas, reflecting local economic geography (as well as the availability of data); and

- The extent of the local catalytic impacts, whether they be the influence on business location decisions, the facilitation of growth in wider markets (especially internationally) or the pattern of tourism, is driven by the way in which proximity to the airport makes a location attractive from a business and/or visitor perspective: the evidence suggests that this is broader than the local labour market.

When assessing the potential impacts of runway expansion at either Heathrow or Gatwick Airport, our research suggests that different definitions of the 'local' area will be needed to capture the different types of impact (see Table 3).

Table 3: Basis for defining and assessing local areas

Impact type	Basis for defining local areas
Direct	• Defined by local labour market (e.g. the travel to work area (TTWA)) in which the majority of 'on-airport' (and 'off-airport') employees reside • In the case of Gatwick Airport this is the Crawley TTWA (as defined by ONS) and, in the case of Heathrow Airport, four TTWAs are relevant (London, Reading & Bracknell, Guilford & Aldershot and Wycombe & Slough)
Indirect	• Depends on how widely/narrowly the scope of the airport is drawn • In the case of both Heathrow and Gatwick Airports, the multiplier used in any assessment needs to reflect the airports' footprints across large parts of London and the South East
Induced	• Arguably, less meaningful to define local area • Will be closely linked to the definition of the local area for the purposes of direct and indirect impacts
Catalytic	
Business location	• Influenced by workplace location of airport users • In the case of Heathrow and Gatwick, this is likely to cover a broader region across London and the South East
Tourism	• Influenced by destination of in-bound visitors relative to the airport • Depends on which markets are served by the airport and the extent of competition from other airports (and, to a lesser extent, other modes of transport available)

2 Introduction

2.1 Background

PricewaterhouseCoopers (PwC) was commissioned by the Airports Commission to undertake research designed to provide the Commission with a better understanding of the impacts of airports and airport expansions on local economies. Our research is intended to inform the Commissioners' final decision on the preferred long-term expansion option by feeding into further work to set the baseline and assess the economic impacts of the proposed schemes (including additional surface access infrastructure) on the local area.

2.2 Aim of project

The purpose of our project is to develop the evidence base on the local economic impacts of airport expansion, both immediately at and around airports, and more widely (whilst remaining local to the airport). It provides the Commission with a 'road map' which links the available evidence in relation to the local economic impacts of airport development to its Appraisal Framework[8]. Specifically, the aims are to:

- Identify the local economic impacts of increases in airport capacity/use in general, not just for the shortlisted schemes, focusing primarily on the supply chain effects of airports, but also considering their impacts as catalysts of wider economic impacts for airport users; and
- Undertake a series of six case studies which examine these issues in specific local contexts:
  - Four of the case studies examine the historic evolution of the local economic impacts of Heathrow, Gatwick, Manchester airports and the New York system as a whole;
  - Two more focused studies look at the impacts of airport expansion/use in the context of the origin-destination market at Paris Charles de Gaulle and surface access links at Frankfurt.

Our research and analysis has focused on the evidence relating to the key questions in the Airports Commission's Appraisal Framework:

- What types of business and services are likely to be attracted/deterred from locating at/around an airport and more widely (but still locally)?
- What scale and type of employment does an airport generate directly and indirectly, how productive is it and where is the labour drawn from?
- What factors influence individuals' decisions on where to live in the local and wider area of an airport, and what type and supply of housing is clustered around airports?
- What type of land is required for new commercial, residential and other development, and how easily can this land be identified and developed following airport expansion?
- To what extent are businesses/employment/housing displaced from other areas or additional?
- Following the development of airports, how do local areas mitigate the additional pressures placed on services?

A key issue for our research has been to understand and assess how the 'local' area has been defined in previous studies.

2.3 Approach

Our work has involved collating and examining existing research (both theoretical and empirical) and case studies (in the UK and internationally).

[8] Airports Commission, Appraisal Framework, April 2014 (see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf)

The scope of our research is limited in that it builds on existing research and does not duplicate that being undertaken as part of other modules. This means that:

- It excludes impacts such as those covered in the national economy impacts module[9], quality of life, sense of place, landscape and environmental impacts;
- It does not involve modelling or secondary data analysis (beyond the literature review): we envisage that this will be undertaken as part of the local economic impact assessment; and
- It builds on the literature review by SDG on aviation and the economy[10].

2.4 Report structure

Our report summarises the evidence we have been able to collect in relation to the four themes in the Airports Commission's Appraisal Framework:

- **Section 3** explores the types of business and services attracted to (and deterred from) locating at or around an airport and more widely (but still locally);
- **Section 4** examines the scale and type of employment generated directly and indirectly, how productive this employment is and where the labour supply is drawn from, including the factors that influence individuals' decisions on where to live in relation to the airport;
- **Section 5** considers the available evidence on how airport construction and expansion affects demand for housing and social infrastructure; and
- **Section 6** examines the influence of land availability.

A series of Appendices provide details of each of the six case studies as well as a list of the existing studies which have been reviewed.

[9] We recognise that there will be some overlap with the national economic impact, to the degree that local impacts contribute to the national picture

[10] Steer Davies Gleave, 'Aviation and the economy – Framework and Evidence', 2014 (see https://www.gov.uk/government/publications/airports-commission-interim-report)

3 Business and services

In this section we summarise the impact of an airport, or airport expansion, on those businesses and services which locate at or around an airport. We consider those directly involved in airport operations, those involved in the airport's supply chain, those dependent on the spending of employees at the airport and its supply chain, and those more widely affected by the air transport services provided through the airport. For this latter group of impacts, we focus on three key questions:

- What differences, if any, are there in the types of businesses attracted to locate near different types of airports?
- What value of output do these businesses generate?
- What factors attract/ deter a business to locate near an airport?
- We also consider briefly London's industrial structure, the role of clusters and how it has evolved.

Our key findings are summarised in Box 1.

Box 1: Business and services – key findings

Our analysis of business and services has focused on two questions:

- How has the nature of the local business environment been affected by local airport development?
- What businesses have been attracted to/ deterred from the local area?

Direct impacts

Our key findings in relation to the direct impacts are that:

- The majority of the direct business activity generated at airports is seen through passenger or freight airlines, although the sectoral breakdown of impacts is more commonly expressed in employment terms than business activity, and the definition of relevant industry groups varies between studies
- In addition, in the case of both London Heathrow and Manchester, nearly 90% of the total was direct activities on the airport site
- The scale of additional business activity generated by expansion of airport capacity (measured in terms of additional passengers handled) depends on several factors including the share of air traffic movements which are long-haul flights (rather than low cost carriers), how developed non-aviation activity is on the airport site and how much freight is handled
- Also, the scope of airport impact studies often differs significantly which means comparisons require careful interpretation

Indirect & induced impacts

Our key findings in relation to the indirect and induced impacts are that:

- Most of the impact studies rely on either input-output analysis and/or surveys of airport supply chains to determine the indirect and induced impacts
- The economic impact studies reviewed use a broad range of multipliers to estimate the local indirect and induced impacts on value added of airport operation: a multiplier of 1.45 was used for Edinburgh Airport and one of 2.9 at Copenhagen Airport
- The size of the multiplier is partly influenced by how broadly or narrowly the local area is defined: multipliers tend to be larger when the impact is being assessed at regional level (e.g. North-West England in the context of Manchester Airport and the Ile de France in the case of the Paris airports)
- How attractive the locality of an airport is as a location for firms also affects the level of indirect and, to a lesser extent, of induced business activity
- There is evidence that differences in findings are partly driven by measurement issues: for example, local indirect and induced impacts often depend on estimating regional input-output tables (from national models) but different approaches lead to differences in the multipliers

Catalytic impacts

The catalytic impacts are rarely quantified, and often not discussed, within the literature concerned with the economic impact of individual airports. Our key findings are summarised below:

Investment and productivity

- There is an extensive literature on the role of connectivity and market access on investment and location decisions: this

highlights the positive influence of good transport infrastructure on firms' investment location decisions

- For example, a survey of UK companies shows that access to the air transport network is rated as vital or very important by more than 40% of companies, ahead of the cost of labour and business taxes[11]
- Similarly, the series of European Cities Monitors prepared by Cushman & Wakefield indicate that the most important factor influencing firms' choice of location is 'Easy access to markets, customers or clients'
- The limited evidence available suggests that, in addition to companies which directly support aviation activity, occupiers of commercial space at or close to airports are typically in the technology and telecommunications (T&T) and manufacturing sectors
- Businesses in the financial services, tourism, distribution and high-tech/ knowledge intensive manufacturing sectors are often cited as amongst those most influenced by connectivity: the list, however, varies significantly depending on the local context
- This means that findings from airports outside the London system do not readily transfer to London because the local economic context is different

Tourism

- The impact of tourism on local business and services will predominantly be determined by the definition of the 'locality' which is assumed. While there may be limited benefit in close proximity to the airport, beyond the direct and induced impacts, there may be more significant impact when the nearest metropolitan area or region are considered[12]
- For a given number of passengers visiting the local area, the value added by tourism varies greatly: the share of international and long-haul flights are key factors which can affect the level of impact[13]
- In the UK, tourism value-added is 40% of visitor spending and average visitor spending is more than twice as high for non-European visitors as it is for European visitors (£1,027 vs £451)
- In addition, £24.2bn of expenditure was generated through outbound tourism from the UK, which is a further source of value added facilitated by the airport (ONS, 2013)

Clustering & agglomeration economies

- Some studies also refer to the agglomeration benefits which they claim are reflected in the composition of firms which cluster around an airport, but the evidence is typically qualitative
- The emergence of the aerotropolis (Kasarda, 2008) and airport city models reflects a belief that airports can drive the development of (local) industry-specific concentrations of economic activity. These are enabled by improvements in connectivity and access to related services. They, therefore, typically comprise a far broader range of firms than just those directly in the aviation industry
- Research by Warffenmuis (2010) shows that firms' motivation to locate within logistics clusters proximate to airports is more strongly motivated by the opportunities to realise agglomeration benefits than a desire simply to be near to the airport
- Recent analysis has suggested that the clustering benefits may be limited once proximity to transport hubs is controlled for (Overman et al, 2012)
- In addition, the existing literature suggests that the composition of firms which cluster around an airport depends on the local context which limits how far the findings and experiences from one airport can be translated to another

Table 4 highlights some of the key studies we refer to in this section besides those reviewed as part of the case studies: a full list of studies used is provided in Appendix G.

Table 4: Summary of key sources used

No.	Title	Authors	Year	Airport covered
1	Economic and social analysis of potential airport sites	Ernst & Young	2012	Sydney
2	Economic Effects of Airports in Central Europe: A Critical Review of Empirical Studies and Their Methodological Assumptions	Zak & Getzner	2014	Central Europe
3	Minneapolis-St. Paul International Airport	InterVISTAS	2012	Minneapolis-St. Paul

[11] Cited in Oxford Economic Forecasting (2006), The Economic Contribution of the Aviation Industry in the UK, http://www.gacag.org/images/gacag/pdf/The%20Economic%20Contribution%20of%20the%20Aviation%20Industry%20in%20the%20UK.pdf.

[12] See Hakfoort et al (2001)

[13] This can be seen, for example, in comparing Deloitte (2013) and BERL (2008)

No.	Title	Authors	Year	Airport covered
4	The Regional Economic Impact of an Airport: The Case of Amsterdam Schiphol Airport	Hakfoort et al	2001	Amsterdam
5	The Economic Catalytic effects of Air Transport in Europe	Britton, Cooper & Tinsley	2005	EU

3.1 Types of business and services associated with airport operation

Potentially, an airport has a wide range of impacts on the local economy which can be categorised into four groups:

- Direct – those generated through airport operation;
- Indirect – those generated through activity in the upstream airport supply chain;
- Induced – those generated through employee spending (whether employed directly or in the supply chain); and
- Catalytic – spillover demand and supply side effects from airport operation.

A summary of how each of these effects is generated is set out in Figure 1 which is adapted from Britton et al. (2005).

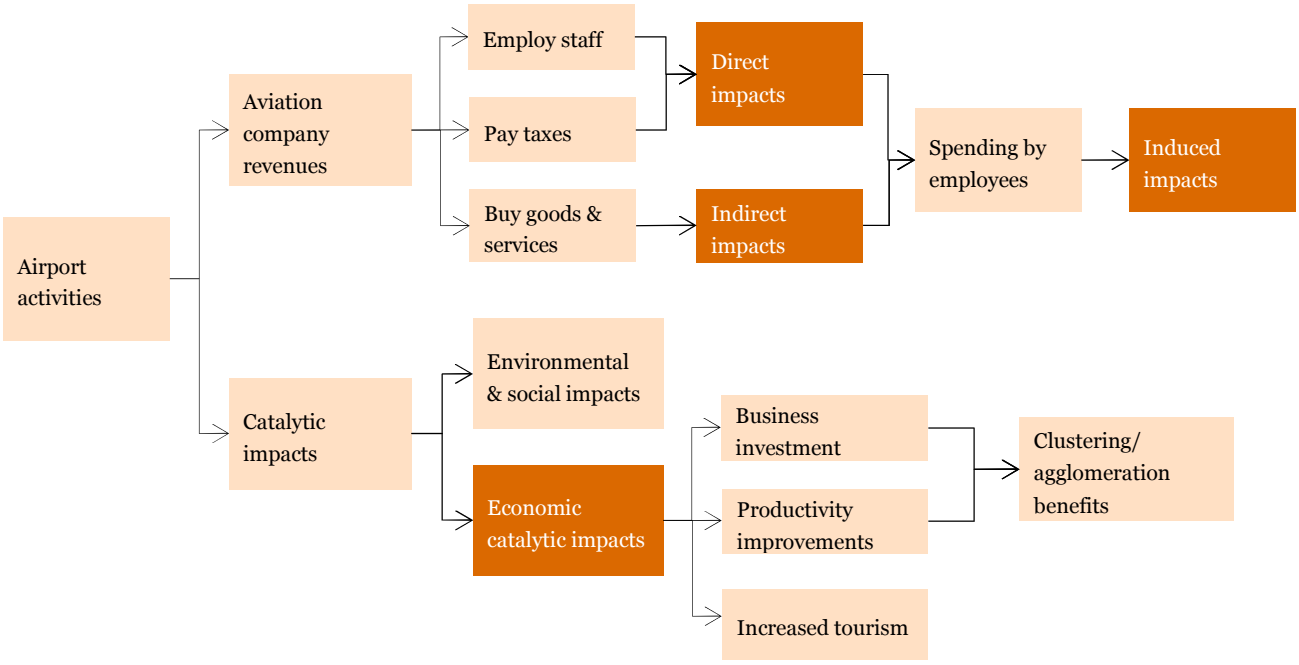


Figure 1: Local direct, indirect, induced & catalytic impacts of airports

Source: Adapted from Britton et al. (2006)

We examine each of the areas highlighted in terms of the business and services associated with each type of impact by reviewing the available evidence on the magnitude and drivers of the impact. We also consider the data required and the different methodologies used so that we can assess the implications of data availability and the choice of methodology for the robustness of the impact estimates.

3.2 Direct economic impacts

The first category of impact we examine is the direct economic impact. This is typically defined as the value added by (or the employment associated with) the activities directly related to the operation of the airport. These activities will typically be undertaken on the airport or in the immediately surrounding area because this is essential to providing the air transport services required by passengers.

Table 5 summarises the findings from a range of previous studies which have been selected because they have a comparable scope and clearly-stated methodology which can be assessed. A key driver of the direct economic impact of an airport is the level of airport activity (as measured by the number of passengers handled). The biggest total impact is at Heathrow and Sydney although there is a large variation in the value generated per passenger, ranging from £22 in Manchester to over £170 at Paris. Figure 2 shows, for a selection of studies, that this variation is in part driven by differing employment densities ranging from low density (300-600 FTEs per million passengers) to very high (1,200+ FTEs per million passengers)[14]. Adjusting for differences in years and currencies, there is a positive correlation between the density of employment and the value generated per head. As wages and salaries make up the majority of GVA, 61% in the UK (Optimal Economics, 2011), hiring additional FTEs will tend to feed through to value added. Some of the difference between airports could also be linked to methodological differences in how employees not directly employed by the airport are counted. Differences in the approach to this could change the estimated workforce without impacting on value-added, thus altering productivity estimates.

Table 5: Summary of direct economic impacts of airports[15]

Airport	Study (date)	Passengers (million)	Direct impact (value added)	FTEs	Value added per passenger	Value added per FTE
Europe						
London Heathrow	Optimal Economics (2011)	70.0	£3.6bn	76,700	£51.40	£46,900
London Gatwick	BHC (2011)	34.2	n/a	24,900	n/a	n/a
Frankfurt am Main	INFRAS (2013)	58.0	£5.52bn	78,000	£95.16	£70,810
JF Kennedy, New York	New York State (2010)	61.5	£3.79bn[16]	69,945	£61.70	£54,185
Paris Charles de Gaulle	BIPE (2012)	62	£11.00bn	115,400	£177.42	£95,321
LaGuardia, New York	New York State (2010)	33.5	£1.36bn	55,100	£40.67	£24,726
Manchester	York Aviation (2008)	21.2	£477m	19,300	£22.50	£24,715
Vienna	WIFO (2007)	19.0	£963m	16,031	£50.70	£60,000
London Stansted	Oxford Economics (2013)	17.4	£556m	10,231	£32.00	£53,900
Cologne/ Bonn	ARC et al. (2008)	9.3	£656m	12,460	£70.50	£52,600
Budapest	Dusek et al. (2010)	8.1	£196m	6,822	£24.10	£28,700
Frankfurt-Hahn	Heuer and Klophaus (2007)	3.1	£91m	2,431	£29.40	£37,400
Other						
Sydney	Deloitte (2013)	36	£2.9bn	28,030	£80.30	£103,200
Minneapolis- St. Paul	InterVISTAS (2013)	33.2	£1.2bn	17,500	£36.10	£68,000
Vancouver	Vancouver Airport	16.8	£1.0bn	21,633	£60.70	£47,200

[14] See York Aviation (2004).

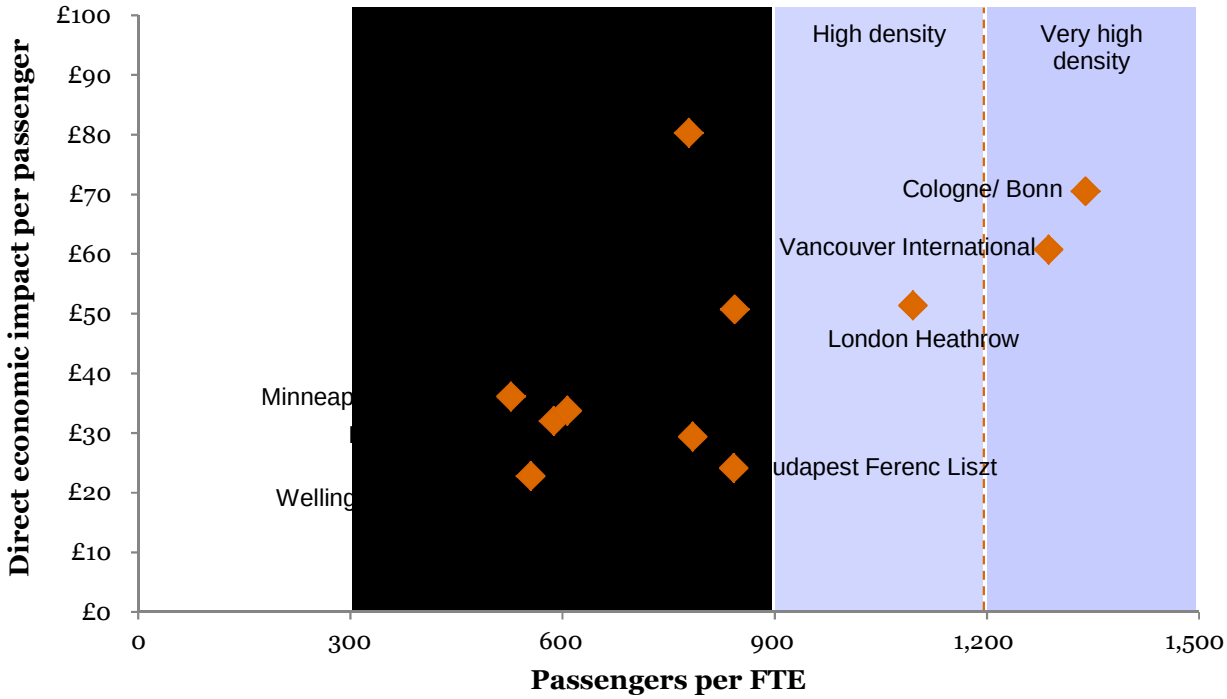
[15] Where relevant, exchange rate adjustments to pound sterling have been made based on the average exchange rate in the year of publication. To ensure consistency with original analysis, figures are not adjusted for inflation.

[16] The direct impact in terms of value added is not available, only wages paid to employees.

Airport	Study (date)	Passengers (million)	Direct impact (value added)	FTEs	Value added per passenger	Value added per FTE
	Authority (2011)					
John Wayne	InterVISTAS (2014)	8.9	£300m	5,400	£33.70	£55,600
Wellington	BERL (2008)	5.0	£115m	2,775	£22.80	£41,300

Source: Compiled by PwC based on previous studies

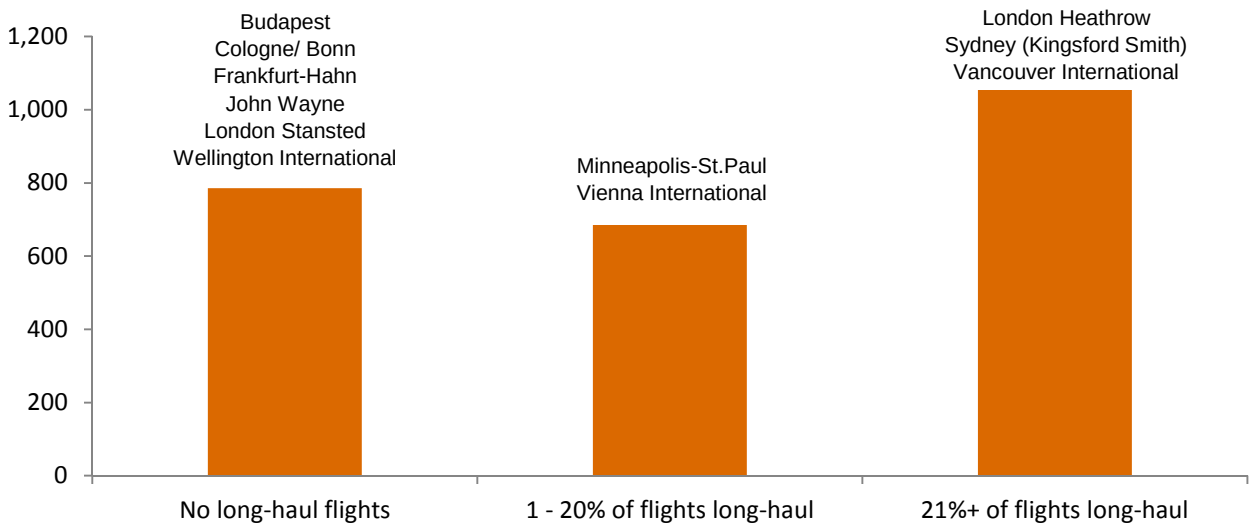
Figure 2: Direct economic impact per passenger by density of employment



Source: Compiled by PwC based on previous studies

A report by York Aviation (2004) suggests that airports which predominantly service short-haul 'no frills' flights typically have lower than average employment densities, due to cost pressures and higher productivity. Our survey of the evidence broadly supports this, with hub airports where more than 20% of passengers are long-haul having the highest employment densities.

Figure 3: Employment density by share of long-haul flights

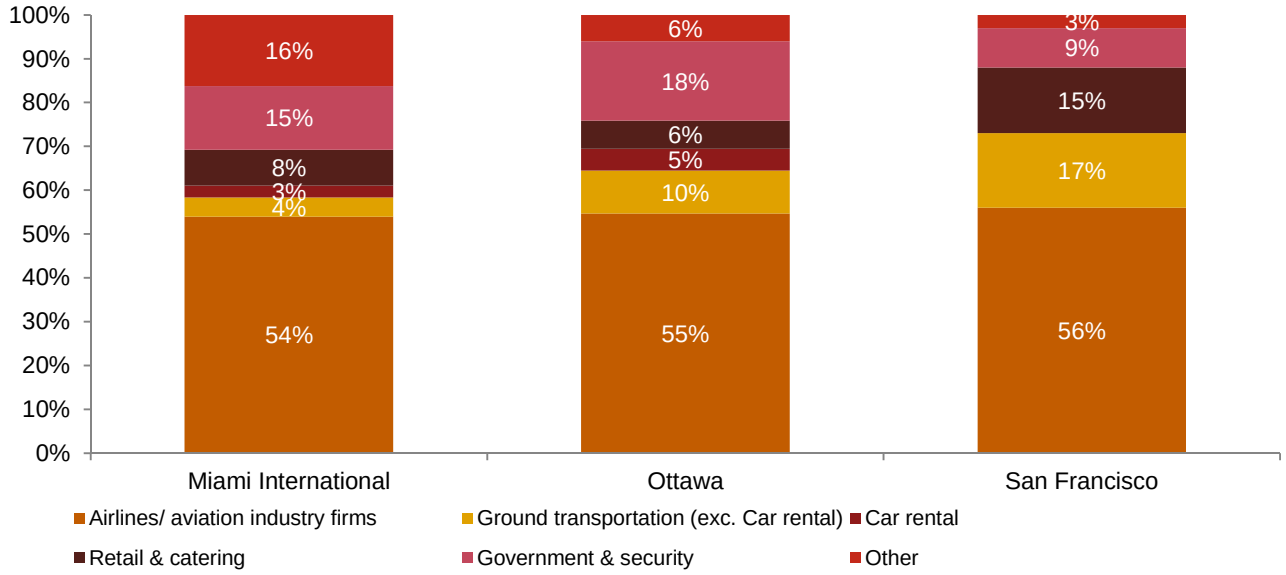


Source: Compiled by PwC based on previous studies, flight data from airport websites

Another factor which impacts total employment, besides employment density, is the volume (and value) of freight handled. For example, Cologne-Bonn Airport has the highest employment density. It handles three times as much freight per passenger as Heathrow and freight transport contributes 39% of its direct on-site employment. At London Heathrow, Amsterdam Schiphol and Miami International, retail and catering are estimated to account for more than 10% of the direct impact. These examples highlight the impact which different airport business models can have on employment and value-added and, therefore, the importance of studies considering the entirety of the business model in their analysis.

Figure 4 summarises the share of employees working in different sectors, at three major airports. In each example the share of jobs relating to airlines, or aviation industry firms (such as aircraft maintenance), is between 54% and 56%. The split between the other sectors is more varied, although this may be partly due to different approaches to counting employees. For example, in San Francisco, only private sector employees are included, with the result that the share of employees relating to government and security is far lower. Similarly, the largest categories in the 'other' category in Miami are cleaning services and consulting & construction. These sectors are not discussed in relation to either of the other two airports. One possible explanation for this is that these services are sub-contracted and, therefore, employees performing such tasks are not direct employees of the airport or its tenants. This would not change the total impact of the airport, but would change the estimated direct employment impact. As well as demonstrating the largest areas of employment likely to be generated within an airport, this example highlights the need to understand airport-specific business models and assumptions when interpreting findings.

Figure 4: % of employment by sector at Miami, Ottawa and San Francisco airports



N.B. The San Francisco data relate only to private sector employees

Source: PwC analysis, Miami-Dade Aviation Department (2009), Leigh Fisher (2011), EDRG (2013)

Box 2: Types of direct business employment – case study evidence

The evidence collected as part of our case studies is broadly consistent with the picture at Miami, Ottawa and San Francisco although some care is needed in interpreting them because the methodologies and definitions may not be consistent:

- At London Heathrow airport, 62% of direct on-site employment was in the airline sector (and 900 out of 7,700 off site jobs were also in the airline sector);
- The study of the New York system used a different structure which makes any comparison problematic; and
- At Frankfurt am Main airport, the airline sector accounted for 61% of direct employment.

Source: PwC case studies

Methodological issues

In addition to the factors discussed above, methodological differences will further broaden the range of estimates. For example, studies apply different definitions of the geographic and sectorial 'scope' of the airport and aviation activity. This is particularly the case with 'airport city' type developments where the limit of activity which is directly linked to the running of the airport is not clear. Similarly, studies apply different approaches to turning headcount numbers into FTEs (e.g. estimating total hours worked, or applying a full of thumb such as a part time worker equates to 0.5 FTEs). These issues mean that the results for one study cannot be directly compared with those from another, as any differences in the results may be driven by methodological differences rather than fundamental differences in the level of airport impact.

3.3 Indirect and induced impacts

The indirect economic impacts of an airport on the local economy are those generated by the activities in the upstream airport supply chain (i.e. those businesses providing goods and services to the airport) and the induced economic impacts are those generated through the spending of those employed either directly by the airport or in its supply chain.

The level of indirect and induced impact is often estimated using (local) multipliers which measure the ratio of direct to indirect and induced impacts (on employment and/or value added). Table 3 summarises a sample of these multipliers from previous studies. There is a reasonably broad variation in the estimated multipliers, from 1.45 in Edinburgh to 2.9 in Copenhagen. It can also be seen that the size or type of the airport has little bearing on the multiplier, with no noticeable correlation between the size of the multiplier and the number of airport passengers. What is more relevant is the variation in how the different studies define their local region of interest. This is likely to have a significant impact on the multiplier.

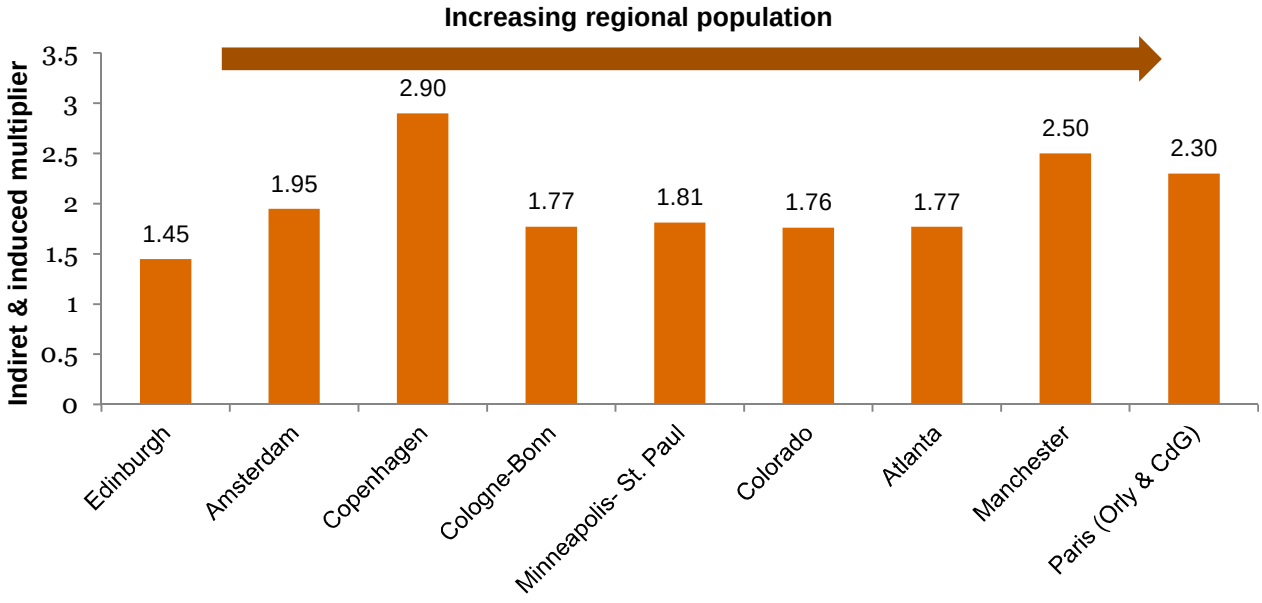
Table 6: Local indirect and induced multiplier estimates

Airport(s)	Year of study	Local area studied	Passengers (2013)	Regional population (m)	Indirect & induced multiplier
Amsterdam Schiphol	2001	Greater Amsterdam	52.6m	1.6	1.95
Atlanta	2009	Atlanta Metropolitan Area	94.4m	5.5	1.77
Cologne-Bonn	2008	Cologne-Bonn Region	9.1m	2.8	1.77
Colorado system	2013	Colorado State	52.6m	5.3	1.76
Copenhagen	1991	Copenhagen Region	24.1m	1.7	2.90
Edinburgh	2009	Edinburgh City Region	9.8m	0.5	1.45
Manchester	2008	North West England	20.7m	7.1	2.50
Minneapolis-St. Paul	2012	Minneapolis-St. Paul Region	33.9m	3.4	1.81
Paris (Orly & Charles de Gaulle)	2013	Ile-de-France	90.6m	12.0	2.30

Source: Compiled by PwC based on previous studies, population data taken from national statistical authorities

The size of the region used to assess the 'local' impact will affect the magnitude of the multiplier as any supply chain spending outside the region studied is a leakage from the system which reduces the multiplier (all other things being equal). This means that studies with a broader definition of 'local' will tend to have larger indirect and induced impacts. Figure 5 shows a weak relationship between the population in the 'local' area studied and the scale of the multiplier.

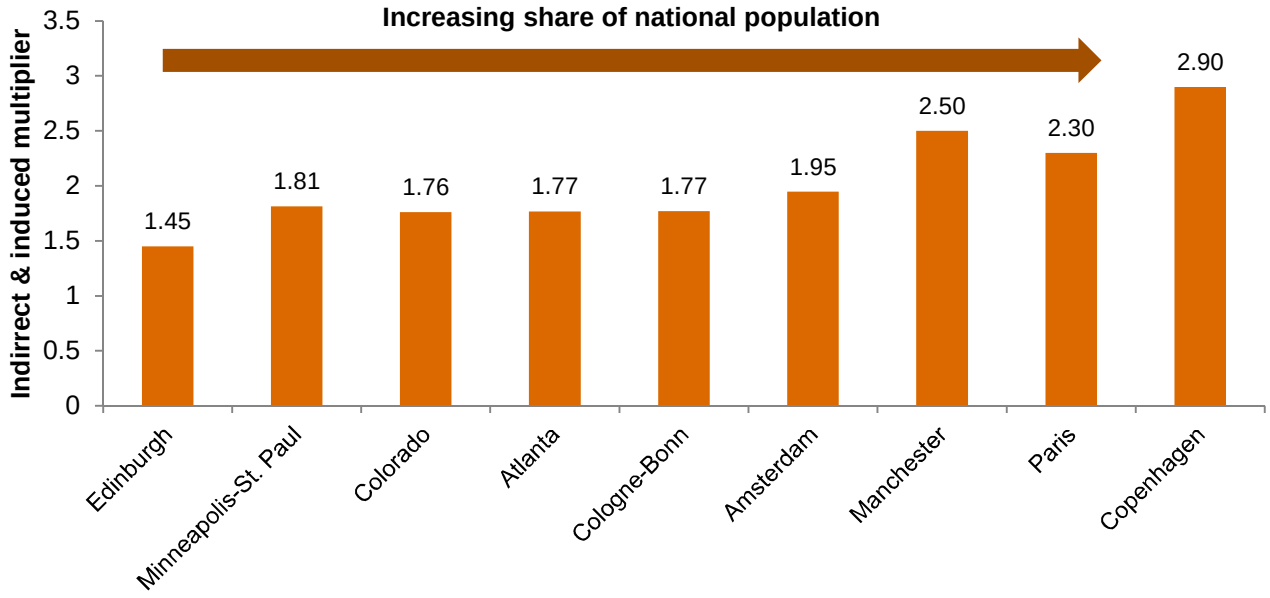
Figure 5: Local induced and indirect output multipliers by population of region studied



Source: Compiled by PwC based on previous studies and population data taken from national statistical authorities

The transaction costs associated with cross-border trade mean that firms are more likely to purchase from domestic suppliers than to import. As a result, more supply chain spending may be expected to leak between regions domestically than internationally. As a result, local areas which make up more of a national economy will tend to experience less domestic leakage and the indirect and induced multipliers will consequently be higher. This relationship is shown in Figure 6. This re-emphasises the importance of the region of study chosen in determining the multiplier estimates.

Figure 6: Local indirect and induced output multipliers



Source: Compiled by PwC based on previous studies, population data taken from national statistical authorities

Methodological issues - multiplier estimates

As described above, the geographic scope of any input-output table has a significant bearing on the multipliers which can be estimated from them. Most tables are at the national level although sub-national tables are sometimes derived or estimated. In these latter cases, while a more detailed table may appear to provide a more reliable estimate of the local impacts, the difficulties accessing accurate information at the local level means that the results need to be interpreted with care. Where this is attempted it is important to understand the source of the information and the assumptions which were made in generating the result.

Local (or regional) input-output tables are typically not produced by national statistics authorities and, therefore, need to be estimated. Rickman and Schwer (1995) tested the IMPLAN, REMI and RIMS II models, three examples from the USA, and found significant differences in the multipliers. These models are commonly used in some of the North American studies which have been analysed. According to the Transportation Research Board (2007), the differences were driven, by the 'techniques used to regionalise national input-output co-efficients'. Similarly, the 2010 study for John Wayne Airport found that using the IMPLAN increased the multiplier estimate for construction spending from $2.01 to $2.20 compared to the RIMS II model.

These examples highlight the importance of understanding the models used to estimate the indirect and induced impacts. They also demonstrate how the findings from one study cannot be compared directly with those of another without an appreciation of the input data and modelling techniques used (and the confidence intervals around the results).

3.4 Catalytic impacts of airports

In this part of the section we examine the catalytic impacts of airports on business and services in the local area. We consider the following impacts:

- The role of the airport in business location decisions;
- The impact of the airport on the productivity of the airports' business users;
- The role of the airport in facilitating tourism; and
- The potential for the airport to lead to the development of local clusters.

Our analysis builds on the work completed by SDG (2013), which looked at the wider impacts of aviation and connectivity on the national economy, but focuses on the specific factors which alter the local dimension of the impact, and the approaches taken to measure those impacts.

Influence of connectivity on business location decisions

Table 7 highlights the importance of transport networks to occupiers of industrial, retail and office space.

Cushman & Wakefield's European Cities Monitor (2011)[17] examines the key factors that businesses consider when assessing new locations. For the third year running, the most important factor influencing the choice of business location was 'Easy access to markets, customers or clients' with 61% of respondents stating that this is absolutely essential. 'Transport links with other cities and internationally' were viewed as absolutely essential by 42% of respondents. Whilst this factor retains its position in fourth place, it slipped back in respondents' perception of importance.

Oxford Economics reinforce this view by stating that although air services are only one component in the assessment that companies make in choosing where to be based or to locate new investment, a wide range of studies confirm that they are one of the most important considerations. Oxford Economics' survey of UK companies[18] highlights that the air transport network is rated as vital or very important by more than 40% of companies, marginally ahead of the cost of labour and business taxes.

Table 7: Key factors influencing business location decisions (2011)

Factor	% of businesses regarding factor as essential for locating a business
Easy access to markets, customers or clients	61
Availability of qualified staff	58
The quality of telecommunications	55
Transport links with other cities and internationally	51
Value for money of office space	36
Cost of staff	33
Availability of office space	31
Languages spoken	27
Ease of travelling around within the city	26
The climate governments create for business through tax policies or financial incentives	27
The quality of life for employees	20
Freedom from pollution	19

Source: Cushman & Wakefield (2011)

Impact on productivity of local firms

A second potentially positive catalytic impact of connectivity offered by an airport is the benefit to firms' productivity. This primarily occurs through two channels:

- Increasing the access of UK firms to international markets; and
- Facilitating the freer movement of workers and capital across borders.

This analysis has typically been undertaken at a national level:

[17] Cushman & Wakefield (2011), European Cities Monitor. http://www.cushmanwakefield.co.uk/en-gb/research-and-insight/2012/european-cities-monitor-2011/.

[18] Cited in Oxford Economic Forecasting (2006), The Economic Contribution of the Aviation Industry in the UK, http://www.gacag.org/images/gacag/pdf/The%20Economic%20Contribution%20of%20the%20Aviation%20Industry%20in%20the%20UK.pdf.

- Oxford Economics (2006) found that a 10% increase in aviation connectivity (all other things being equal) increased GDP by 0.6%; and
- IATA (2006) found that a 10% increase in connectivity raised long-term productivity by 0.9%.

These findings relate to the national level. It is also important to understand the local impact. The analysis of the local economic impacts of airport capacity on business productivity is severely limited by the absence of robust data on sub-national trade flows within the UK. Overman et al (2009), however, have shown that proximity to an airport had a beneficial impact on firm productivity.

Impact on tourism

Inbound tourism

An additional catalytic impact of airports considered by several studies is their role in generating value added locally by facilitating inbound tourism. The scale of this impact depends on the number of additional inbound visitors to the local area arriving through the airport and how much they spend in the locality. Table 8 shows that spend per head varies greatly by airport and type of passenger. The Canberra and Sydney studies show that international passengers spend considerably more per head than domestic visitors. This is also shown through the increased spend per head at airports such as Miami and Wellington, which service more international flights, relative to airports with a more domestic and regional focus such as Edinburgh, Budapest and Sacramento. There is less consistent evidence on the relative spending of business and leisure visitors: evidence from Sydney suggests a 15-20% premium for leisure passengers, while data from Budapest suggest the opposite. The specific nature and local context of flight patterns, for example the relative shares of charter and scheduled flights, ensures that the direction of this relationship is not consistent across all examples.

Table 8: Spend by visitors arriving at international airports[19]

Airport (year)	Visitor profile	Region	Spend per visitor (£)
Canberra (2011)	Day visitors	Canberra & surrounding region	£99
	Domestic overnight		£266
	International		£954
Sydney (2013)	Domestic business	Western Sydney	£275
	Domestic leisure		£342
	International business		£848
	International leisure		£982
Denver (2013)	Commercial	Colorado	£481
Miami (2009)	All	Miami Metropolitan Area	£1,007
Budapest (2011)	Holiday/ sightseeing	Hungary	£354
	Business trip		£426
Sacramento (2011)	All	Sacramento Area	£397
Wellington (2008)	All	Wellington Region	£640
Edinburgh (2009)	All	Scotland	£351

Source: PwC analysis, based on publically available reports (see bibliography)

In addition to greater spend by international passengers, as demonstrated in Table 8, Figure 7 shows that visitors to the UK who have travelled longer distances from their country of residence also tend to spend more (in part because they tend to stay longer). Of the 18 countries which were the origin of the most visitors to the UK in 2012, the 12 European countries in the list are at the bottom when ranked by spend per head. Average

[19] Where relevant, exchange rate adjustments to pound sterling have been made based on the average exchange rate in the year of publication. Figures are adjusted to be in constant 2013 prices based on relevant national exchange rates.

spend by European visitors from the countries in this list is less than half that of non-European visitors (£1,027 per visitor compared to £451).

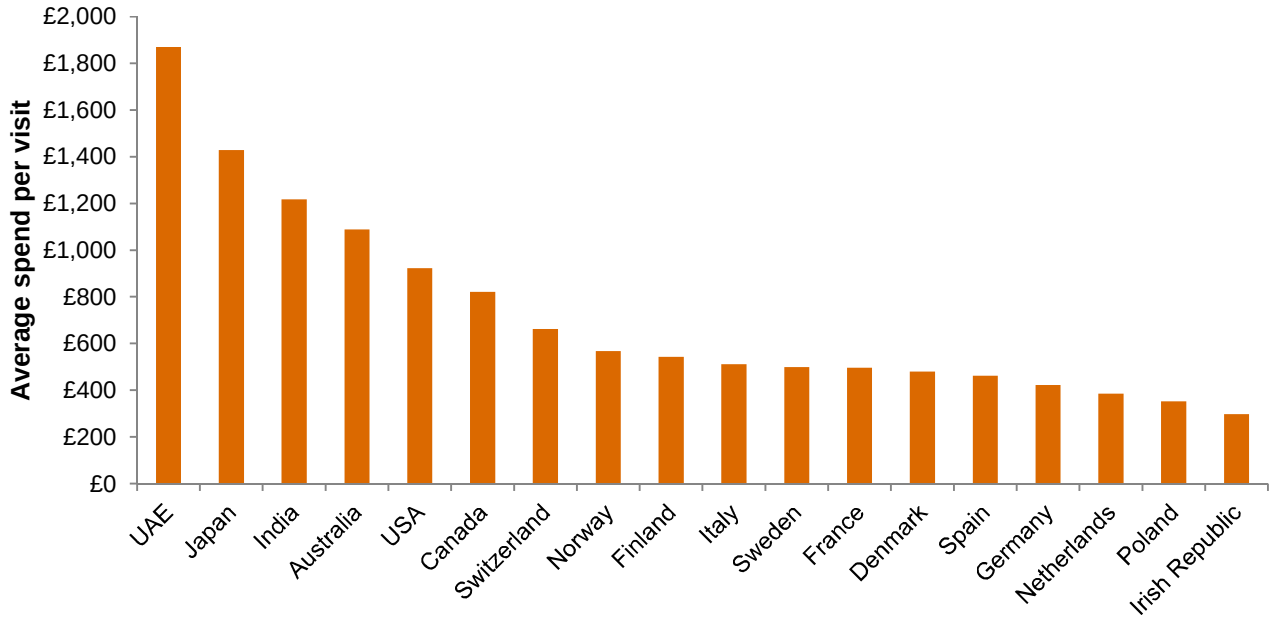
Box 3: The contribution of New York's airports to inbound tourism

Our case study of New York's airport system includes some indication of the economic impacts of those tourists visiting New York and arriving through one its three main airports. It shows that:

- Domestic visitors add more to the local economy than international visitors at all airports;
- LaGuardia contributes more from domestic passengers than JF Kennedy and Newark, despite only providing 15% of the operational impacts; and
- JF Kennedy is significantly ahead when it comes to international tourism.

Overall, tourism at the three airports is estimated to have made an important economic impact creating over 190,000 jobs between 2000 and 2004 and supporting $6.6 billion and $17.6 billion in wages and sales respectively across the same period.

Figure 7: Average spending per visit by visitors arriving by air to the UK by country of residence (2012)



Source: Visit Britain (2014)

In estimating the local economic impact of an airport, it is important to recognise that total visitor spending does not measure either the direct or the indirect and induced effects on value-added which arise from this spending. This is because some of the output generated within the local economy will be spent on purchasing goods and services.

The Office for National Statistics (ONS) satellite tourism accounts show that in 2011 direct GVA generated through tourism in the UK was £53bn (ONS, 2013), which is over 40% of the total internal tourism expenditure of £125bn. Less than £21bn of this expenditure was generated by inbound tourists (rather than UK residents). A significant proportion of this spending (14%) is on air passenger transport services. Such spending will lead to impacts which are captured as either direct or indirect effects. Only a few studies have sought to assess the local impact of inbound visitors at individual airports because it requires detailed visitor spending data across industries.

Recognising outbound tourism

A further impact of tourism, which has often not been considered by existing studies of local economic impact, is the role of airports in facilitating outbound tourism. ONS data show that in 2012 the UK ran a tourism deficit of £13.8bn because UK residents spent more when visiting countries abroad than visitors to the UK spent in the

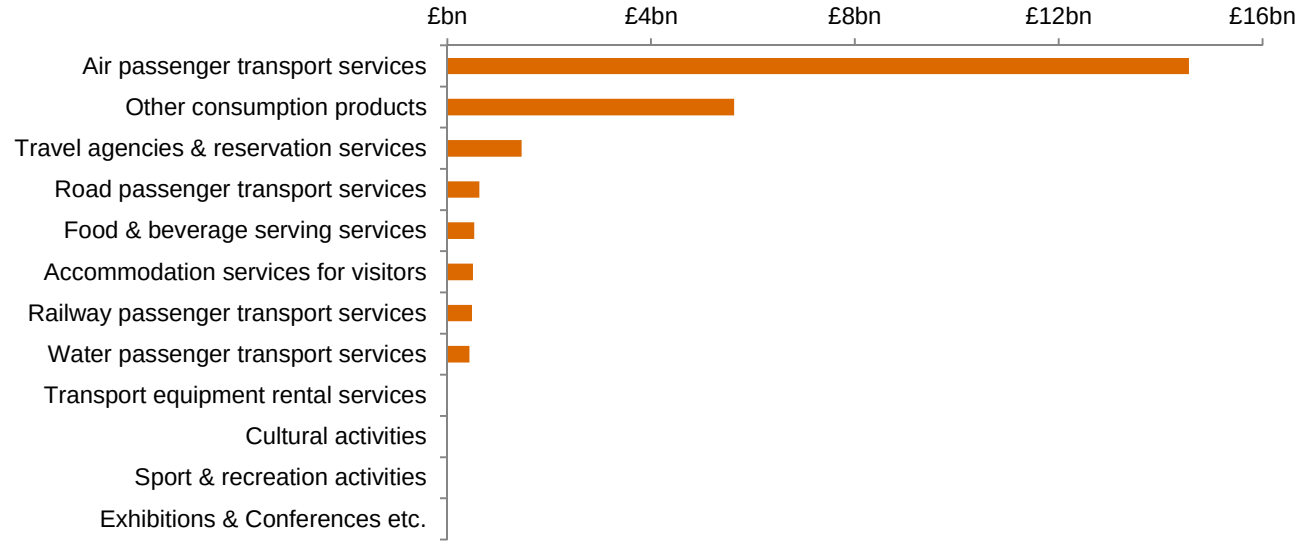
UK. If expenditure overseas would otherwise be spent in the local region of the airport, were it not for the increased availability of outbound flights, then this leakage would have a negative impact on the airport's local impact.

On the other hand, the satellite tourism accounts show that UK residents making overseas visits spent £24.2bn within the UK in 2011 (in addition to the amount they spent whilst in the UK) (see Figure 8). This was predominantly focused on air passenger transport services, demonstrating the role of air transport in generating this output (relative to other modes of transport).

Finally, although outbound tourism potentially has a negative effect on value added in the UK, its welfare effect may be positive if the outbound tourism facilitated by the airport improves individuals' economic welfare by increasing consumer surplus, relative to a constraint on the level of outbound tourism.

In conclusion, the effects of additional runway capacity need to be assessed on both inbound and outbound travellers.

Figure 8: Spending within the UK by residents making overseas visits by industry (2011)



Source: ONS (2013)

Methodological issues - estimating the local impact of tourism

As discussed above, a key challenge with estimating the local value-added (or employment) generated through tourism enabled by airport expansion is the need for detailed data on visitors' expenditure with and without additional capacity. Within this, a reliable breakdown by industry is needed to estimate the value-added component of the expenditure, while location -specific data are needed to estimate the share of the impact which is local to the airport. While these data can be collected through surveys, this cannot necessarily be done consistently across airports and, therefore, a degree of variation in the results would be expected.

In addition, impact studies need to recognise the marginal impact of an increase in airport capacity on the quantity of tourism. Apportioning all value-added generated by passenger spending to an airport inherently assumes that none of this activity would have otherwise occurred. It is likely that a share of this activity would be substituted either to another airport or another form of transport, which could lead to a positive impact in the local region, even in the absence of the airport.

A final important area to consider is the locality of the tourism impact. ONS data show that more than half of overseas visitors to the UK visit London. As a result, if London & the South East were defined as local areas for the airport, then a large share of the national benefit would be felt in the local economy. However, this would be expected to greatly decrease if a much narrower definition of 'local' were to be taken, such as the local authority

area immediately adjacent to the airport. This further highlights the importance of the 'local' definition on the findings, and the relative magnitude of the different elements of impact.

Similar considerations are needed when assessing the local impacts of outbound tourism. It is possible that the increased presence of transport and tourism firms in the locality of an airport means that outbound tourism has a net positive impact at this level. This would occur if the value-added generated through the outbound tourism industry were greater than the value-added substituted away from local spending to spending abroad.

Impact on clustering & agglomeration

The available evidence suggests that the local catalytic effects of airports include attracting business investment and raising productivity. Combining these two effects may lead to the development of new concentrations of economic activity in the locality of the airport. In some cases, these may take the form of industry 'clusters' which benefit both from the proximity of the airport and each other.

These clusters have led to the development of 'aerotropolis' (Kasarda, 2000), or airport-city like business models, where airports are increasingly being seen as 'centres of economic activity' (Prosperi, 2007). As a result, many studies in the economic impact literature assess the benefits of 'clusters' of economic activity surrounding airports.

What are the benefits of clusters?

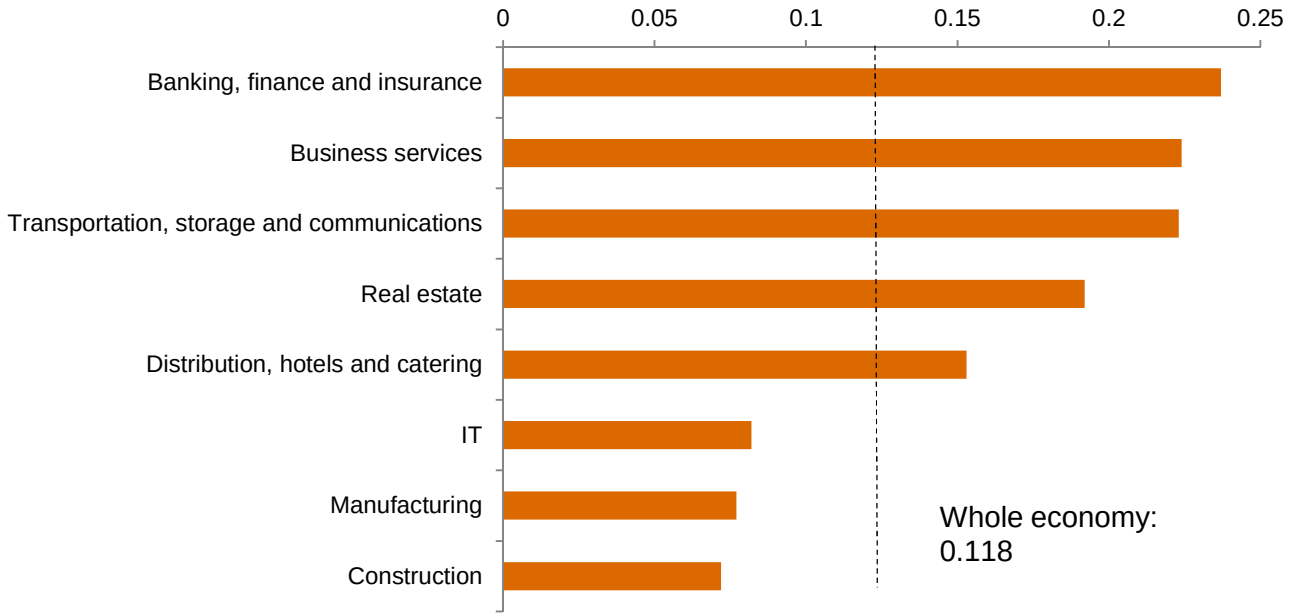
The positive effects of clustering economic activity are known as agglomeration economies. They arise where there is an efficiency gain for all firms within a cluster, resulting from their close proximity to each other. The majority of the literature on the topic (see, for example, DfT (2006) and Cohen & Paul (2008)) summarises the drivers of these benefits in three distinct categories:

- **Knowledge spillovers** – firms interact with, and learn from, each other within the cluster thereby facilitating efficient sharing of knowledge within the market;
- **Access to labour** – the cluster attracts skilled labour to an area, thus increasing firms' access to a high quality workforce and reducing search costs; and
- **Input effects** – the cluster attracts suppliers to locate nearby, providing firms with access to a greater range of specialised inputs, whilst also reducing transport costs.

A study by Rosenthal and Strange (2004) reviewed the literature which has attempted to quantify these benefits. It found that doubling the size of a city leads on average to an increase in productivity of 3-8%. This does not, however, fully capture the breadth of estimated impacts, or specific drivers which may alter the magnitude of this relationship.

For example, Graham (2007) showed that the impact varies greatly by industry, with productivity in banking, finance and insurance being more than three times as responsive to an increase in agglomeration as construction and manufacturing (see Figure 8). Here, agglomeration is proxied by the density of employment, while the elasticity of productivity estimates show how far a firm's productivity changes as the level of agglomeration changes. A score of 0.15 means that a 10% increase in agglomeration increases productivity by 1.5%. This implies that in order to estimate the positive impact of airport expansion it is necessary to identify how industry clusters would develop (including the degree of agglomeration which would occur).

Figure 9: Elasticity of productivity with respect to agglomeration by industry



Source: PwC analysis, BEA (2014)

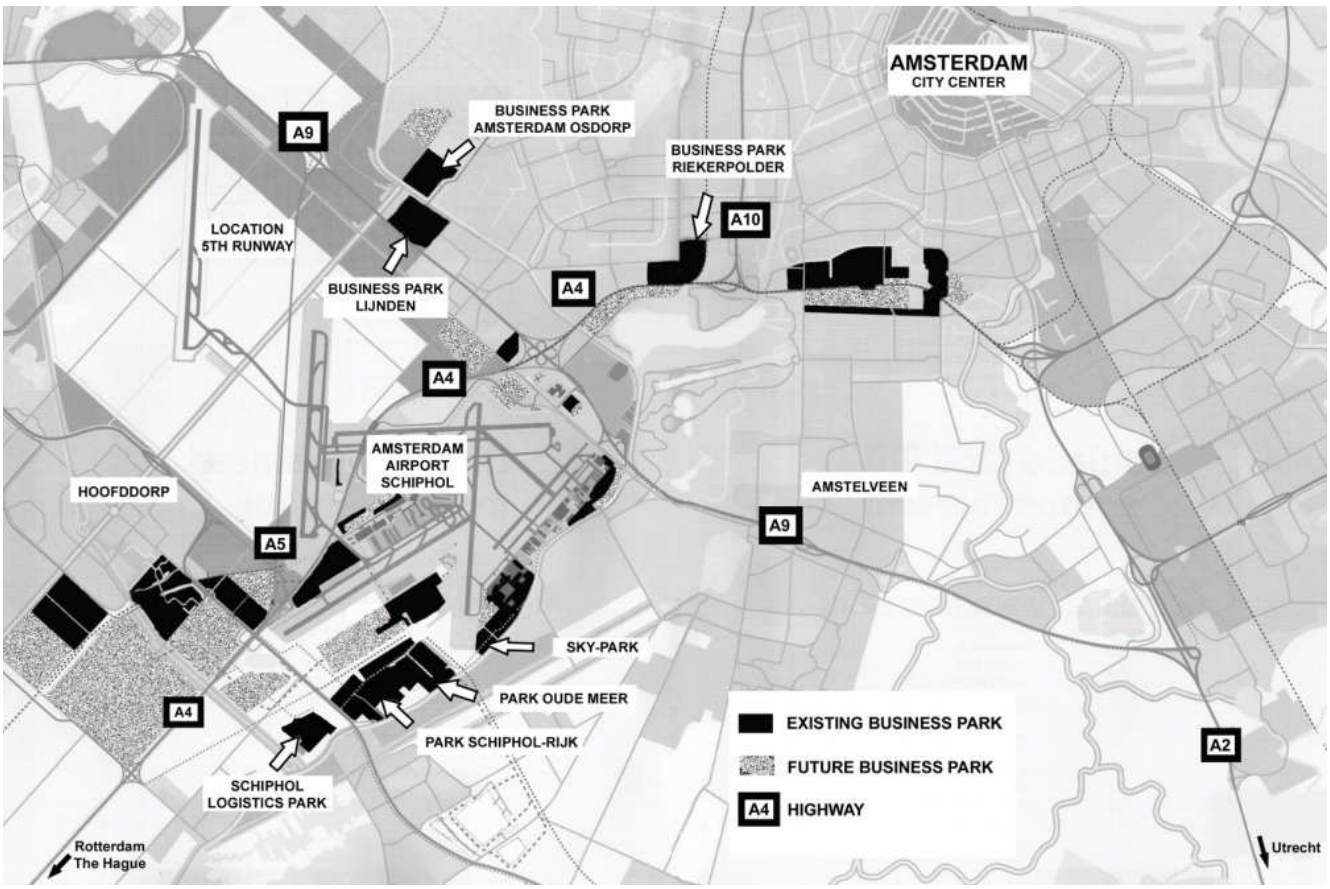
Examples of clustering around international airports

Although not typically considered as part of the economic impact of an airport, several studies have examined the role of airports in facilitating the development of clusters. Two such studies are summarised below: one is for Amsterdam Schiphol Airport and the other a comparison of three American airports. These studies demonstrate that there re different approaches for identifying and quantifying the role of an airport in generating industry clusters and also highlight the importance of the local context in determining the nature and scale of the clusters which develop.

Amsterdam Schiphol Airport

As can be seen from Figure 10, a number of business parks have been established in the vicinity of Schiphol Airport, which has an area 'larger than the extended historic centre of nearby Amsterdam'. Warffemuis (2007) looked at one particular element of this, the clusters of distribution centres that have developed in the area. Along with Rotterdam, these two sites contain more than half the distribution centres in the Netherlands.

Figure 10: Business parks in the Amsterdam area



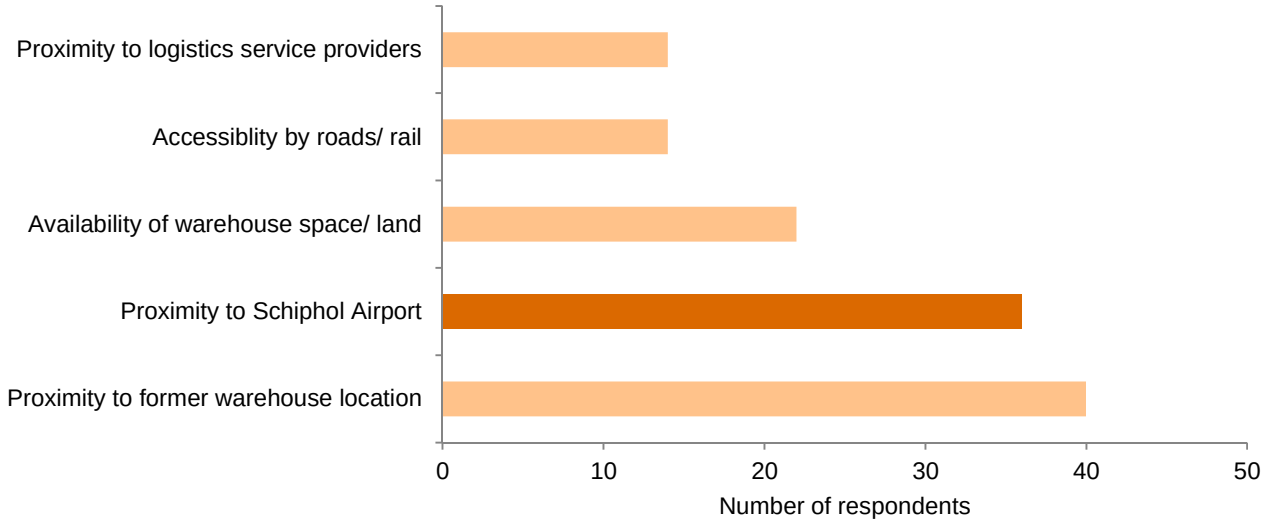
Source: Warffemuis (2007)

When surveying the distribution centres, Warffemuis showed that more respondents named location factors linked to the agglomeration benefits of clustering in motivating their investment decision than the presence of the airport itself (see Figure 11). Proximate access to vital products and services for the business (such as warehouses, transport links and service providers) was of particular importance. Warffemuis further demonstrated that only a minority of distribution centres located in the surrounding area were Schiphol-dependent due to the nature of their cargo and business activities. The remaining firms were at least partially influenced in their location decisions by the agglomerative benefits that the airport indirectly generated.

These findings have three clear implications for how the benefits of clustering in the locality of an airport should be considered:

- They demonstrate the potential of an airport to attract activity, beyond that directly requiring the airport for its success.
- They highlight the importance of the supporting services and infrastructure in facilitating the development of clusters. In this case, for example, the level of investment in transport infrastructure beyond that of the airport was vital in the decision making process of the distribution centres. As a result, airports highlighting the potential for business clusters to develop in the locality would need to demonstrate the availability of required sector-specific support services.
- The nature of the influences on this particular cluster shows the importance of understanding the local context. For example, limited availability of land or land-intensive warehouses and the lack of a developed logistic service provider industry would prohibit this particular model being recreated elsewhere.

Figure 11: Importance of location factors to distribution centres surrounding Schiphol Airport



Source: Adapted from Warffemuis (2007)

Atlanta, Dallas & Memphis airports

Prosperi (2007) investigated concentrations of economic activity around Atlanta (Hartfield-Jackson) International Airport, Dallas/ Fort Worth Airport and Memphis Airport. The different sector-specific concentrations are outlined in Table 9. These are the 'signature' collections as they represent the most distinct industry-specific collections of activity.

The report notes that the distribution of economic activity in these areas is not significantly different to typical urban centres. It argues that only the transport-related activity in each site and the finance and computer activity in Dallas are sufficiently densely concentrated to be described as "cluster-like", as opposed to "concentration-like". This evidence, therefore, suggests that while an airport may lead to an increased concentration of economic activity, it will not necessarily stimulate clustering behaviour beyond the existing distribution of industries in the locality.

Table 9: Sector-specific concentrations of economic activity surrounding airports

City	Transport-related activity	Communications	Finance & computers	Corporate headquarters	Food & food processing
Atlanta	✓	✓			✓
Dallas	✓		✓		
Memphis	✓			✓	✓

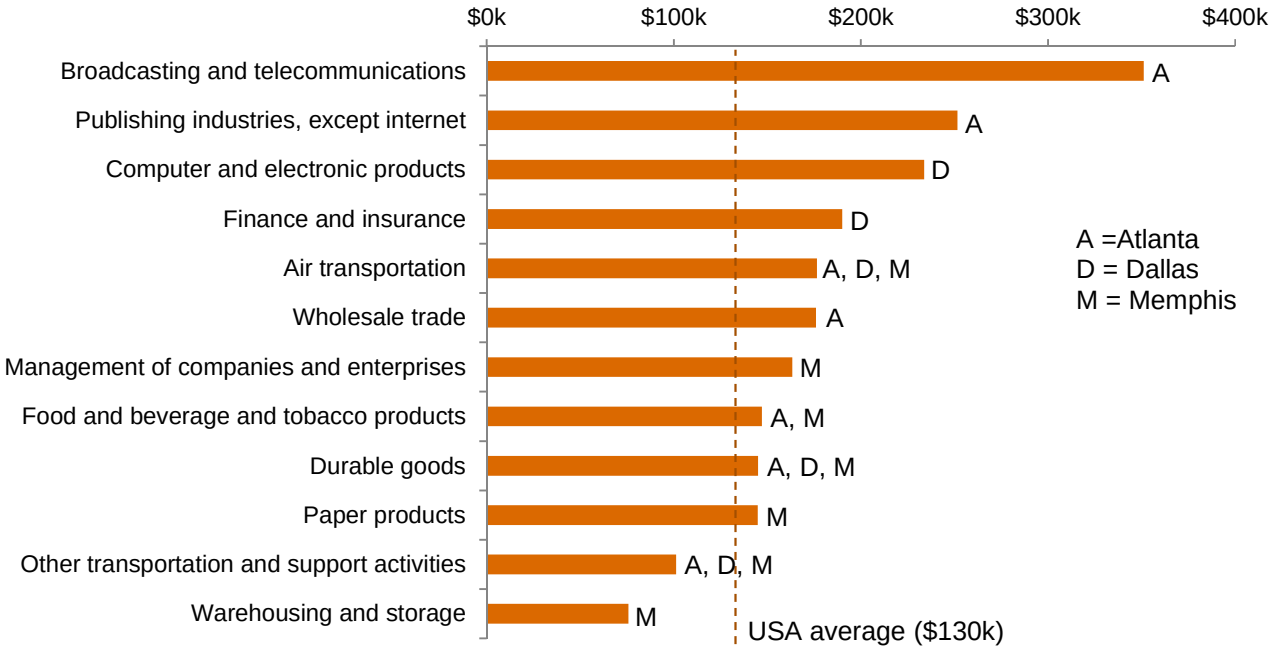
Source: PwC analysis, Propseri (2007)

Also evident from the study is the lack of consistency between the industries which choose to locate around different airports. This further reinforces the importance of the local context in understanding why a cluster forms. This means that, with the possible exception of aviation/ transport-related activity, no evidence suggests that any one particular industry cluster will be particularly likely to develop. The author recognises that these differences are driven by a blend of historic land use and economic features. For example, the long standing roles of Atlanta and Memphis as centres of inter-state and regional highway systems have made them suitable as communication hubs and locations for corporate headquarters respectively. Alternatively, the more recent development of Dallas/ Fort-Worth International Airport has provided 'fresh land' for new firms to locate within.

One implication of these differences is that the impact on the value-added generated by an airport cannot be easily predicted. Figure 12 shows the distribution of productivity (measured by value-added per FTE) across the

industries which are most concentrated around one or more of the three airports. Both the range of industries, from paper products to finance and insurance, and the range in value-added per FTE, are evident. Although typically higher than the national average, the range in productivity represents a risk to any estimates of the positive impact of clustering.

Figure 12: Value-added per FTE by industry (2012)



Source: BEA (2014)

Methodological issues - measuring agglomeration benefits

Several studies have estimated the impact of agglomeration economies on productivity, often producing significantly different results. In addition to different local contexts, a further reason for these differences may be methodological.

The Department of Transport for Victoria (2012) highlights two separate aspects of methodology which may lead to measurement error in accurately estimating agglomeration effects:

- Controlling for bias; and
- Finding a suitable dataset.

The majority of studies estimate changes in productivity by specifying economic models which could be subject to bias if the models are mis-specified. For example, the presence of higher productivity firms in more densely populated areas could be the result of sorting, whereby more productive firms move to these areas, rather than the reverse. This would over-estimate the impact of agglomeration on productivity. The Department of Transport in Victoria notes that recent studies have attempted to control for this effect.

Studies would also need to ensure that agglomeration effects could be separated from the positive impact of proximity to a transport hub or being located in a large urban environment. For example, in the case of the UK, Overman et al (2009) concluded that there were no substantial benefits to industry-specific clustering, once these two factors were controlled for.

Finally, accurately estimating this impact requires detailed information about firm productivity, as well as information on the degree of agglomeration. For example, estimating agglomeration based on employment density (see Graham (2007) above), only accurately captures the 'access to labour' element of agglomeration economies, and provides little understanding of the significance of 'knowledge spillovers' or 'input effects'. As

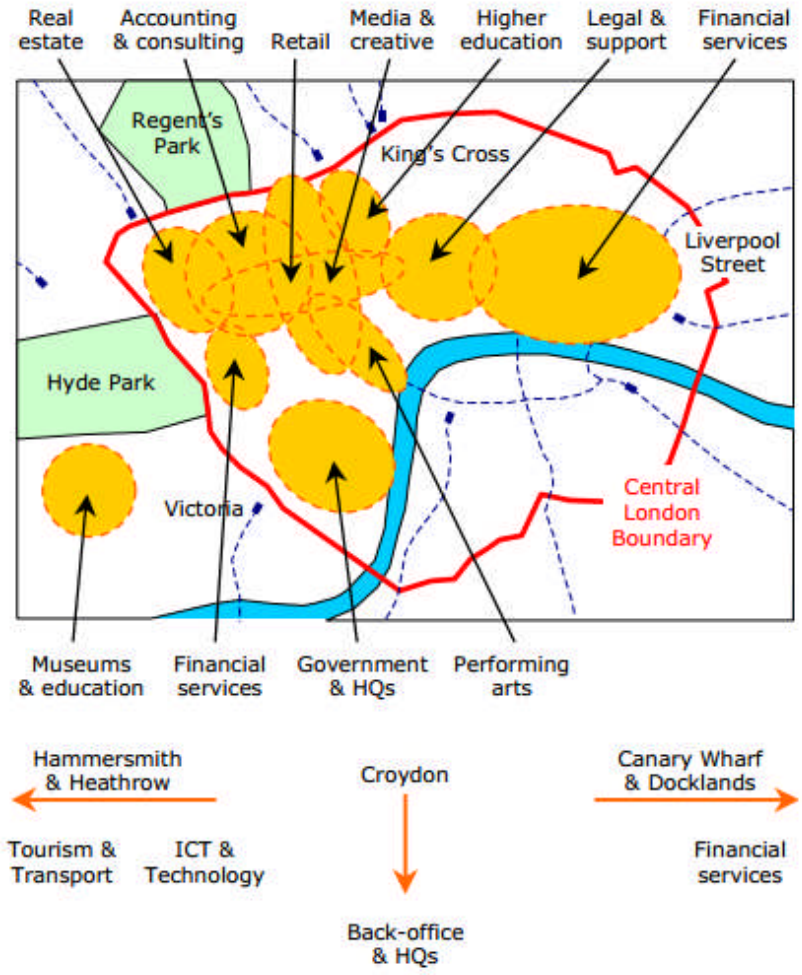
they are less tangible, these two elements are more difficult to estimate, but excluding them from the analysis means that some differences between areas will not be fully controlled for.

3.5 Industry structure in London

Our earlier analysis highlights the importance of understanding the local context when considering firm location decisions and clustering as area-specific factors play a key role in driving each of these. This section briefly looks at the existing analysis of industry cluster within London and highlights the role that its airports have played in developing them.

Figure 13 shows the Prime Minister's Strategy Unit map of industry clusters within London in 2004. It highlights the breadth of industries which are perceived to have formed clusters which are rarely separate from each other. It also shows the importance of Central London. Ten distinct clusters are identified there.

Figure 13: Summary map of industry clusters in London



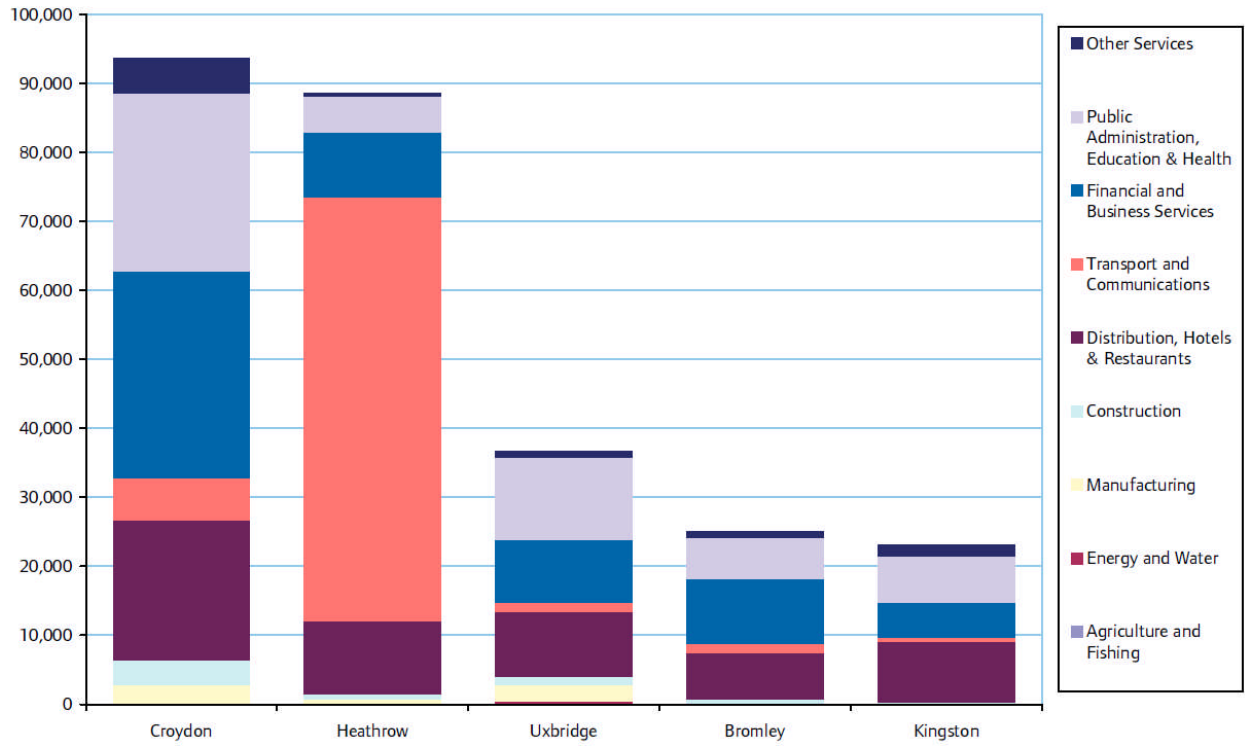
Source: Prime Minister's Strategy Unit (2004)

A similar picture emerges from more recent work to map industry-specific clusters, such as that of the London Councils in 2010 which shows that the majority of clusters are located in London's core, with additional clusters in the periphery. This distribution demonstrates the pull of London's centre in firms' location decisions. It seems likely that in the context of London the impact an airport has on access to this core will be of particular importance. Figure 13 also recognises that additional industry clusters exist in Outer London, most relevantly in the form of tourism & transport and ICT & technology clusters in Hammersmith & Heathrow.

This finding is consistent with that of Prosperi (2007), who identified that "cluster-like" concentrations of transport-related activity developed in the locality of airports in Atlanta, Dallas and Memphis. This finding is further demonstrated in Figure 14, taken from GLA Economics (2010), which identifies the magnitude of employment in transport & communications in the Heathrow area relative to other selected Outer London areas. It also specifies more precisely the nature of the cluster identified by the Prime Minister's Strategy Unit as "Tourism & Transport", as being more heavily weighted towards Transport and Communications, than areas of tourism spend such as Hotels & Restaurants.

These highlight the potential that an airport has to attract and support the development of clusters within London and suggests the types which are most likely to develop.

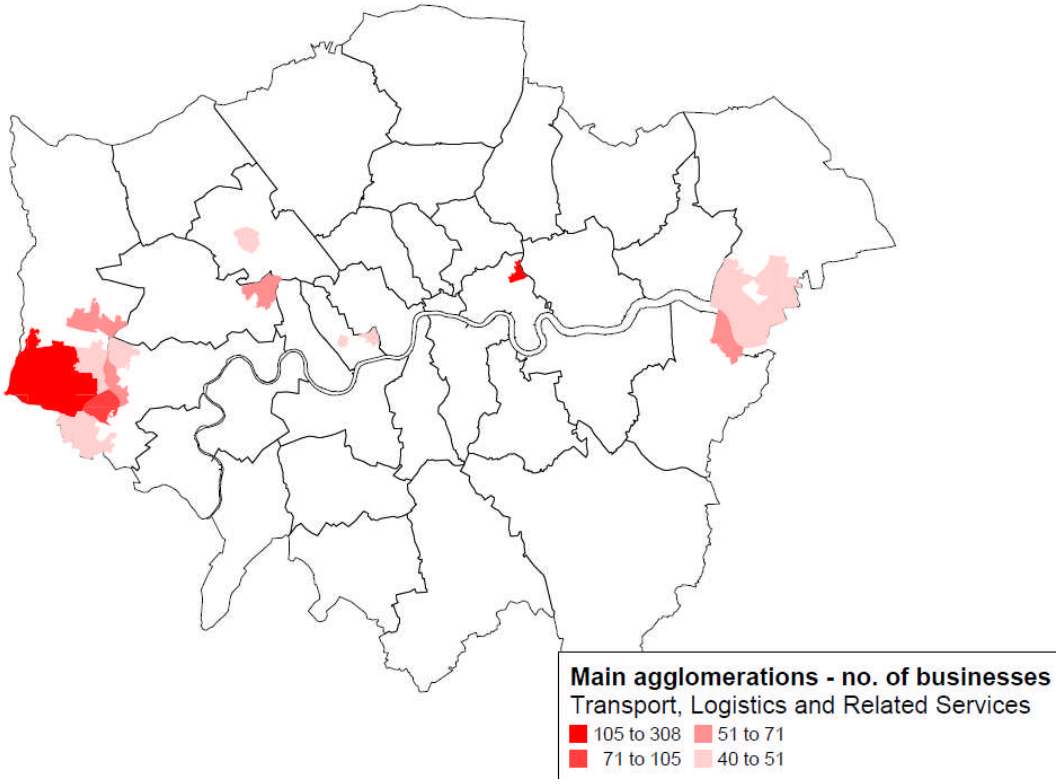
Figure 14: Employees in selected Outer London areas by broad industrial group



Source: GLA Economics (2010)

Analysis commissioned by the London Councils in 2010 further demonstrates the presence of Heathrow Airport's transport cluster - defined as a cluster of 'Transport, Logistics and Related Services' – see Figure 15. This highlights that, despite small pockets of activity elsewhere, the predominant transport industry hub is located in West London and can presumably be linked to the presence of Heathrow.

Figure 15: Transport and logistics clusters in London



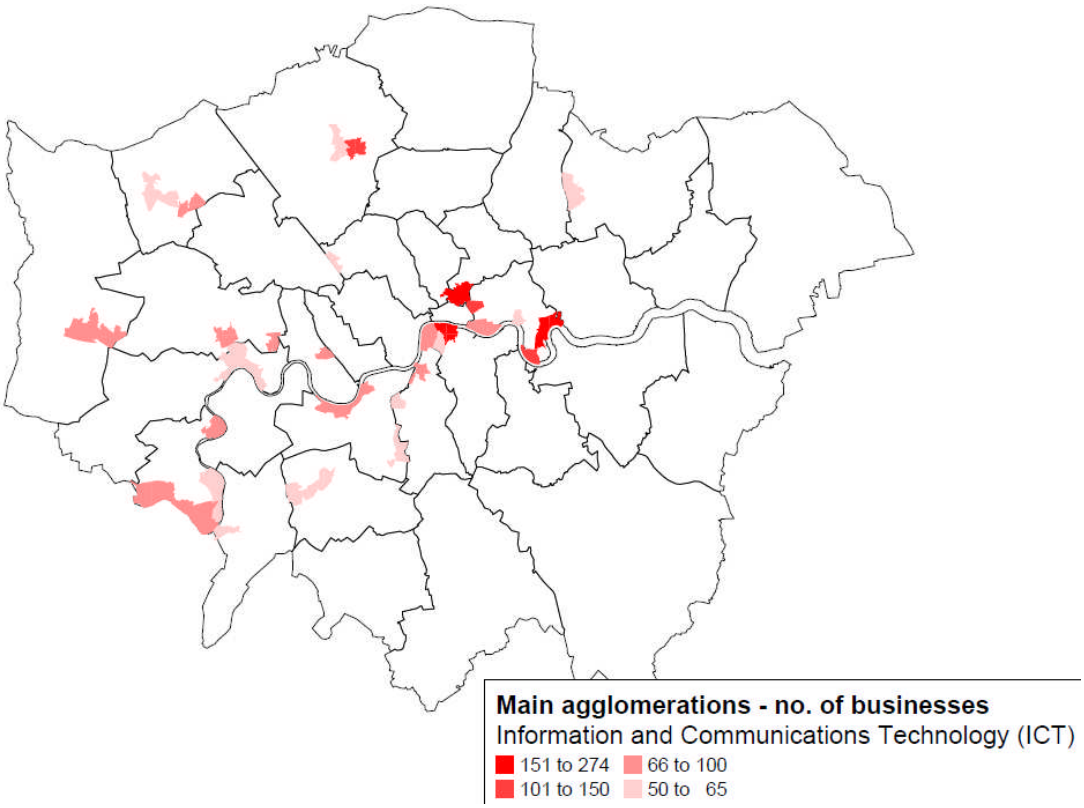
Source: London Councils (2010)

The second cluster highlighted by the Prime Ministers Strategy Unit in West London was ICT and Technology. Similar analysis from the London Councils (2010) is shown in Figure 16. It demonstrates that while these firms have tended to concentrate in West London, there appears to be little evidence of a cluster close to Heathrow.

Although the evidence on the distribution of firms is less concrete than in the case of transport-related activities, a 'Western Wedge' of economic activity is identified by both GLA Economics (2010) and the London Plan (Greater London Authority, 2011). This is described as "an economic corridor with historical specialisation in information technology that stretches from Central London through Heathrow and into the Thames Valley, including towns like Reading and Slough". This region, which is located around London Heathrow, is a key centre of international headquarters and contains industry concentrations:

- Video reproduction;
- Publishing;
- Motion picture and video production/ distribution;
- Radio & television activities;
- Scientific research and development; and
- Data processing and computer manufacturing.

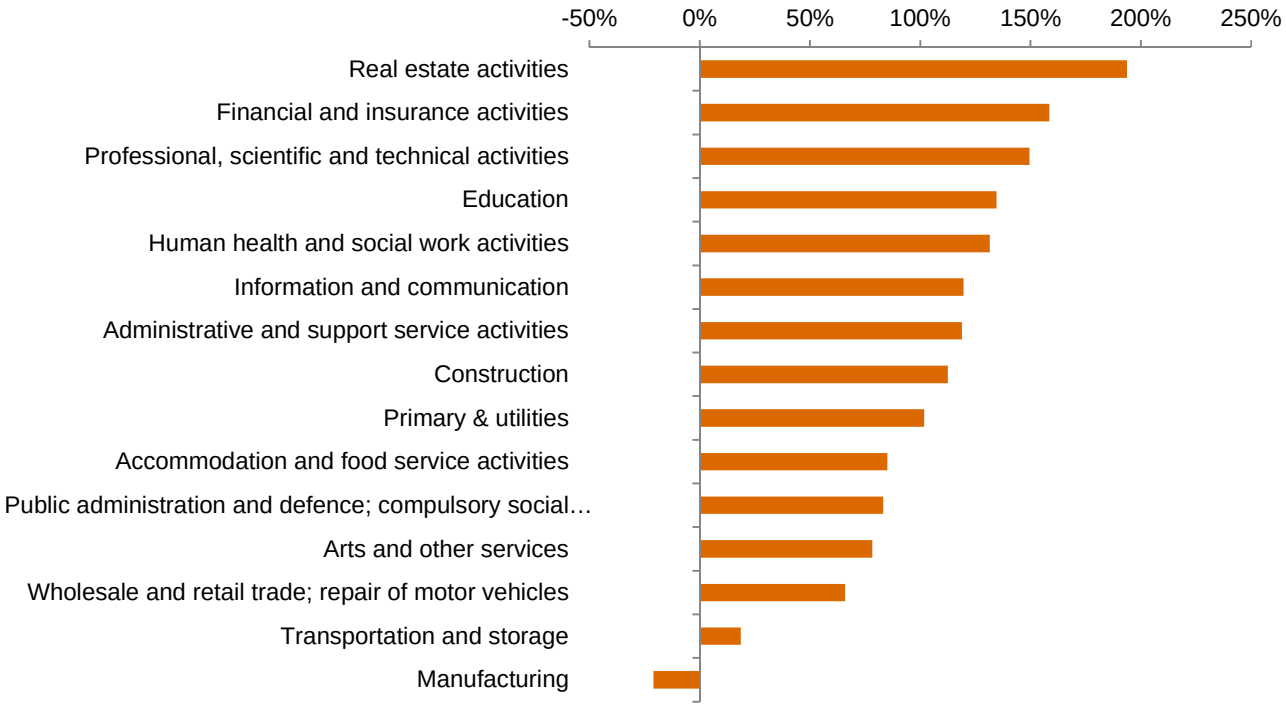
Figure 16: ICT clusters in London



Source: London Councils (2010)

A further element of London's industry clustering which needs to be considered is how the geographic distribution and magnitude of industry-specific value-added may change in future. Figure 17 summarises changes in the magnitude of the value-added generated by different industries between 1997 and 2011. This shows that there are big differences in the growth rates between the fastest growing industries, such as real estate and finance and insurance, and industries such as transportation and storage and manufacturing which have remained reasonably flat or decreased in magnitude of value-added. These growth rates suggest how the relative magnitudes of the value-added generated by different industries may differ in future, which would affect the potential impact generated by an activity cluster in the locality of an airport.

Figure 17: Change in GVA in London (1997-2011, current prices)



Source: PwC analysis, GLA Economics (2014)

4 Labour demand and supply

In this section we summarise the evidence of the impact of an airport, or airport expansion on employment and labour demand, both directly at/ around an airport and more widely. We also consider how local labour supply adjusts to changes in demand as a result of airport expansion.

As highlighted in the Heathrow and Gatwick case studies (see Appendices A and B), many jobs are created as a direct result of airport operations, with the vast majority of these based on or around the airport site. A significant change in airport capacity may, therefore, have a significant impact on local labour markets. This section explores the nature of the jobs created as a direct result of airport operations, specifically considering:

- The number of jobs supported;
- The types of job which are created;
- The skill mix of the workforce; and
- The productivity of the jobs.

Box 4: Labour demand and supply – key findings

Labour demand & supply

Our analysis of labour demand and supply has focused on two questions:

- What employment has been generated: direct (on- and off-site), indirect, induced and catalytic?
- Could the jobs be met by the local and wider area? What was the remaining 'net additional labour demand'?

Direct impacts

- Evidence from previous studies reveals a wide range of estimates of the direct impacts of aviation activity
- The average number of direct jobs generated for each million passengers handled ranges from under 500 to over 1,500
- The drivers of these differences include: the share of long-haul flights, the nature of the terminal and passenger experience, the level of freight transport and the business operating model
- In addition, differences in methodology also contribute: for example, different studies use different definitions of the 'scope' of the airport and aviation activity and adopt different approaches to converting headcount numbers into FTEs and this affects their comparability
- Our review of airport economic impact studies suggests that just over half of direct jobs created at airports are in airlines or other aviation industry firms: other major employment groups include government & security (9-18%) and ground transportation (6-15%)
- In the UK and USA, transport industry jobs are more skilled and more productive than the national average whereas jobs in the storage, trade and retail sectors tend on average to be relatively lower skilled
- The commuting patterns of direct employees (airport workers) are relatively consistent across those airports where information is available: over 75% live within a 30-minute drive of the airport, and the majority travels by car
- This pattern of commuting provides some indication of the geographic scale of the local labour market
- It is also relevant for considering the effectiveness and efficiency with which labour supply adjusts to changes in labour demand as a result of airport development

Indirect & induced impacts

- There is less evidence on the share of national indirect and induced employment impacts which are felt locally and regionally
- A key factor influencing the employment multipliers is the size of the local area being considered: all other things being equal, multipliers will be larger in larger areas because leakages from the 'local' economy will tend to be smaller
- Evidence from Sydney Airport suggests that the nature of the local labour market will need to adjust to accommodate the increase in supply
- Similarly, evidence from the Joseph Rowntree Foundation highlights that new unskilled workers have moved into local communities, while the existing workers have taken on higher skilled jobs
- These adjustment mechanisms determine how labour cost and pressure on social infrastructure will change with labour demand changes
- They can only be fully assessed through general equilibrium modelling

Catalytic impacts

Investment & productivity

- The evidence is mixed on the impact in the labour market of airport expansion since it depends on the nature of industries which locate in the locality: for example, Dallas/ Fort Worth International Airport has attracted high-productivity industries, such as computing, finance and insurance whereas evidence from Memphis International and Amsterdam Schiphol airports suggests concentrations of low productivity distribution and storage firms
- These differences indicate how the local economic geography and history affect the labour market demand through changing required skill mixes

Tourism

- The value added by tourism is associated with additional jobs in tourism intensive sectors, notably accommodation and transport
- What proportion of these jobs is local to the airport depends on the travel patterns of airport users in relation to their final destinations: for example, some are closer to the final visitor destination than others
- Further jobs will also be created through outbound tourism: the majority of these (60%) are in the air transport industry (i.e. direct or indirect jobs), with additional employment in areas such as retail (25%) and travel agencies (7%)
- Outbound tourism could also reduce value-added by facilitating the substitution of local expenditure for expenditure in other regions or abroad: local economic welfare may be enhanced by changes in the opportunity for travel
- How far an increase in airport capacity will lead to increases in outbound travel depends on levels of demand and price adjustments in the air transport market: for London runway capacity expansion this is being analysed through the DfT's transport modelling, which should be applied in this module

Clustering & agglomeration economies

- There is very little evidence in the existing literature on the impact that industry clustering around airports has on the level and nature of labour demand
- A wide range of industry clusters (including, transportation, telecommunications, publishing and distribution) have developed, and these have very different implications for productivity, skill mix and employee numbers

Table 10 highlights some of the key studies we refer to in this section besides those reviewed as part of the case studies: a full list of studies used is provided in Appendix G.

Table 10: Local employment - relevant studies

No.	Title	Authors	Year	Geographies covered
1	Economic Impact Study	Leigh Fisher	2011	Ottawa
2	2013 Economic Impact Study of San Francisco International Airport	EDRG	2013	San Francisco
3	Transportation and storage sector: skills assessment	UK Commission for Employment and Skills	2012	UK
4	Employment Generation and Airports	BITRE	2012	Australia

4.1 Labour demand

In the first part of the section we review the available evidence in relation to the local impact of airports on labour demand. We start by reviewing the scale of employment linked to airports and then consider the available evidence on the mix of skills and labour productivity.

Employment

Table 11 summarises the local direct, indirect and induced employment associated with airports in Europe and the rest of the world. Also shown – as another measure of the size of the airport - is the number of passengers handled.

Table 11: Summary of local employment linked to case study airports

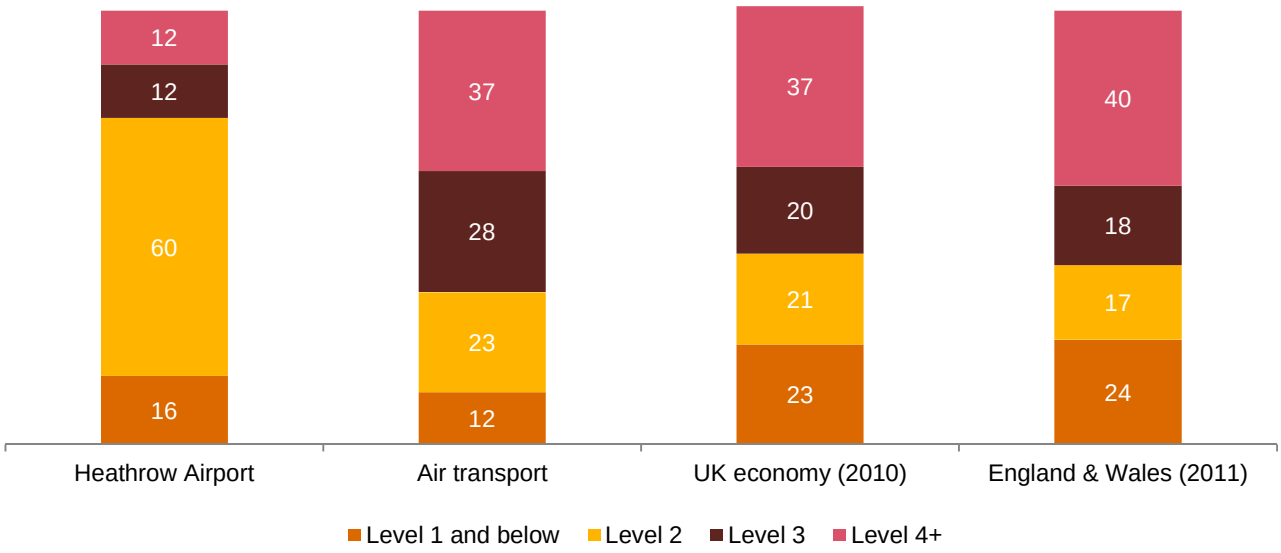
Airport	Study	Passengers (million)	Direct FTEs	Indirect FTEs	Induced FTEs	Total FTEs
London Heathrow	Optimal Economics (2011)	70	84,400	11,100	18,600	114,100
London Gatwick	BHC (2011)	34.2	24,900	1,900	6,400	33,200
Frankfurt am Main	INFRAS (2013)	58.04	78,000	38,300	39,200	155,500
JF Kennedy, New York	New York State (2010)	61.5	132,600	92,000	n/a	224,600
Paris Charles de Gaulle	BIPE (2012)	62	86,000	49,100	60,200	195,300
LaGuardia, New York	New York State (2010)	33.5	55,100	39,200	n/a	94,300
Manchester	York Aviation (2008)	21.2	19,300	12,900	9,000	41,200

Source: Compiled by PwC based on previous studies

Skills mix

The skills required of employees linked to an airport are a key dimension of labour demand. The UK Commission for Employment and Skills (2012) looked at skill levels within the transport and storage sector. It demonstrated, as shown in Figure 18, that the skill mix within the industry was broadly higher than that in the overall economy, when measured by the highest educational attainment. Specifically, the share of workers with Level 4 qualifications or above (broadly equivalent to a diploma, foundation degree or higher) was similar to the national average. The air transport industry, however, employed little over half the number of individuals with only a Level 1 qualification or below, relative to the national average. Also shown is the breakdown of the qualifications of Heathrow Airports' employees: this highlights the concentration of employees at Level 2.

Figure 18: Distribution of employees by highest educational attainment (2010)



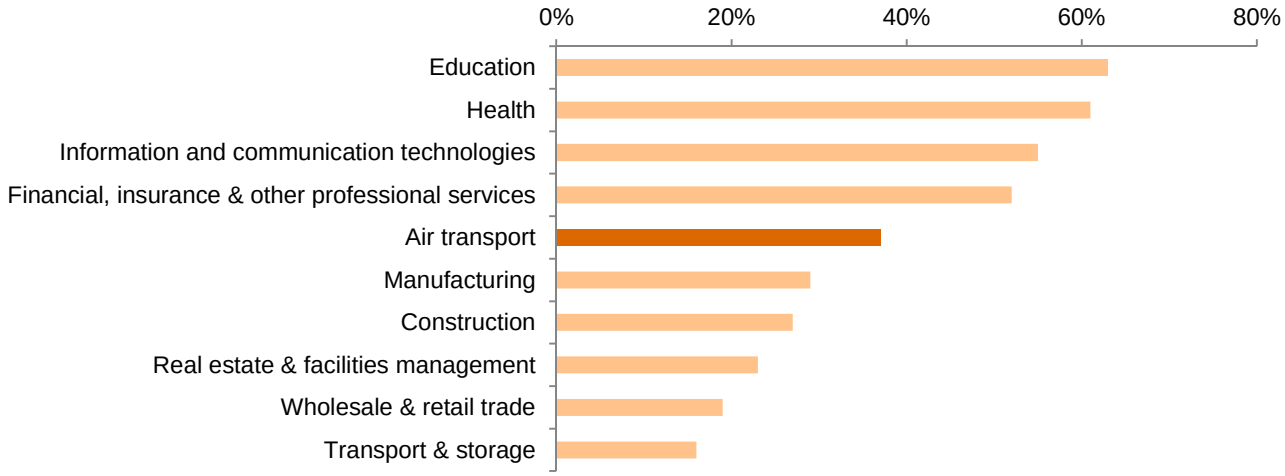
Sources: UK Commission for Employment and Skills (2012), Heathrow Related Employment, Optimal Economics (2011)

As highlighted by BITRE (2012), the most common occupations of those employed in the air transport sector were:

- Personal service occupations (36%);
- Associate professional and technical (23%); and
- Managers and senior officials (12%).

This suggests that the definition of workers in air transport excludes roles such as retail staff and cleaners, which are typically lower-skilled roles. This may explain the difference between these findings and those of Ernst & Young (2012) and Hakfoort (2001) who both identified that more than half the jobs associated with airport activity would be lower skilled. This difference highlights the importance of being able to understand which sectors are impacted at the local level and what level of skills are needed for the jobs created in order to assess the impact on local labour markets.

Figure 19: % of workers with Level 4 qualifications or higher by industry sector (2010)



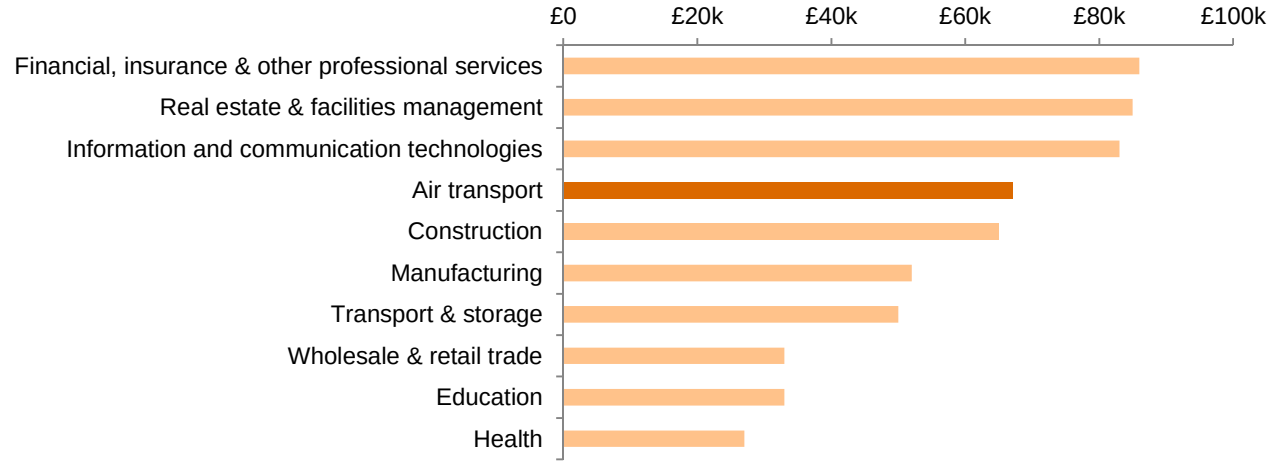
Source: UK Commission for Employment and Skills (2012)

Labour productivity

A further aspect of the labour market investigated by the UK Commission for Employment and Skills is the productivity of jobs in the transport and storage sector.

Figure 20 summarises this, showing that the average Gross Value Added (GVA) per head in the air transport sub-sector is approximately £67,000 (nearly 50% higher than the average across all industries). The chart also demonstrates that sectors such as wholesale & retail trade and wider transport & storage, which represent a significant share of direct jobs created by an airport (see Figure 15), are noticeably less productive.

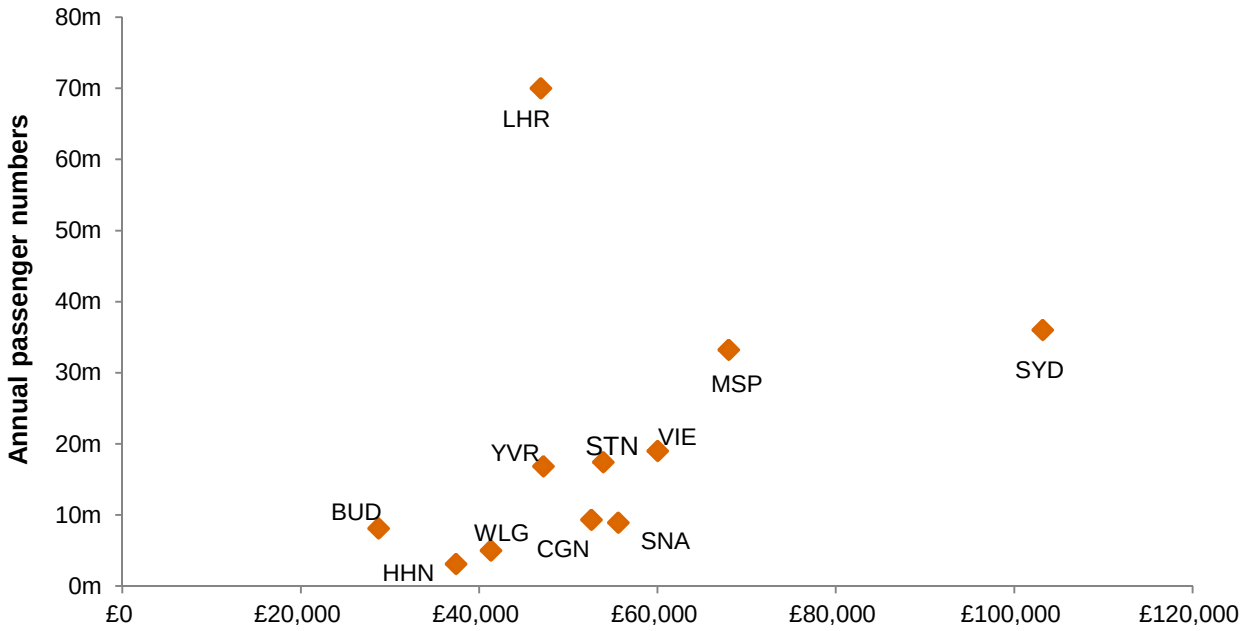
Figure 20: Value added per employee by industry sector (2010)



Source: PwC analysis, UK Commission for Employment and Skills (2012)

Aside from the industry-mix, it is also likely that the size and type of airport will impact on productivity. For example, it could be expected that larger airports would see higher productivity arising from economies of scale in areas such as procurement and financing. Using data from the 11 airports discussed earlier, Figure 21 shows the relationship between number of airports passengers and value-added per FTE. There appears to be a generally positive trend between the number of passengers at an airport and its productivity, potentially suggesting economies of scale in operation[20]. While these results cannot be used to specify the relationship - due to the small sample size, methodological differences between the studies and the specific local context of each example - they highlight a potential area of interest which could be investigated further through analysis of time series data or econometric modelling.

Figure 21: Value-added per FTE by passenger numbers



Source: PwC analysis

Key: BUD - Budapest, HHN – Frankfurt Hahn, WLG - Wellington, CGN –Colgne-Bonn , SNA –John Wayne (Orange County) , YVR - Vancouver , STN – Stansted, VIE – Vienna, MSP – Minneapolis-St Paul, SYD – Sydney, LHR - Heathrow

[20] This relationship would exclude a few outliers, most notably London Heathrow.

Indirect and induced employment

We also need to consider the extent to which airports support local indirect and induced employment.

The local impact of indirect and induced employment largely depends on the share of suppliers which are local to the airport. As shown through the distribution of output multipliers in Figure 5, this largely depends on the definition of 'local' which is used. Unlike the literature on direct employment, there is much less evidence on the share of indirect and induced employment impacts which are felt locally and regionally. The best example is the study of London Heathrow (see Appendix A).

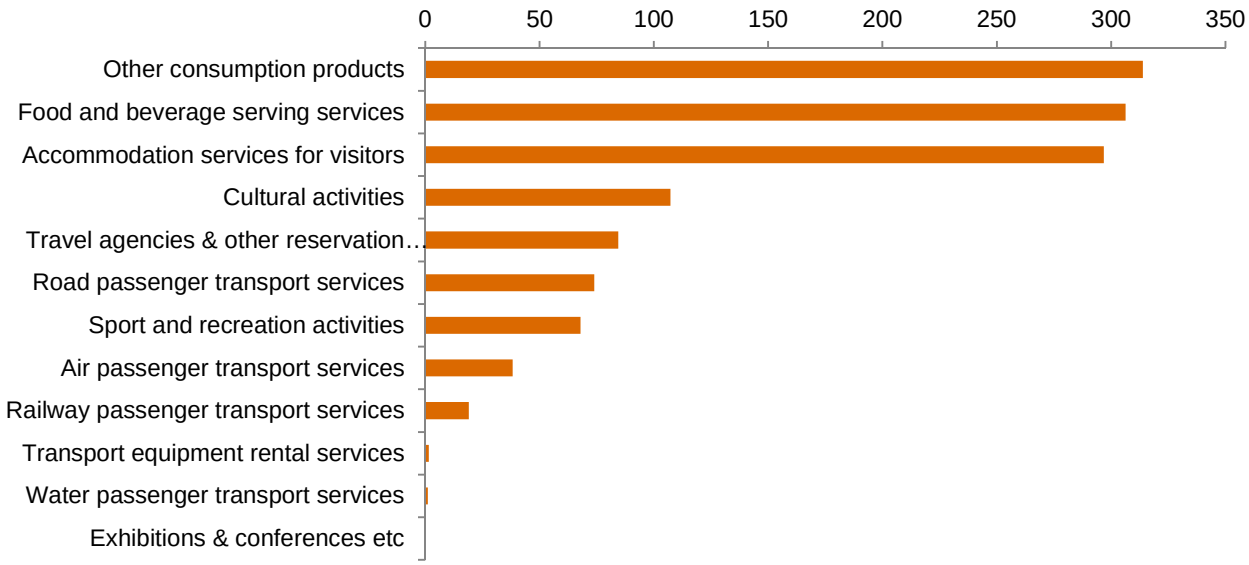
Catalytic employment

Evidence of the additional employment created through the catalytic impacts of an airport is limited. Such evidence as there is tends to focus on the impact arising from inbound tourism. In addition, there is no consistent evidence on the 'locality' of the impact.

Employment impact of tourism

Figure 22 shows the distribution of employment directly linked to tourism in the UK by sector. These estimates are based on data from the tourism satellite accounts.

Figure 22: Direct employees from tourism in the UK by industry group ('000 FTEs, 2011)



Source: Characteristics of Workers in Tourism, ONS (2013)

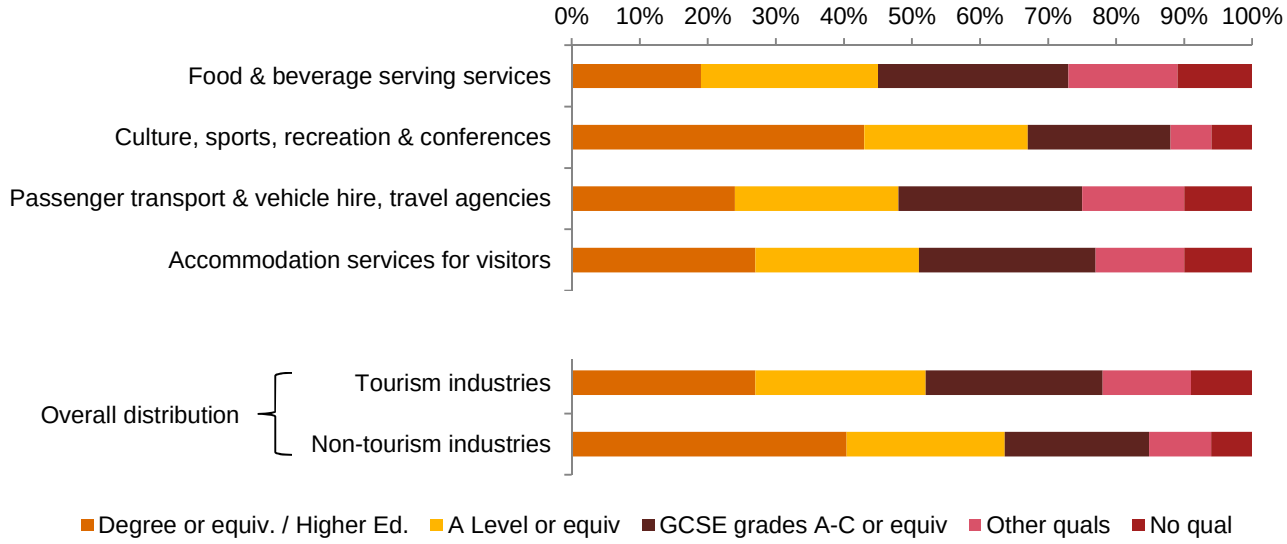
In addition to stimulating employment in the specific sectors highlighted above, the profile of employees in tourism industries in terms of qualifications is different to the UK as a whole. Figure 23 looks at the skill level of employees within the industry. It demonstrates that, aside from culture, sports, recreation & conferences, tourism typically employs individuals with lower skill levels (when measured according to highest educational attainment). Differences are also seen between the age, gender and ethnicity of employees in the tourism and non-tourism industries. All these factors would need to be considered when evaluating the impact of tourism on the local labour market, and the ability of the labour supply to react to this change in demand.

Box 5: Employment impacts of tourism linked to airports – evidence from the case studies

Two of our case studies have reviewed studies which have assessed the role of an airport in sustaining local tourism employment:

- A report for CDG estimates that around 52,600 jobs depend on spending by tourists using Charles de Gaulle airport in Paris
- A similar study in New York in 2004 estimated that 190,000 jobs depended on spending by domestic and international visitors using New York's airports

Figure 23: Distribution of highest education attainment for employees in tourism industries (2011)



Source: Characteristics of Workers in Tourism, ONS (2013)

4.2 Labour supply

Potential sources of labour supply

In this part of the section, we examine how airports secure their labour supply in order to meet changes in demand. Ernst & Young (2012) identify three potential sources of resident labour which would meet such demand:

- Unemployed residents in the local area seeking employment (above and beyond the long-run rate of structural unemployment);
- Inactive and underemployed residents in the local area seeking full-time employment; and
- Future resident labour force in the local area, above and beyond those employed by other new jobs.

Mobile labour comes from employees who choose to commute to their place of work. Its scale has implications for road and public transport use. We consider the available evidence on the place of residence of employees in relation to the airports where they work and the commuting pattern of airport workers.

A further dimension which needs to be considered is the matching of appropriate skills and experience to fill the roles which are created. In its analysis of a potential site for a new airport near Sydney, Ernst & Young (2012) found that, although total labour supply was expected to exceed demand by roughly 5,000 in 2060, this would be through an "over-supply" of 9,000 skilled workers and an "under-supply" of 4,000 unskilled workers. Rebalancing the labour market to meet the expected demand would require some combination of:

- Less skilled workers to be sourced from a wider area (which could be difficult since the extent that employees are prepared to travel is often linked to their skills/expected remuneration); and/or
- Persuading more skilled workers to accept less skilled roles (with a potential reduction in both their earnings and productivity).

This example highlights the importance of understanding the relationship between labour demand and supply in sufficient detail. Table 12 summarises some example indicators on the nature of the labour supply in three local authorities which house the largest airports in the South-East of England, relative to regional and national benchmarks. These data suggest that, relative to the benchmarks, these local areas have higher unemployment rates, a slightly lower skilled workforce (with the exception of Hillingdon) and an above average share of the labour force working in transport and communications. Only a limited understanding can be gained from this information alone, but it indicates the type of information which studies ought to consider.

Table 12: Labour supply indicators for selected local authorities and regions (2013)[21]

	Hillingdon (Heathrow)	Crawley (Gatwick)	Uttlesford (Stansted)	Largest London LAs		London	South East	UK
				Croydon	Barnet			
Economic activity rate- aged 16 to 64 (%)	77.6	82.9	86.5	81.0	77.5	76.8	80.0	77.3
Unemployment rate - aged 16+	8.4	13.1	N/A	8.4	5.5	8.5	5.7	7.5
% in employment working part-time - aged 16-64	21.3	18.6	17.7	25.3	23.0	21.5	26.3	25.5
% with degree or equivalent and above - aged 16-64	34.3	19.9	25.4	33.0	43.8	42.3	29.3	26.5
% with no qualifications - aged 16-64	6.8	9.5	5.6	6.1	4.4	7.8	6.5	9.7
% all in employment who are in professional occupations	19.5	13.3	19.9	20.8	27.0	25.0	21.3	19.7
% all in employment who work in transport and communications	17.8	19.1	9.2	11.6	9.3	12.0	10.3	8.8

Source: PwC analysis, NOMIS

Place of residence of airport employees

As the majority of the direct impacts from airport expansion are likely to be generated on the airport site, there will be pressure for the roles to be filled by residents local to the airport site. Understanding the geographic distribution of individuals who work on the airport site is useful as it helps to define the local area and the geographical breadth of the impacts. It can also be used as the basis for assessing the availability of labour within the local area and the potential impact on commuting patterns and supporting transport infrastructure.

Table 13: Place of residence of workforce at Heathrow Airport

	No. working at Heathrow	% of Heathrow workforce
Hounslow	10,760	14.6
Hillingdon	8,960	12.2
Ealing	5,760	7.8
Slough	4,090	5.6
Spelthorne	3,920	5.3
Local labour area	47,660	45.5
Other areas	25,770	54.5
Total	**73,430**	**100.0**

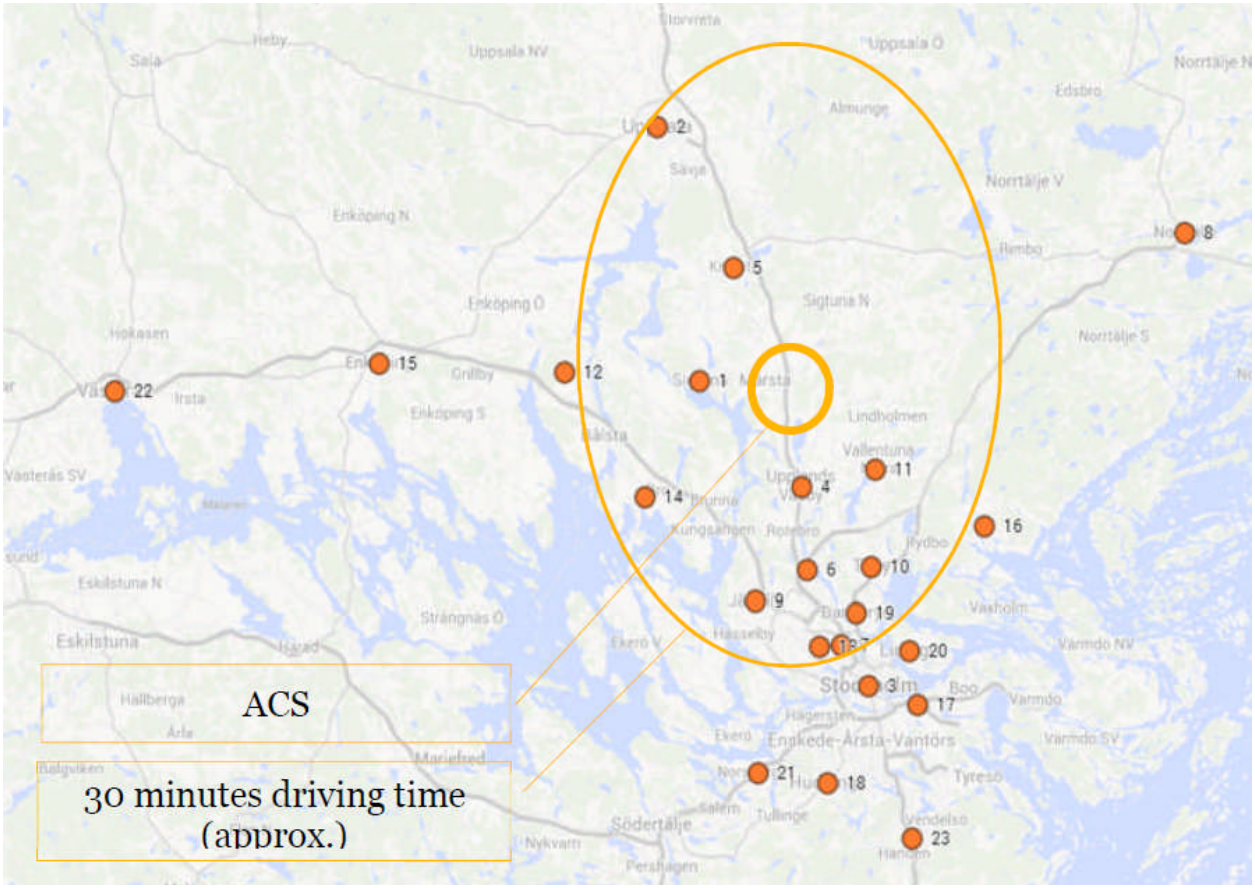
A number of studies have mapped this distribution. In in all cases the large majority of the on-site workers travel less than one hour. For example, some 60% of the airport employees at Frankfurt-am-Main Airport live within approximately 35 km of Frankfurt-am-Main airport. Nearly 75% of the direct employees at John Wayne Airport live in Orange County and therefore less than a 30 minute drive away from the airport. Looking more narrowly, more than half the employees live in the towns of Santa Ana, Orange and Costa Mesa, within a 15 minute drive. Similarly, nearly 90% of employees at Kingsland Smith Airport in Sydney live within a 50 minute

[21] Data is taken from the Annual Population Survey

drive of the airport, while more than 60% live in areas adjacent to the airport within a 15 minute drive. Both these examples are airports which are located in the centre of densely populated areas: Sydney Airport is a little over 10km from the centre of Sydney (with a population density of 380/km²) and Orange County is the second most densely populated county in California (density of over 1400/km²).

Alternatively, Stockholm Arlanda Airport is located in Sigtuna municipality (density of 120/km²). It is more than 35km away from the nearest cities of Stockholm and Uppsala. This does not, however, appear to impact significantly on the distribution of travel times for workers travelling to the site (see Figure 24). Again, over 75% of workers live within a 30-minute drive and nearly 90% live within an area extended to include Stockholm (which is a 32 minute drive away).

Figure 24: Areas with more than 100 workers commuting to Sigtuna (a close proximity for Arlanda Airport)



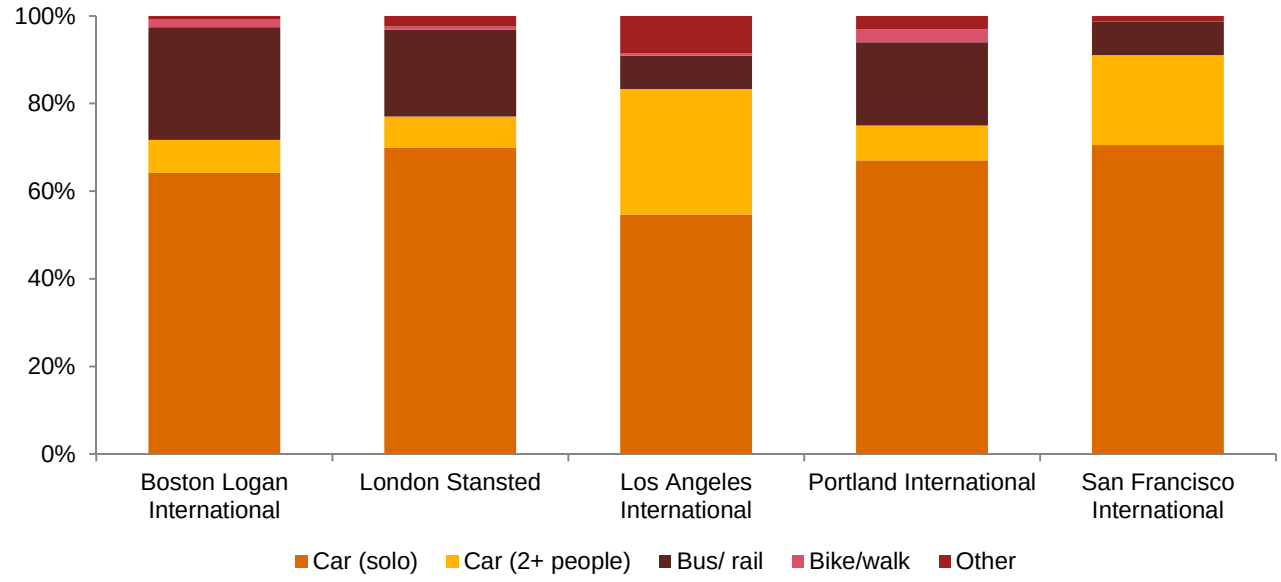
Source: PwC analysis

Commuting patterns

A final consideration in relation to the supply of direct labour is the commuting patterns of the workers at the airport. When combined with the understanding of the local area and the expected labour supply, this allows for analysis of how the local transport infrastructure will be able to cope with increases in demand.

Figure 25 shows the distribution of commuting methods at major international airports. This demonstrates that the majority of people (at least 70% in each case) use a car to drive to work, with the majority of those travelling alone. Despite the different infrastructure and geographical context of each airport, the commuting methods are reasonably similar, and do not differ greatly between Stansted and the four American airports. However, the differences which do exist, such as the increased use of carpooling in Los Angeles over bus/ rail use, demonstrate the importance of understanding the local context. Information at this level would be the very minimum needed to understand the potential impact of a change in capacity on local transport infrastructure.

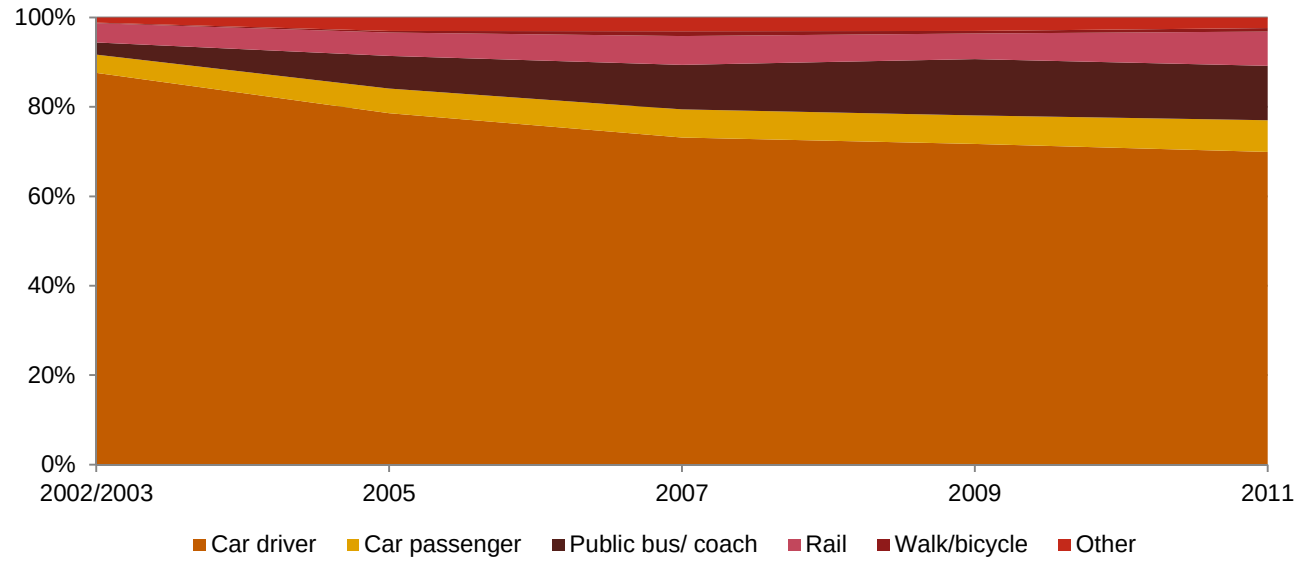
Figure 25: Distribution of commuting patterns by employees of major international airports



Source: Transportation Research Board (2012)

In addition to understanding the existing situation, studies would need to consider how this may change in future and with the introduction of a change in capacity. There is little evidence in the existing literature on the impact of a change in capacity on commuting methods, and any effect would be so specific to a local area that reasonably little could be learned from the findings. Figure 26 displays a more general trend, seen at London Stansted, of employees increasingly using means of transport other than the car. In particular, there appears to have been a large amount of switching to public buses and coaches. As a result, the use of alternatives to car transport has nearly trebled in less than 10 years. Trends such as this would be important to consider in any future projections of commuting patterns.

Figure 26: Change in commuting patterns to London Stansted (2002/03-2011)



Source: Transportation Research Board (2012)

5 Housing & land

This section summarises the impact of an airport, or airport expansion, on the need for, and availability of, housing, and the use of land at and around an airport. Two key questions which broadly cover the areas of interest with regards to this are:

- Housing: How do local housing markets adjust to airports and what factors influence individuals' decisions on whether to live in the locality of an airport?
- Land: What factors influence the location of real estate developments and how does local planning influence developments close of airports (or other transport infrastructure improvement)?

Box 6: Housing & land – key findings

Housing

Our analysis has examined two main questions:

- How much of the 'net additional labour demand' will add pressure to the local housing market and associated services?
- How much housing demand could there be from other sources, such as people wishing to live close to the airport for connectivity reasons?

Our key findings are that:

- To the extent that airport expansion increases direct and indirect employment in the local area, this will create pressure in the local housing market
- The extent of this pressure depends in part on the scale of the local area (geographically and the economically active population); changes in commuting patterns are also an important adjustment mechanism
- Evidence from the Joseph Rowntree Foundation in relation to Heathrow suggests that proximity to employment opportunities has affected the location decision of many residents
- How airport expansion affects local housing markets is ambiguous: on the one hand, it directly stimulates housing demand as more airport workers are needed, and indirectly as improved connectivity attracts mobile firms and/or enables existing firms to become more competitive (thus boosting their demand for labour). On the other hand, negative externalities associated with airport expansion (e.g. noise, congestion) can make the area less attractive so reducing housing demand
- McMillen (2004), for example, finds that the impact of 'severe noise' in reducing demand lowers house prices by 9.2%. The impact of additional airport capacity on noise is considered in module 5 of the Appraisal Framework.
- Conversely, demand for housing is shown to be increased by Lipscomb (2003) through the improved connectivity brought by an airport.

Land

Our analysis has examined the factors that influence the location of real estate developments and how local planning influences developments close to airports (or other transport infrastructure improvements)

Our key findings are that:

- The evidence demonstrates that the amount of land which is required in the locality of an airport varies greatly according to the local context.
- For example, Dallas/ Fort Worth airport covers 18,000 acres, of which 6,000 are for non-aviation activity. Most other airports are, however, considerably smaller
- Baker et al (2012) suggest that the nature of the land used by airports has changed with their recent development, stating that "large international airports in Europe, North America and Asia have varied functions beyond airport traffic and operate as metropolitan hubs with a diverse range of land uses"
- Similarly, CBRE research demonstrates how the role of land used by airports has changed, showing that occupiers of office space at airports are dominated by the technology and telecommunications (T&T) and manufacturing sectors
- The result of this has been to increase land rents on airports sites, to the extent that land at Amsterdam Schiphol is now more expensive than in the Amsterdam CBD. This type of adjustment mechanism with regards to an increase in demand will have a significant impact on the nature and level of land use in the vicinity of an airport.

Table 14 highlights some of the key studies referred to in this section besides those considered as part of the case studies. For a full list of studies used, please see Appendix G.

Table 14: Housing & land - key sources used

No.	Title	Author	Year
1	Airport Office Developments: Assessing the Potential for New Schemes	CBRE	2013
2	The Impact of Airport Noise on Residential Real Estate	Randall Bell	2001
3	Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line	Antoniou & Efthymiou	2013
4	Airport expansions and property values: the case of Chicago O'Hare Airport	Daniel P McMillen	2004
5	Developing tools to support complex infrastructure decision-making	Baker & Mahmood	2012

5.1 Housing

In this part of the Section, we briefly consider the limited available evidence on the influence of airports on (local) housing demand and value. This includes a report by the Joseph Rowntree Foundation on the local community surrounding Heathrow, however no similar study exists for the area around Gatwick. We focus on the factors that influence individuals' decisions on where to live in relation to an airport.

Factors influencing individuals' decisions to live in the locality of an airport

The development of transport infrastructure is an important driver of urban development. According to Efthiamou et al (2013), its impact on house prices "is either positive, due to the capitalization of the commuters' travel costs in the housing market of the area, or negative, when there are generated externalities (such as noise)".

Bell (2001) states that there are hundreds of detrimental conditions that affect property market values. Airport noise is recognised as an externality that is imposed on property owners, generally on a permanent basis. Empirical studies indicate that airport noise reduces residential property values. McMillen undertook research in 2004 which attempted to quantify the effect of airport noise on property values around one of the world's busiest airports, Chicago O'Hare. The author notes that "while much of the opposition to airport expansions focuses on aircraft noise, it is ironic that airports are actually becoming significantly quieter over time. New aircraft are much quieter than older planes, and the older aircraft are being retired. Indeed, a single model, the B72Q, which is being phased out by the major airlines, generated over 70% of the incidents of "severe noise" at O'Hare in 2001. In addition, airports have become quieter as night flights are reduced." Nevertheless, McMillen states that opponents of airport expansions continue to cite increased noise as a major complaint. Using transactions data from 1997, McMillen finds that home prices are 9.2% lower in the area affected by severe noise. However, it is suggested that as a result of aircraft becoming quieter, new runway reconfigurations and proposed changes to flight paths, the forecast net impact of the proposed additional runway at O'Hare was actually an increase in house prices by nearly $300 million.

In the case of Manchester Airport, sources cited in Efthymiou et al reached opposite conclusions when measuring the impact of the airport: Pennington (1990) found that aircraft noise created a negative impact, whilst Lipscomb (2003) concluded that increased accessibility led to an uplift in values. The length of time between these studies and the development in aircraft technology in the intervening period (as highlighted above) may explain the differences in findings. We note that the impact of airports on noise and quality of life is being considered more fully as part of other Modules.

Research published by the Joseph Rowntree Foundation in 2011 suggests that proximity to employment opportunities at Heathrow Airport has affected location decision-making for many local residents. The research considered community experiences and understandings of globalisation in the UK and examined the 'Heathrow

Village'[22] as a community that is outwardly connected and associated with a long history of immigration. As such, it has strong and diverse external connections in economic, social and cultural terms. The report described Heathrow Village as a 'tight', though ethnically diverse, community, on the basis that so many people worked at Heathrow in a variety of roles such as catering, transit, baggage handling and customer services. The authors state that "many people in the area are tied to Heathrow airport through their employment by a range of firms, which often operate through dense and complex global contractual relationships. The area contains a variety of ethnic groups, reflecting successive waves of inward migration from Ireland, south Asia and more recently Somalia, which continues to open the area up to broader global social and cultural flows and influences. By UK standards, the local labour market [around Heathrow Airport] is relatively buoyant, with low levels of unemployment and median earnings in line with the national average."

A local councillor interviewed by the researchers observed that as residents are upskilled they move further away from the airport: "And what quite often happens is that the really unskilled work tends to get taken up by the incoming communities… Because it's been easier to do those jobs and they've (the established communities) actually stepped up a grade. They're integrated into the wider society. So they step up and move out further which lets more people in."

This finding only provides one viewpoint; nevertheless, it suggests that the housing market in Heathrow Village is not seen as a desirable location in which residents want to settle; although employment levels are high, the dominance of unskilled workers may constrain house price growth on the basis of affordability.

5.2 Land

In the second part of this Section, we consider the limited available evidence on the influence of airports on land use and values. First, we examine the development of airport commercial markets and then consider how accessibility shapes commercial property developments. Second, we review how airports influence local economic and land use planning. Due to a lack of data availability around Heathrow, the second section focusses on the experience of Gatwick Airport.

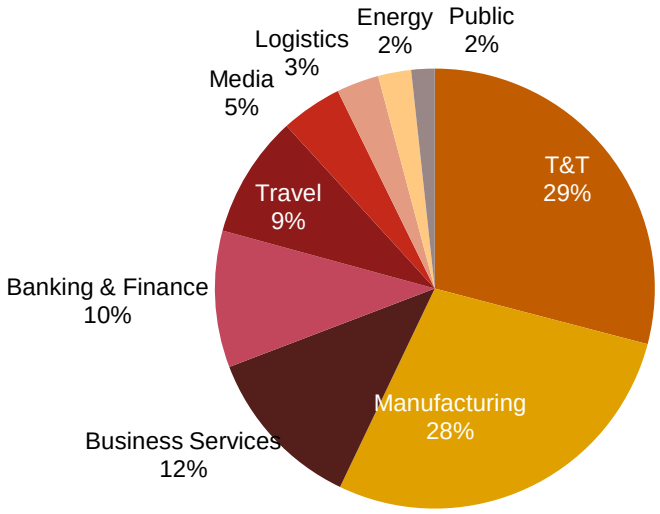
Airport commercial property markets

Baker et al (2012) state that the role and scale of major urban airports worldwide have changed over the past decade as a result of corporate and economic transformation. Modern airports can no longer be considered in isolation from the metropolis that they serve: "Large international airports in Europe, North America and Asia have varied functions beyond airport traffic and operate as metropolitan hubs with a diverse range of land uses. Most large international airports have developed land on the airport for commercial and light industrial purposes that are often not associated with aviation-related uses. The change in land use around the airport, coupled with the increasing use of the airport for international travel, has often placed demands on the transportation infrastructure that services the airport area. Included in this demand is a wide range of stakeholders, users and infrastructure providers that have differing goals, objectives, models and interests."

CBRE has assessed a number of European airport markets. Its research shows that in addition to companies which are directly related to aviation activity, occupiers of office space at airports are dominated by the technology and telecommunications (T&T) and manufacturing sectors (see Figure 27).

[22] Referring to the communities to the west of London around Heathrow airport, spanning the boroughs of Hillingdon, Hounslow and Ealing.

Figure 27: European airports occupier profile (2013)



Source: CBRE

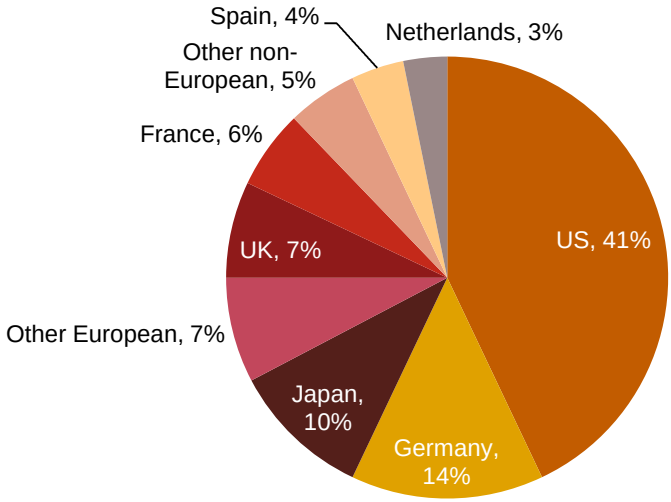
In terms of occupier trends, discussions with CBRE reveal that the large US hardware manufacturing firms who established office campuses around European airports in the late 1980s/1990s are currently consolidating their space in these locations, or are moving offices to more central areas. The new generation of technology firms that is driving demand from this sector prefers central locations in order to appeal to their target workforce. As a result, demand from this sector around airports is significantly lower than in the past. Manufacturing firms and travel related occupiers still have a tendency to locate in these areas – they are less concerned with locating in central markets and still benefit from the good connections and cheaper rents they typically find in the airport area.

According to CBRE, market conditions in the majority of non-central business districts, including airports, have been challenging during the economic downturn. Three general features have driven the airport-based office markets that have performed best during this period:

- Connectivity to other major global cities and to the local economy;
- Prominence in the region of established occupiers from the potential occupier's business sector; and
- Supply and location of suitable, high quality office space.

CBRE argues that the global connections at an airport are of particular significance to multinational firms based outside Europe. Figure 28 shows that more than half of occupiers originate from non-European locations. Of these, over 70% are located at an airport that had direct flights to the city of their global headquarters.

Figure 28: Country of origin of key European airport occupiers (2013)

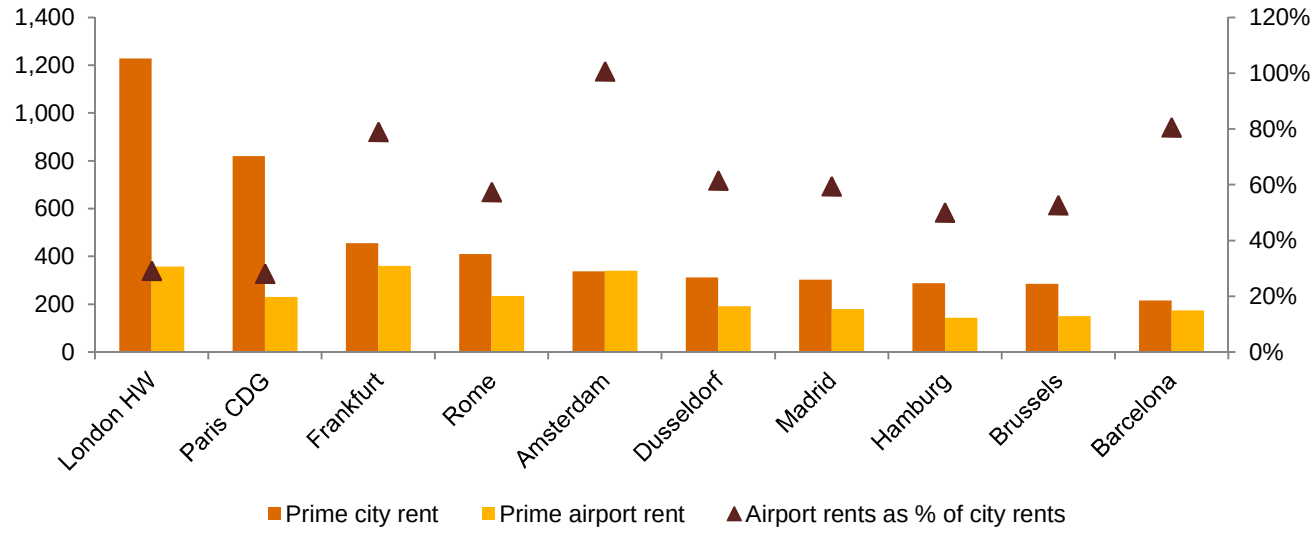


Source: CBRE

The level and quality of connections to the local economy are also important like global connectivity. Figure 29 highlights that the highest rents of the main European hub airports are achieved at Frankfurt and Amsterdam. In addition to being large hub airports, both have quick transfer times by train to the city centre (10-15 minutes), but are also connected to the high speed national and international rail networks (see, for example, the Frankfurt case study). Discussions with CBRE revealed that there have been a few examples of business services / banking companies setting up offices at airports; however these are only at airports which have very high grade central business district style office space and extremely quick connections to the central business district (less than 15 minutes).

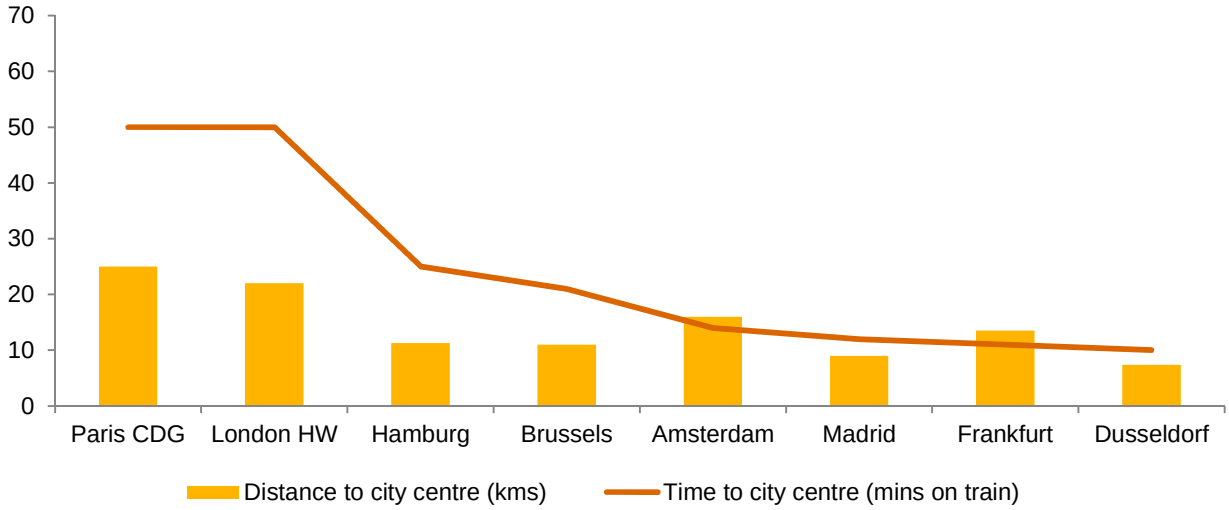
In contrast, average transfer times from Paris and Heathrow to the city centre are significantly longer (see Figure 30). The size of these airports and land pressures close to their perimeters have resulted in the location of business parks further from their perimeters .

Figure 29: Prime airport and city office rents (€/sq. m per annum)



Source: CBRE

Figure 30: Distance and time from airport to city centre

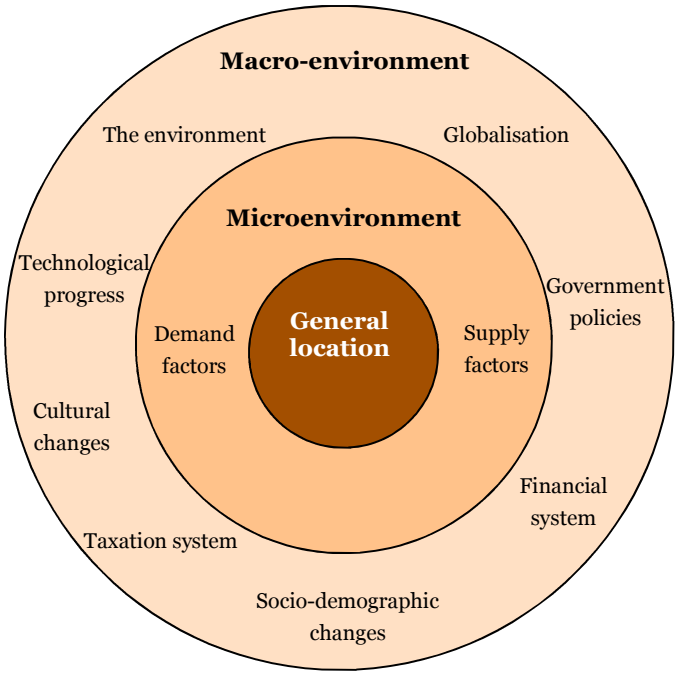


Source: CBRE

Influence of accessibility on location of commercial property developments

Rymarzak et al (2012)[23] provide a recent systematic review of the literature related to factors affecting the choice of location for real estate developments. The authors analyse factors connected with both the distant environment (the macro-environment) and those relating to the more immediate environment (the micro-environment). These factors are summarised in Figure 31.

Figure 31: Factors affecting general location choice



Source: Rymarzak et al (2012)

[23] Rymarzak, M and Siemińska, E (2012), "Factors affecting the location of real estate", Journal of Corporate Real Estate, Vol. 14 No. 4, pp. 214-225.

Regarding the macro-environment, the authors state that "the factor covering the widest range of issues in business activities, from a generic point of view, is government policy. By defining priorities and main directions for economic and social activities, the state creates specific conditions and principles for the functioning of various business entities… Therefore, government policy, in conjunction with the global situation, largely determines whether business is good or bad for a given entity, affecting the entities' financial situation and the nature of the location decisions it makes. The economic system and its degree of market freedom and impact are crucially important for the business' objectives, assessment of productivity levels, and therefore, location."

Once a business has decided to locate within a macro-environment, it will try to find a location that will best satisfy the needs of its planned operations (i.e. the micro-environment). Each location has a value which is determined by factors related to both supply and demand. On the demand side, factors that influence a location's attractiveness from a market perspective include the number of consumers, their purchasing power and transportation between consumers and the site; this may involve either delivery of goods to the buyers or the means for the buyers to get to the point of sale or service. Supply side factors are determined by the location's conditions that allow the specific business to be conducted, which directly or indirectly impact the size of investment outlays in the construction phase as well as the firm's net profitability level at this location. Supply side factors may include natural resources, human resources, technical facilities, raw materials and energy.

Table 15: Demand and supply factors affecting the general location choice of real estate

	Demand factors	Supply factors
Industrial space	• Number of consumers (buyers/clients) • Expected sales volume • Seasonality • Prices of substitute products • New household formations • Age composition of new households • Household income • Mortgage credit conditions	• Availability of natural resources (water, quantity, quality of minerals, agricultural, forest) and their prices • Availability of fuels (coal, oil, gas, electricity, fuel expandability, reserves) • Transportation methods and costs (water, rail, highway, air, access) • Human resources (wage rates, skill levels, productivity, availability) • Prices, productivity of production • Number and location of competitors
Retail space	• Population (number, density, growth rate, age and gender pattern, educational attainment) • Households (composition and size, income levels, average disposable income per capita) • Credit conditions and payment plans • Unemployment level • Internal, external migrations • Social mobility • Trend for delayed marriage and parenthood • Customer tastes and preferences • Prices of substitute products	• Number of existing retail outlets (number of major and less immediate competitors) • Retail outlet pattern and size • Proximity of transport networks • Retail saturation in area • Retail space vacancy rate • Growth rate of new outlets • Market share of individual retail facilities • Merchandise offered • Age of retail facilities • Technical standard of existing space • Parking capacity
Office space	• Unemployment level • Number of local firms • Type of business of local firms • Number of local firms (expanding or upgrading, ceasing business or leaving local market) • Number of new firms entering local	• Number of existing office buildings • Office building pattern and size • Accessibility to the client – location vs housing estates and transport networks • Office space vacancy rate • New office facilities growth rate

Demand factors	Supply factors
market • Office space per employee (square feet)	• Age, technical standard of existing space • Parking capacity • Recent absorption of space, including types of tenants or buyers • Market rents/sale prices • Developer expectations • Demolitions, conversions • Credit conditions

Source: Rymarzak et al (2012)

These findings were reinforced by the ULI/EY survey[24] of global real estate and public leaders which highlighted infrastructure as the top factor driving the location of commercial property development: 88% of survey respondents ranked infrastructure quality as a top or very important consideration when determining where real estate investments are made, with infrastructure scoring highest for public leaders (91%) and second to the top for private leaders (86%). In terms of the importance of different infrastructure categories, some interviewees noted that services such as water, electricity and telecommunications are part of the package of infrastructure elements that well-functioning cities are expected to provide and, therefore, differentiators are "proximity to transport, especially high-quality transit, good roads and bridges, and, for some real estate sectors, airport and passenger connections."

Land use planning around Gatwick and Heathrow airports

Finally, the Airports Commission asked each of the local authorities close to Heathrow and Gatwick Airports to provide relevant background information on how their approach to planning took into account the influence of the adjacent airports. Responses were provided for four areas: Crawley, Horsham, North West Sussex (covering Crawley, Horsham and Mid-Sussex) and Surrey. Very limited information was provided in relation to Heathrow Airport.

Two key documents provide some insight into the broad economic trends around Gatwick Airport:

- The North West Sussex Economic Appraisal (September 2009), which focuses on Crawley, Horsham and Mid-Sussex, covers the period from 2006 to 2026; and
- The North West Sussex Economic Growth Assessment (April 2014) covers the Gatwick Diamond (which includes Crawley, Horsham and Mid-Sussex as well as the Surrey districts of Epsom & Ewell, Reigate and Banstead, Mole Valley and Tandridge) and assesses the period from 2011 to 2031.

Both documents provide detailed analyses of alternative scenarios for economic development around Gatwick Airport, considering the implications for planning policy of potential changes in business and employment structure, housing, employment space and land use. Significantly, although both reports consider the effect of growth at Gatwick Airport, neither report considers a scenario in which Gatwick Airport would have a second runway.

Table 16 summarises the overall levels of employment growth and B class space requirement[25] and land requirement for each local authority arising from the different scenarios examined in the most recent, North West Sussex Economic Growth Assessment. Under the 2013 baseline scenario, employment is projected to increase by 35,700 between 2011 and 2031. Just under half (46%) of this growth (equivalent to around 16,500 jobs) is expected to arise in Crawley with almost 10,500 jobs in Mid Sussex and nearly 8,900 jobs in Horsham. The various alternative scenarios generate higher overall levels of employment growth than is implied by the baseline scenario.

[24] Urban Land Institute and EY, Infrastructure 2014: Shaping the Competitive City, http://www.ey.com/Publication/vwLUAssets/EY_-_Infrastructure_2014:_shaping_the_competitive_city/$FILE/EY-infrastructure-2014-shaping-the-competitive-city.pdf

[25] B class space includes B1 Business (offices, research & development, light industry), B2 General Industrial and B8 Storage or Distribution (wholesale warehouses, distribution centres).

The analysis suggests that, in total, up to 48,000 jobs could be accommodated and supported across Northern West Sussex. This is equivalent to an increase of 35% over the baseline scenario and is contingent on relatively significant policy interventions and provision of new employment land.

Table 16: Headline scenario outputs by local authority (2011-2031)

Scenario		Northern West Sussex	Crawley	Horsham	Mid Sussex
Baseline Job Growth	Total employment	35,755	16,440	8,890	10,425
	Jobs per year	1,785	820	445	520
	Gross floorspace requirement (m2)	714,560	387,540	178,770	148,250
	Gross land requirement (ha)	144.2	77.2	36.3	30.7
Higher Growth	Total employment	46,275	20,130	12,720	13,425
	Jobs per year	2,320	1,010	640	670
	Gross floorspace requirement (m2)	896,010	435,300	218,630	242,080
	Gross land requirement (ha)	183.8	87.6	43.4	52.8
Potential Sites Capacity Potential	Total employment	48,000	22,440	15,135	Not modelled: as per baseline
	Jobs per year	2,400	1,120	760	
	Gross floorspace requirement (m2)	828,320	440,330	239,740	
	Gross land requirement (ha)	193.4	110.1	52.6	

*Source: NLP analysis *Note: totals rounded*

Appendix A. - *London Heathrow*

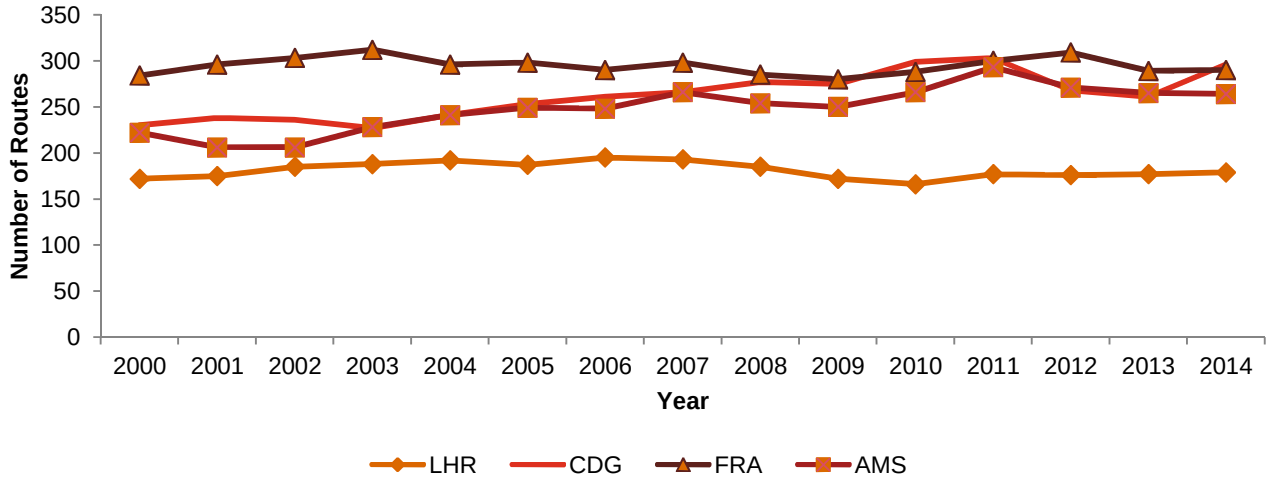
A.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to London Heathrow airport. We provide background information about the development of the airport since 2000. This includes route, passenger and airline data alongside a timeline of infrastructure developments. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing. The case study has drawn heavily on data published in 2011 by Optimal Economics, by far the most comprensive recent source of data, which has enabled analysis of Heathrow-related employment and GVA, as well as earnings, skill levels and employment type.

A.2. *Background*

Heathrow (LHR) is the third largest airport in the world in terms of passenger numbers (after Atlanta and Beijing) having served over 72 million passengers in 2013. Figure 32 highlights the consistently large number of connections at Frankfurt and the growth of the networks at Charles de Gaulle and Schiphol in comparison to that of Heathrow, which has fluctuated slightly but shows no significant growth:

Figure 32: Number of routes available at the major European hub airports (2000-2014)

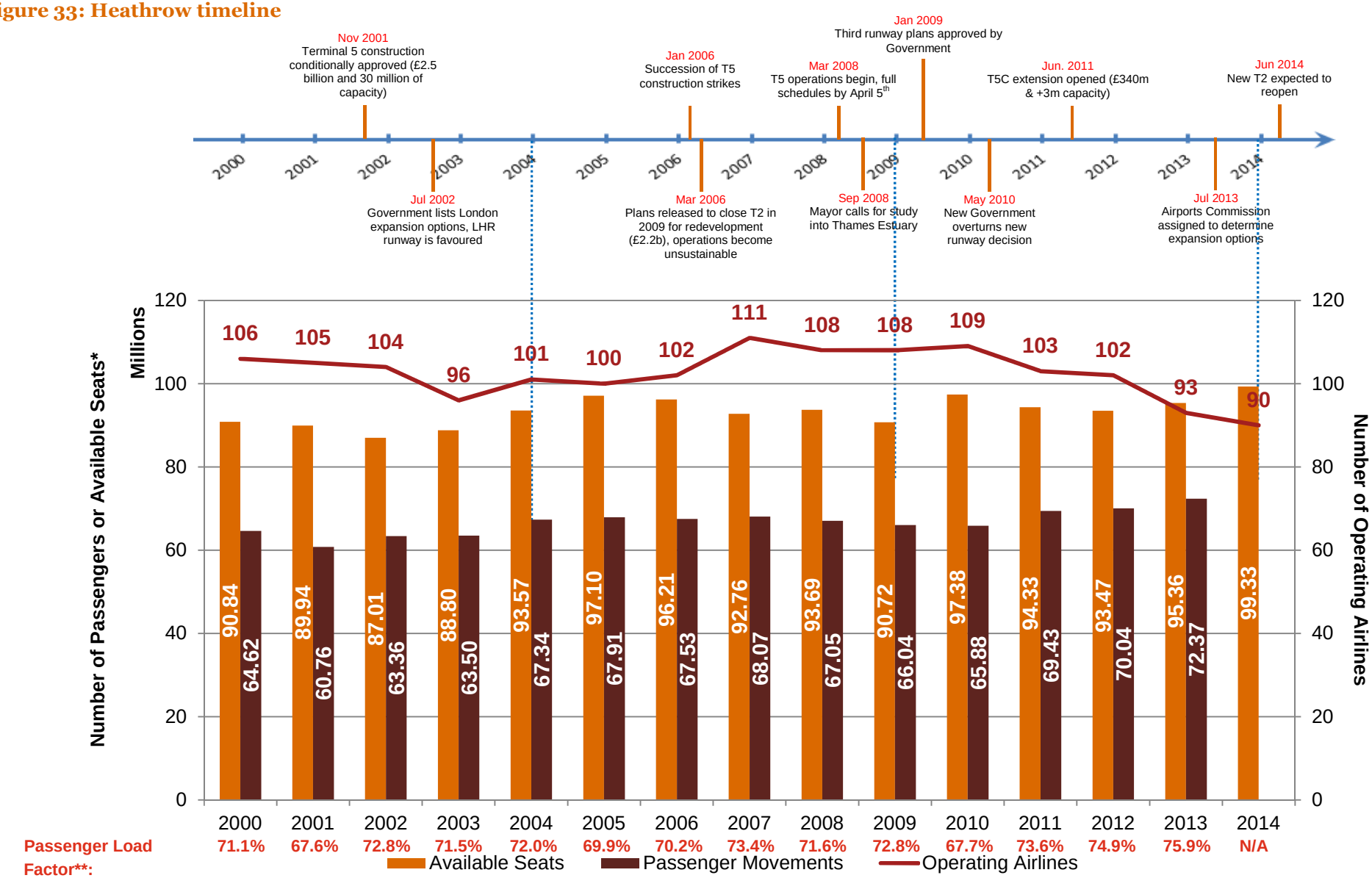


Source: SABRE Airport Data Intelligence

However, restricted capacity will cause airlines to focus on the most profitable routes and it has been estimated that, by 2030, constraints at Heathrow will limit the airport to serving as few as half the destinations provided by Charles de Gaulle (CDG), Schiphol (AMS) and Frankfurt (FRA), the other three major European hubs[26]. In the past fifteen years, Heathrow's principal infrastructure developments have been the construction of Terminal 5, which opened in spring 2008 and the modernization of Terminal 2, which is scheduled to open in 2014. The timeline in Figure 33 highlights both these infrastructure improvements and the trend in the number of operating airlines and passengers.

[26] Heathrow Airport Limited (2011), A Focus on the Economy Towards a Sustainable Heathrow http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Afocusontheeconomy.pdf

Figure 33: Heathrow timeline



*Available departing seats multiplied by 2
** Passengers divided by available seats
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

It is difficult to credit the variation in capacity to one or a series of events as there are a lot of factors to take into account; simply because a new infrastructure development has been opened does not necessarily mean that available seats on flights will increase across the whole airport. The data highlight capacity growth of almost 6 million seats in the period in which infrastructure investment was made at the airport, although some of this capacity may be attributable to the increasing use of larger aircraft.

A.3. *Employment and value added*

The overall aim in increasing capacity at an airport is to be able to accommodate additional passengers. However, a thriving airport also draws new businesses to locate either onsite or nearby (e.g. cargo, logistics, retail, hotels, offices, car parking and light industrial space).

The passenger numbers of an airport can be directly related to the number of jobs available and the gross value added (GVA) to the local economy in terms of the income earned from the production of goods and services in the area.

A report carried out in 2004 for the Airports Council International (ACI) Europe regarding the social and economic impact of airports suggested an average of 950 on-site jobs are supported by every million passengers at airports in Europe[27]. This gives an indication of how important airports are economically at the local level throughout the continent.

Between 2008 and 2009, a survey was undertaken of on-site employees at Heathrow Airport. These results were analysed in 2011 to investigate the impact Heathrow had on employment both directly and indirectly across the UK. The summary of the findings is shown in Table 17.

Table 17: Total employment and GVA as a result of Heathrow (2010)[28]

	Local	London	Rest of UK
Employment (Jobs)			
Direct on-airport	76,600	76,600	76,600
Direct off-airport	7,700	7,700	7,700
Indirect	11,100	20,800	44,400
Induced	18,600	31,500	77,200
Total employment	114,000	136,600	205,900
GVA (£ billion)			
Direct on-airport	3.276	3.276	3.276
Direct off-airport	0.328	0.328	0.328
Indirect	0.656	1.358	2.462
Induced	1.065	2.059	3.616
Total GVA	5.304	7.021	9.680

Source: Heathrow Related Employment, Optimal Economics, 2011[29]

In this context direct employment is considered jobs where activity is directly related to Heathrow and is based either on- or off-site; indirect employment refers to the firms that supply the goods and services to businesses located at the airport; and induced is employment supported by the expenditure of those employees in the

[27] ACI Europe and York Aviation (2004), The Social and Economic Impact of Airports in Europe
https://www.ryanair.com/doc/news/2012/ACI-Report.pdf

[28] Employment figures to the nearest 100. Although the direct on-site figures were from 2009 they were expected to hold for 2010.

[29] Optimal Economics (2011), Heathrow Related Employment
http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Heathrow-Related-Employment-Report.pdf

previous categories. It is also worth noting that "Local" refers to local authorities in the immediate vicinity of Heathrow, i.e. Hillingdon, Hounslow, Spelthorne, Slough and Ealing (see Figure 33).

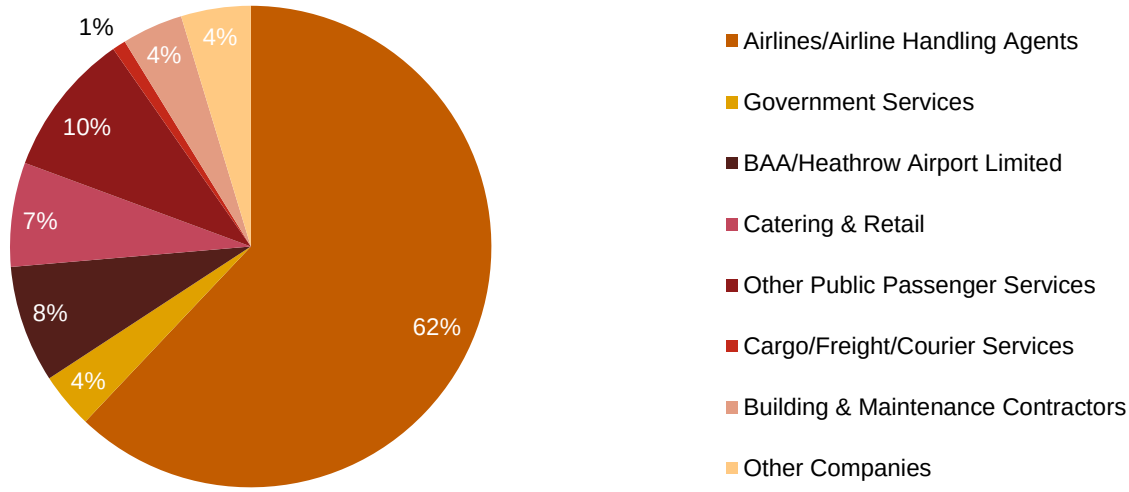
From the figures reported in the 2011 paper, it is evident that Heathrow exceeds the European average quoted by the ACI in 2004 of 950 employees per million passengers; in 2009, Heathrow served c. 66 million passengers and employed 76,600 staff on-site, giving a ratio of around 1,160 employees for every million passengers. Bearing in mind that the European employee numbers may have changed slightly since the survey, this still suggests that in European terms Heathrow has an above-average direct economic impact in the local area.

The 2011 study further breaks down on-site employment by sector. Figure 34 shows the split of employees by employment category and Figure 35 shows the split by employers. The majority of jobs come from airlines and airline associated services although this category has a significantly lower share in terms of employers (because these companies are much larger than other companies on-site).

It is almost expected that cargo/freight/courier services have the lowest share as Heathrow only operates an average of 69% of the freight carried by Charles de Gaulle and Frankfurt by weight (since 2007, FlightglobalPro). Also, since freight companies handle goods rather than passengers, as airlines do, it requires fewer staff to deliver their services.

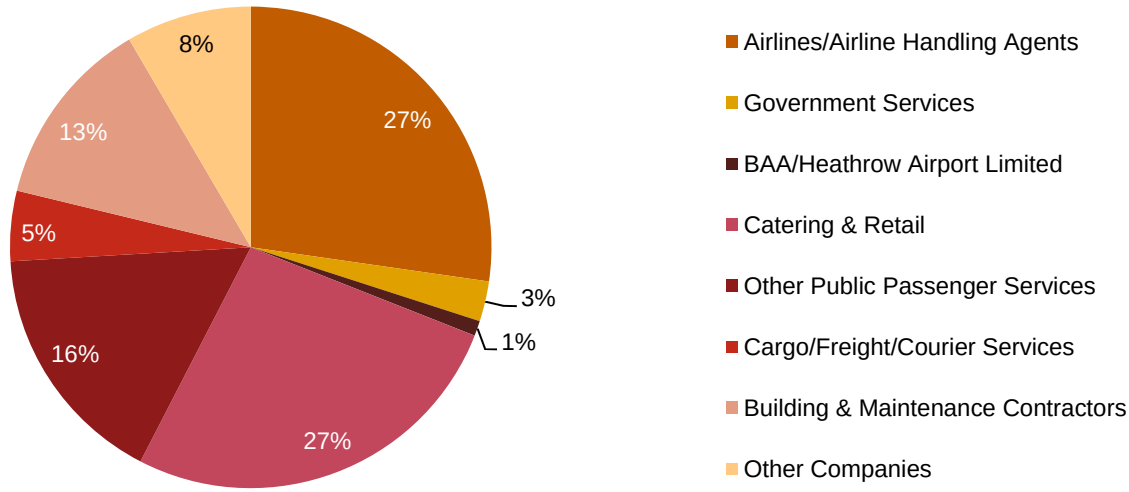
Of the employees surveyed at Heathrow in the study, 99% were permanent, 82% were full time and there was a 57:43 male/female split.

Figure 34: % of direct on-site employment by sector (2009)



Source: Heathrow Related Employment, Optimal Economics, 2011

Figure 35: % of direct on-site employers by sector (2009)



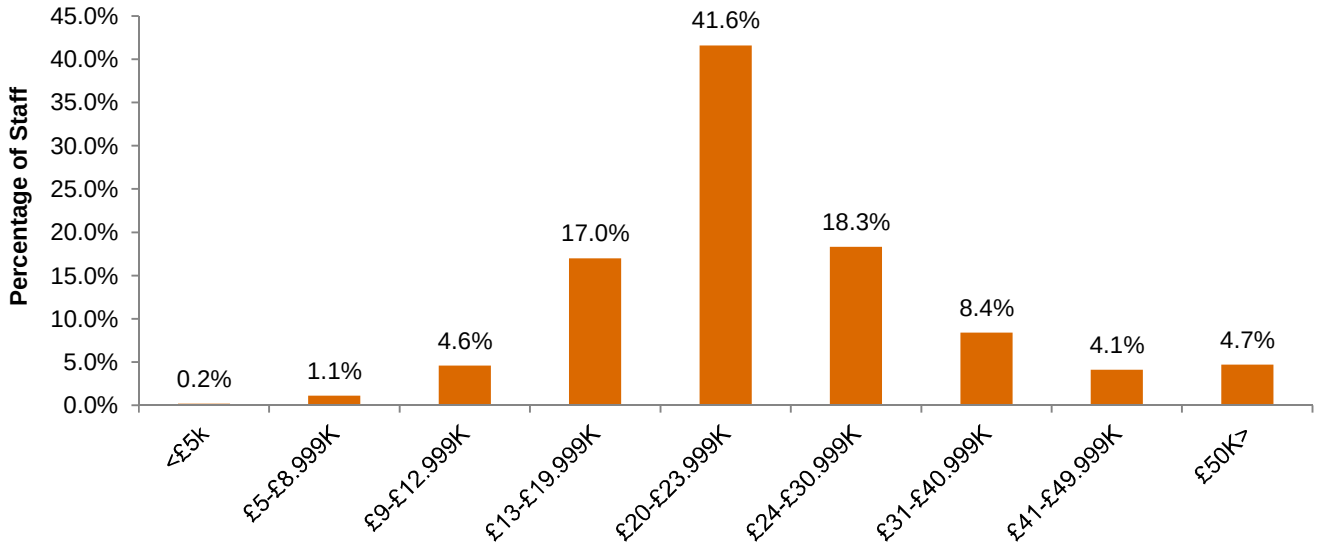
Source: Heathrow Related Employment, Optimal Economics, 2011

A.4. *Earnings and skills*

In 2010, the ONS estimated that salaries in an area contribute to 61% of that area's total GVA[30]; carrying this assumption through to Heathrow allows us to estimate a GVA of £3.3 billion in 2009 from direct on-site employment alone. Figure 36 highlights the distribution of salaries of on-site employees. The majority of staff earn between £20k and 23.999k. Figure 37 shows the split of employees at Heathrow by skill level: level 1 is considered competence associated with general education and gives hotel workers and cleaners as examples of jobs; level 2 occupations require knowledge provided by a good general education such as machine operators, retailing and secretarial positions; level 3 normally require post school study but not to a degree level, such as skilled engineering roles and construction trades; and level 4 covers professional and managerial positions which would usually require a degree or equivalent. The relevance of this pie chart is that almost 60% of the workers are level 2 which includes air cabin crew and baggage handlers ('Airlines/Airline Handling Agents' employer category).

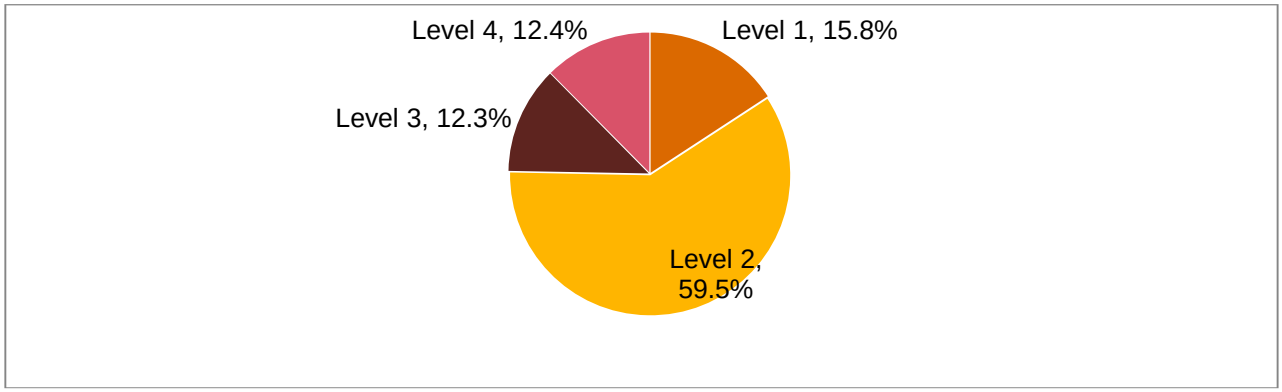
[30] Office for National Statistics (2010), Regional, sub-regional and local gross value added 2009
http://www.ons.gov.uk/ons/rel/regional-accounts/regional-gross-value-added--income-approach-/december-2010/regional--sub-regional-and-local-gross-value-added.pdf

Figure 36: % of LHR on-site employees by salary band (2009)



Source: Heathrow Related Employment, Optimal Economics, 2011

Figure 37: % of on-site employees by skill level (2009)

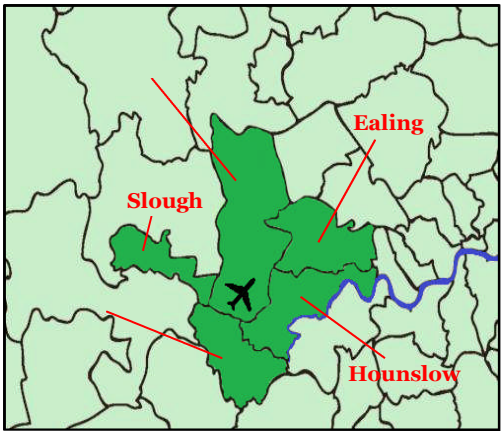


Source: Heathrow Related Employment, Optimal Economics, 2011

A.5. *Labour supply*

Figure 38 shows that Heathrow draws its workforce from a wide geographical area. Almost 55% of direct on-site employees live outside the five closest local authorities. This suggests that the economic impact of the direct, on-site employment of Heathrow extends beyond the local area since those who work at Heathrow and live in the surrounding region will spend some of their wages there, helping the induced effects locally.

Figure 38: Place of residence of Heathrow workforce (2009)

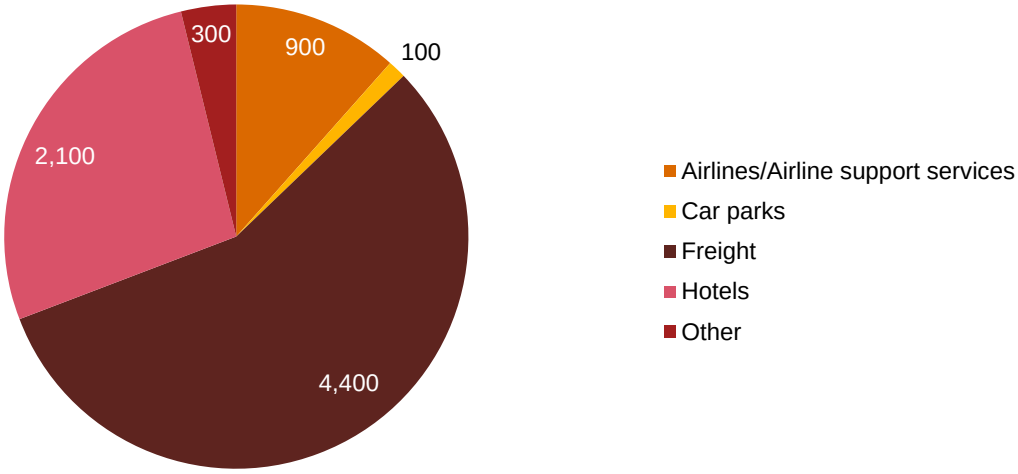


Local area	No. working at Heathrow	% of Heathrow workforce
Hounslow	10,760	14.6
Hillingdon	8,960	12.2
Ealing	5,760	7.8
Slough	4,090	5.6
Spelthorne	3,920	5.3
Local labour area	47,660	45.5
Other areas	25,770	54.5
Total	73,430	100.0

Source: Heathrow Related Employment, Optimal Economics, 2011

Direct off-airport employment was also estimated by the study and divided into the same business sectors as the on-site analysis, but limited to the five local authorities considered in the residency of on-site employment. The results are shown in Figure 39.

Figure 39: Direct off-site employment from LHR (2010)



Source: Heathrow Related Employment, Optimal Economics, 2011

In contrast to on-site employment, direct off-site employment is dominated by freight services (which contributes 57% of the jobs). This is because freight companies tend to be based outside the perimeter of the airport but close enough to make the transport of goods to and from the airport convenient. The total contribution to GVA of Heathrow's off-site businesses is estimated as £0.3 billion.

Indirect employment at Heathrow (i.e. employment resulting from the purchases of goods and services by the companies that provide direct employment) was estimated using a survey of companies in early 2011 and applied to the local, regional and national economy. The results can be seen in Figure 40.

Figure 40: Indirect employment as a result of Heathrow (2010)

Source: Heathrow Related Employment, Optimal Economics, 2011

The study estimates the induced employment supported by the local expenditure of those whose jobs depend both directly and indirectly on the operation of Heathrow by adopting a multiplier and applying this to the figures obtained from direct and indirect analysis. The (assumed) multipliers depend on the size and structure of the economy being considered and multipliers of 1.2, 1.3 and 1.6 were chosen for induced employment on the local, regional and national economies respectively. The resulting employment estimates can be seen in Figure 41.

Figure 41: Induced employment as a result of Heathrow (2010)

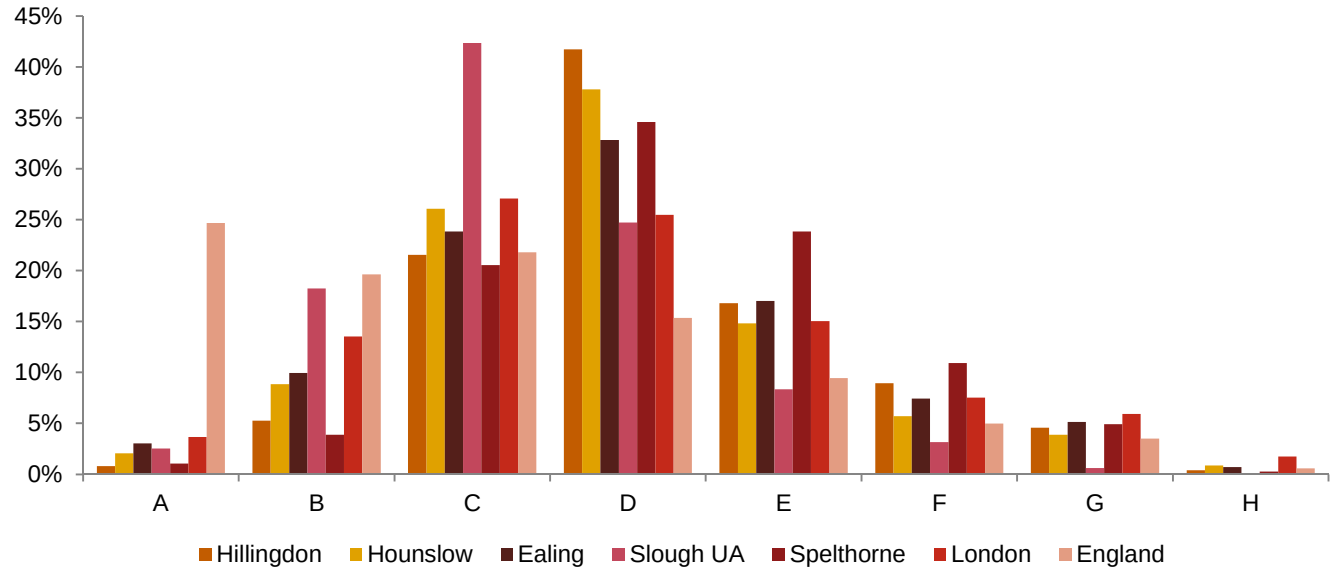
Source: Heathrow Related Employment, Optimal Economics, 2011

A.6. *Housing*

Analysis of ONS data was undertaken for the London Borough of Hillingdon, in which Heathrow is located. There are 105,089 dwellings in the Borough, the majority of which are in private ownership (82.5%), similar to the English average (82.1%).

Figure 42 shows the percentage of dwellings in the five local authorities closest to Heathrow Airport (Hillingdon, Hounslow, Ealing, Spelthorne & Slough), London and England within each Council Tax band[31]:

Figure 42: % of dwellings by Council Tax band (2011)



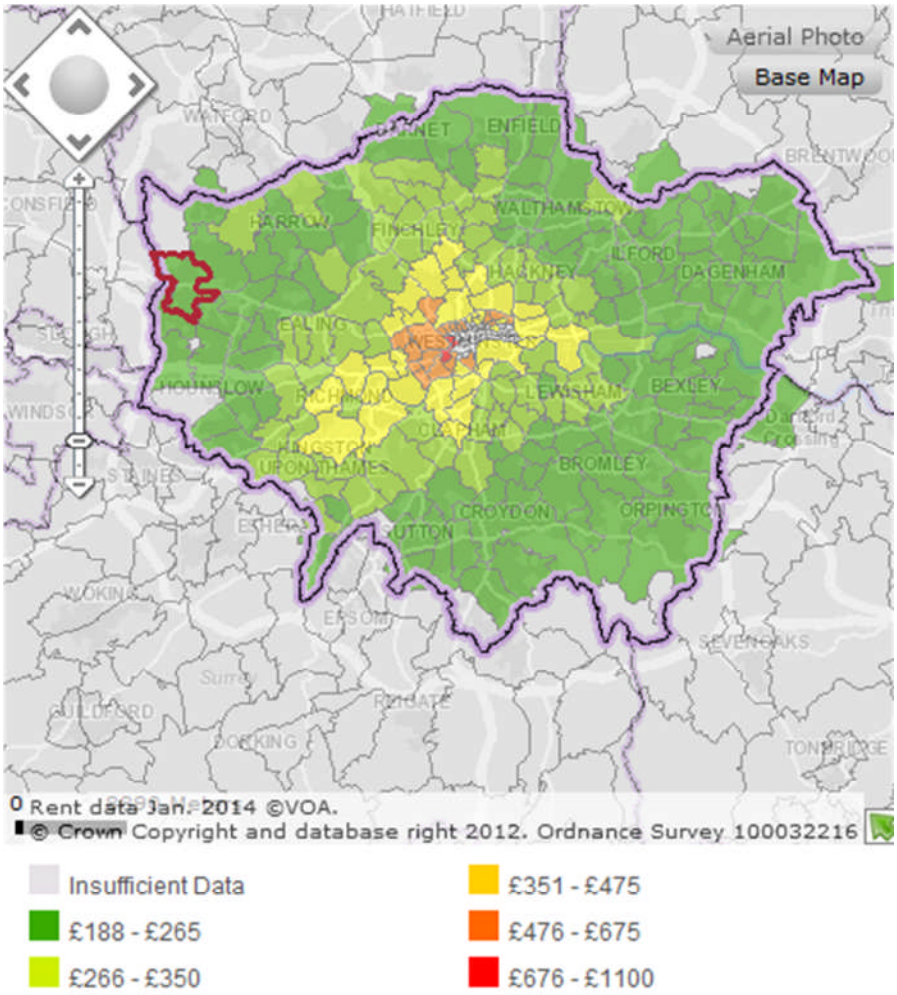
Source: ONS[32]

Rental values in the Borough are 28% lower than the Greater London median (based on a sample of 321 two bed properties in the Borough and 16,402 in the region). These data were derived from the London Rents Map, which shows average private sector rents for different types of homes, and is based on a sample of Valuation Office Agency data covering the last 12 months. Figure 43 highlights the inverse relationship between rental values and distance from central London. Hillingdon Borough is delineated in red.

[31] Council Tax Bandings (based on 1991 valuations): Band A - up to £40,000; B - £40,001 to £52,000; C - £52,001 to £68,000; D - £68,001 to £88,000; E - £88,001 to £120,000; F - £120,001 to £160,000; G - £160,001 to £320,000; and H - £320,001 and above.

[32] http://www.neighbourhood.statistics.gov.uk/dissemination/LeadKeyFigures.do?a=7&b=6275131&c=hillingdon&d=13&e=7&g=6329305&i=1001x1003x1004&m=0&r=1&s=1399399207893&enc=1

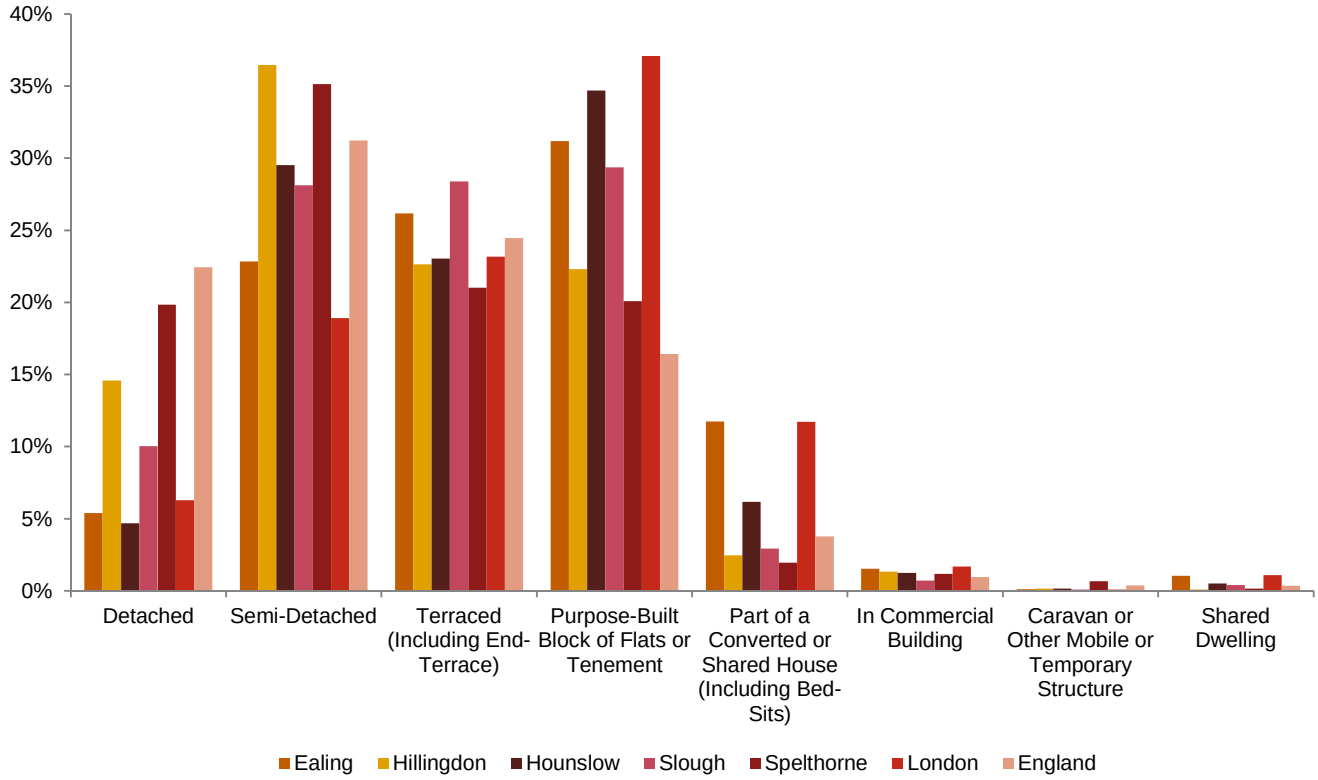
Figure 43: Greater London rental map for 2 bed properties (2014)



Source: http://www.london.gov.uk/rents/

The dominant types of housing clustered around Heathrow are semi-detached (36%) and terraced (23%) houses. At 22%, the proportion of apartments in Hillingdon is much lower than London as a whole (37%).

Figure 44: Housing - %of unshared dwellings (2011)



Source: ONS, 2011[33]

[33] http://www.neighbourhood.statistics.gov.uk/dissemination/LeadTableView.do?a=7&b=6275131&c=hillingdon&d=13&e=7&g=6329305&i=1001x1003x1004&m=0&r=1&s=1399444048370&enc=1&dsFamilyId=2570

Appendix B. - *London Gatwick*

B.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to London Gatwick. We provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing.

B.2. *Background*

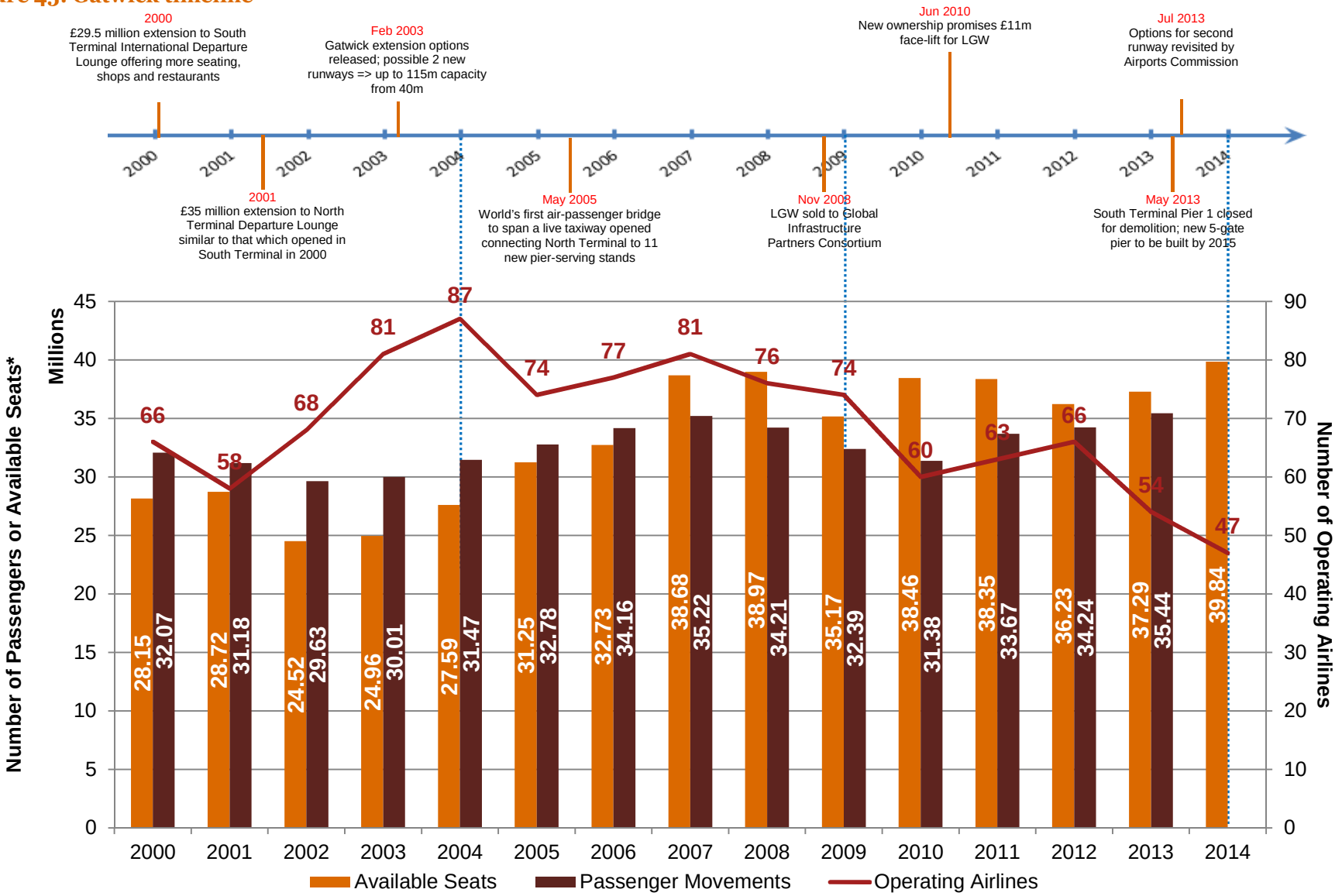
The number of available seats at Gatwick Airport has fluctuated despite the lack of any significant infrastructure developments over the last fifteen years, as shown by the red bars in Figure 45; only in recent years has Gatwick begun to experience capacity constraints. The largest effects have been the result of industry wide changes (i.e. the global financial crisis of 2008 along with the Open Skies agreement between the UK and the USA in the same year halted Gatwick's earlier growth, although there has been a marked shift to low cost carriers). Before the Open Skies Agreement airlines were restricted in where they could operate their transatlantic flights, but the agreement removed these restrictions, allowing more carriers to operate from Heathrow. As a result, a lot of airlines opted to leave Gatwick (also evident in 'Operating Airlines' line graph in Figure 40) and hence reduce the number of seats available on flights to/from LGW.

Major events at LGW are highlighted in the timeline below; investments in recent years have focused on improving facilities rather than building to accommodate additional capacity. Gatwick is currently the world's largest single-runway airport in terms of passenger numbers. The scope for expanding capacity depends on the development of a new runway; increasing the terminal capacity cannot be justified if the runway capacity (number of flights) cannot be increased to utilise it.

Passenger movements at Gatwick have fluctuated almost periodically over time (pink bars in Figure 40) and reached an all-time high in 2013 with 35.4 million passengers served. It is likely that available seats data provided in Figure 45 may be less than passengers served because the data source does not include charter flights which were common at Gatwick in the early 2000s, before low-cost carriers (LCCs) began to dominate the aviation industry.

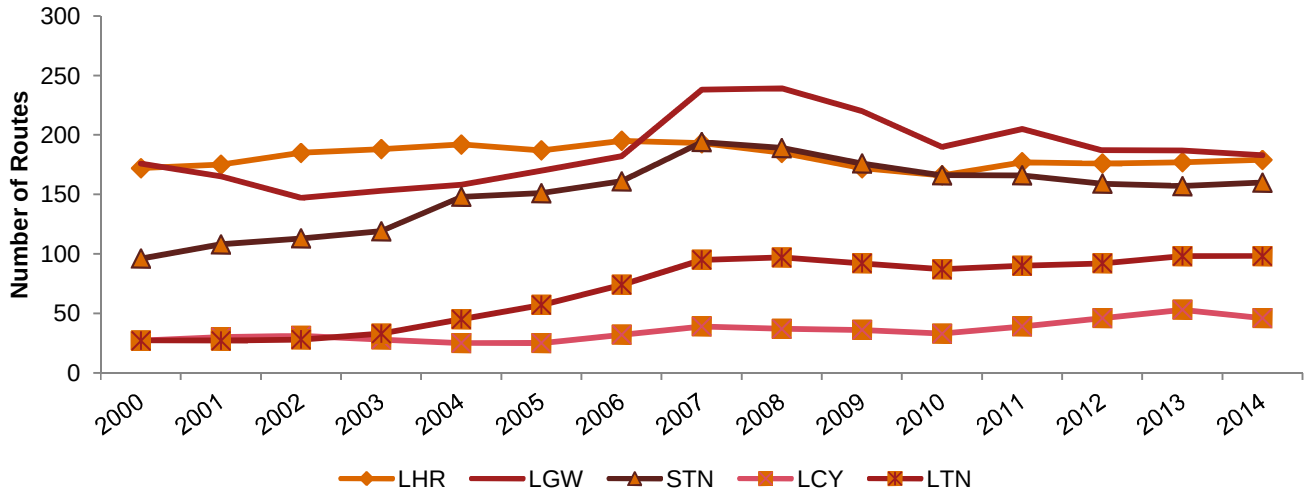
Despite handling considerably fewer passengers than Heathrow (circa 50%), Gatwick currently offers more routes than all other London airports (see Figure 46). Since 2007 Gatwick has served more destinations than Heathrow, although more recently LHR has closed the gap. This lead in destinations served is partly because of the Open Skies Agreement which led to Gatwick introducing more short-haul flights as longer haul flights moved to Heathrow.

Figure 45: Gatwick timeline



NOTE: Available seats (using SABRE data) does not include charter flights, hence passenger numbers appear to be greater than the number of available seats pre-2007, before the rise of low-cost carriers,
*Available departing seats multiplied by 2
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

Figure 46: Number of routes available at London airports (2000-2014)



Source: SABRE Airport Data Intelligence

B.3. *Labour demand*

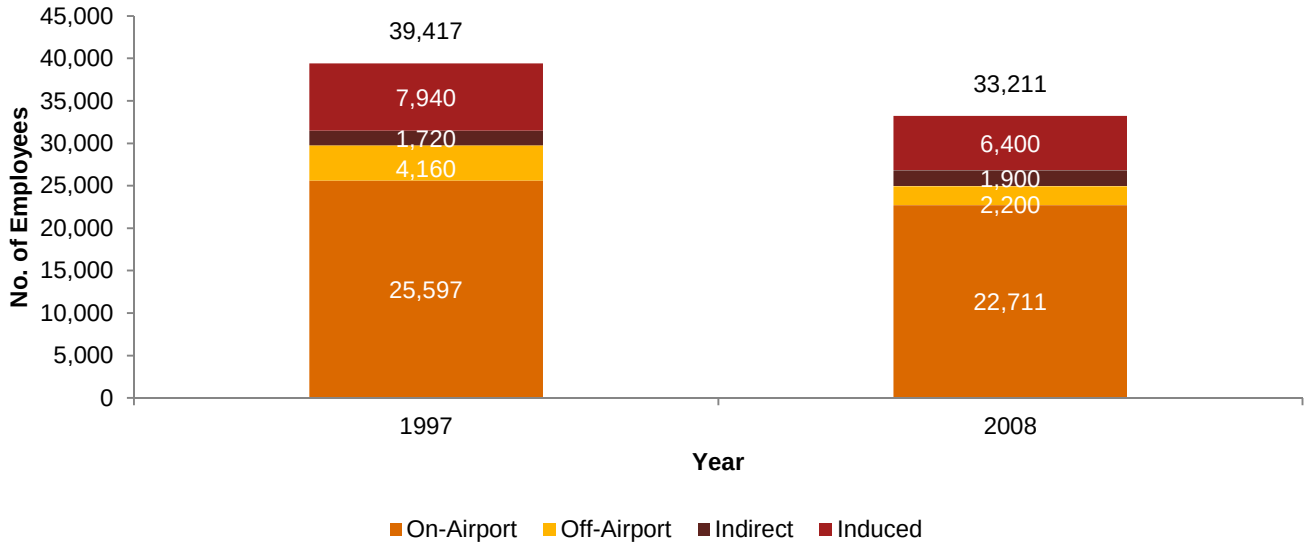
A study of employment linked to Gatwick airport by Berkeley Hanover Consulting Limited34 (BHC) in 2011 estimated that over 33,000 jobs were supported by the airport's operations (based on 2009 statistics) (see Figure 47). These jobs constitute those directly dependent on Gatwick (both on- and off-site), indirect jobs that result from businesses that supply goods and services to the airport and induced employment that comes from spending by employees in both categories in the local area35.

Between 1997 and 2008, the ratio of indirect to direct jobs at Gatwick airport fell from 54 off airport jobs for every 100 on-site jobs in 1997 to 46 off-airport jobs in 2008. The BHC explains this change in terms of the rapid development of LCCs at Gatwick which is seen as having adversely affected local hotels, cargo companies, caterers and car parking services. The report also argues that LCCs "tend to offer lower wages to their staff and negotiate tougher terms with support facilities than the national carriers" which may also have reduced the impact on value added.

34 BHC (2011), Gatwick Airport Employment Generation to 2020 in the Context of the Local Labour Market

35 Note that the BHC study only considers local effects whereas the Optimal Economics report referenced in the Heathrow case study also looks at the wider effect on London and the UK.

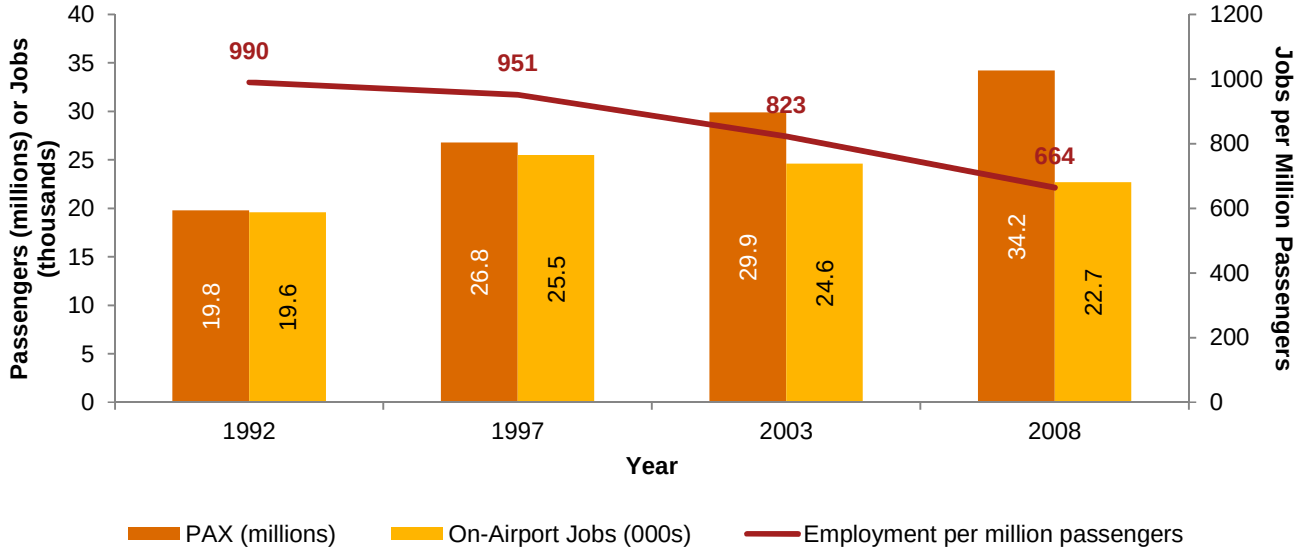
Figure 47: Estimated Gatwick related employment (1997 and 2008)



Source: BHC

Figure 48 shows the number of passengers served (in millions), the number of on-airport jobs (in thousands) and the ratio between the two for the years 1992, 1997, 2003 and 2008. This ratio, the number of employees per million passengers, can be compared with the average for European airports as a whole in 2003 of 950 on-site jobs per million passengers[36].

Figure 48: Employment at London Gatwick (1992-2008)



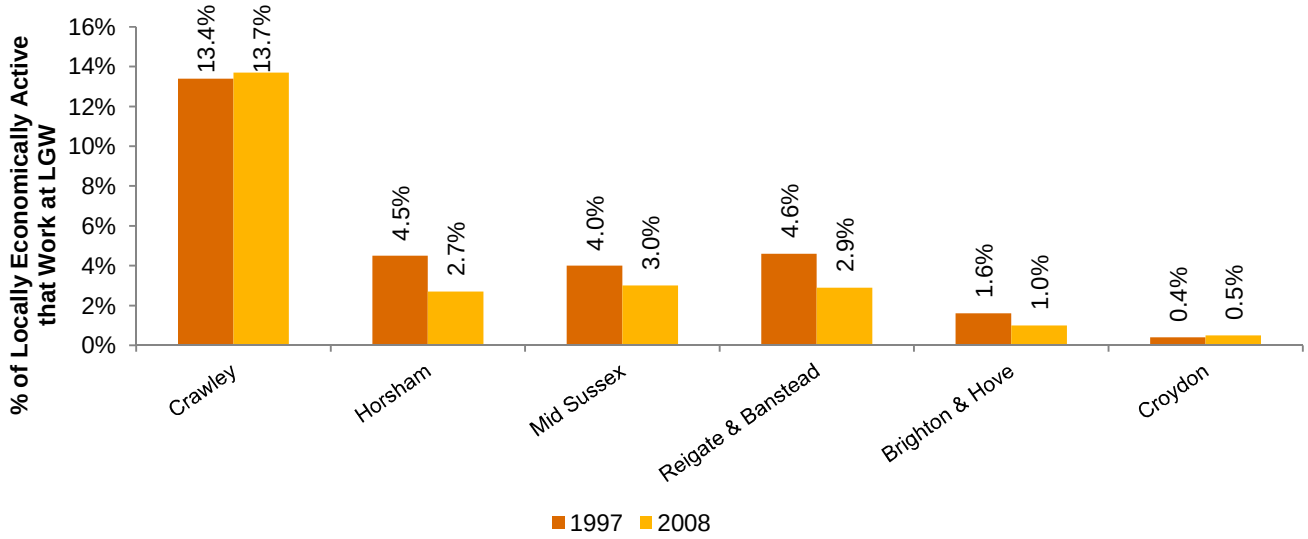
Source: BHC

[36] The Social and Economic Impact of Airports in Europe, York Aviation, 2004

B.4. *Labour supply*

One measure of how far the local economy depends on an airport is the analysis of the percentage of locally economically active persons that are employed there. Figure 49 highlights that the local borough of Crawley is highly dependent on Gatwick in terms of employment: 13.7% of working people in the area worked at the airport in 2008, a small increase from 13.4% in 1997. Crawley is the only local authority that has maintained its dependence on LGW over the 11-year period between surveys.

Figure 49: % of locally economically active persons that work at LGW by local authority (2009)



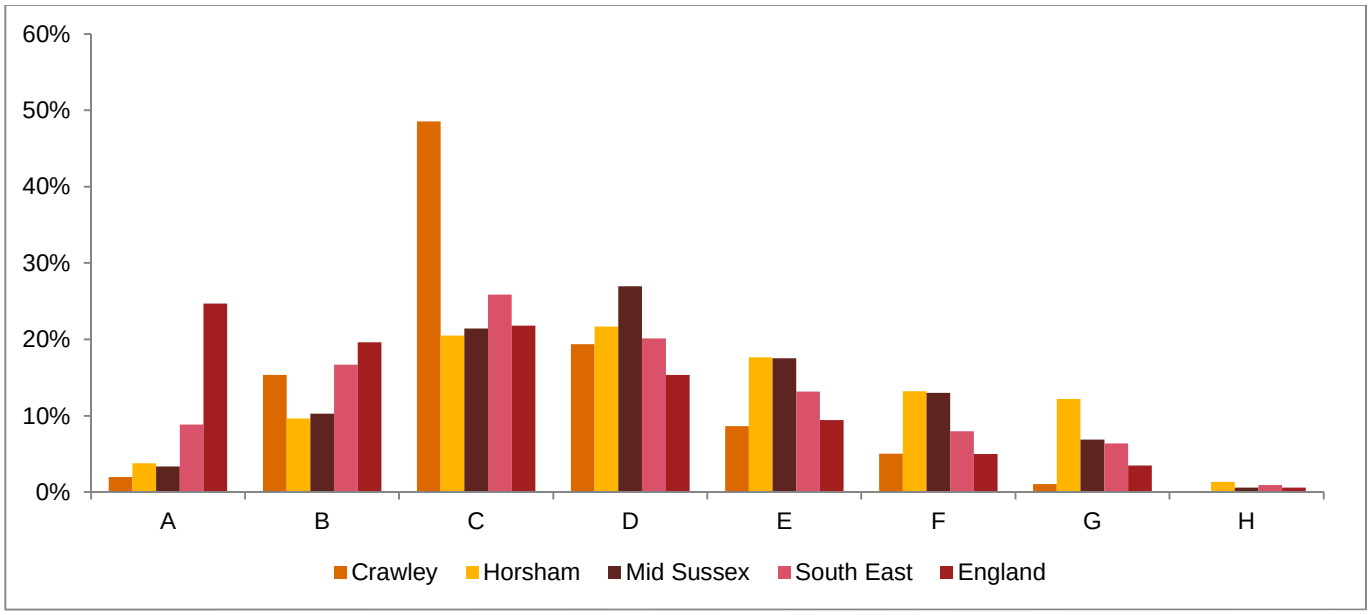
Source: BHC

B.5. *Housing*

Figure 50 highlights the proportion of dwellings in Crawley, Horsham and Mid Sussex, the South East and England that are within each Council Tax band[37].

[37] Council Tax Bandings (based on 1991 valuations): Band A - up to £40,000; B - £40,001 to £52,000; C - £52,001 to £68,000; D - £68,001 to £88,000; E - £88,001 to £120,000; F - £120,001 to £160,000; G - £160,001 to £320,000; and H - £320,001 and above.

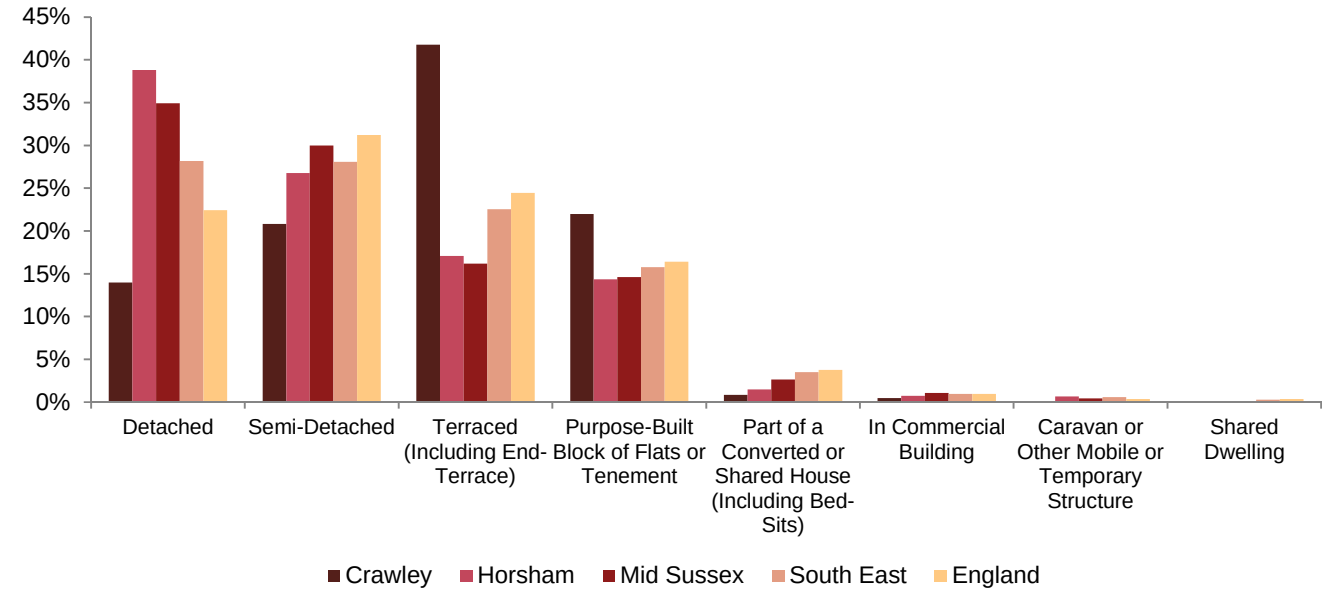
Figure 50: % of dwellings by Council Tax band (2011)



Source: ONS[38]

In terms of the housing supply around Gatwick, Figure 51 highlights that the dominant house type is terraced houses or bungalows (42% compared to the 23% in the South East and 26% in England). The proportion of purpose built apartments is also higher than average across England at 22%.

Figure 51: Housing - % of unshared dwellings (2011)



Source: ONS

[38] http://www.neighbourhood.statistics.gov.uk

Appendix C. - *Manchester*

C.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to Manchester airport. First, we provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local impact on business and services and employment.

C.2. *Background*

Manchester Airport is the third largest airport in the United Kingdom in terms of passenger numbers, serving over 20 million passengers in 201339.

The timeline in Figure 52 highlights the major infrastructure developments at Manchester Airport in the last 15 years, as well as trends in passenger movements, available seats, operating airlines and available routes. It suggests that passenger numbers and movements increased following the opening of Manchester Airport's second runway in March 2001. Subsequently, in line with the global trend, passenger numbers at Manchester Airport declined following the financial crisis in 2008; however, the data suggest signs of recovery. In 2013 Manchester served over 20 million passengers for the first time since 2008.

C.3. *Employment and value added*

York Aviation assessed the economic impact of Manchester Airport in 2008 focusing on two main metrics: the number of employees in terms of full-time equivalents (FTEs) and gross value added (GVA). Like other reports reviewed in these case studies, the impacts are split into direct on-airport, direct off-airport, indirect and induced. The estimates are shown in Table 18.

Table 18: Total employment and GVA as a result of Manchester Airport in 2007[40]

	Greater Manchester	Cheshire	Elsewhere in North West[41]	Total
Employment (FTEs)				
Direct on-airport	16,520	-	-	16,520
Direct off-airport	2,110	700	-	2,810
Indirect	10,150	2,310	460	12,920
Induced	7,100	1,620	320	9,040
Total employment	35,880	4,630	780	41,290
GVA (£ million)				
Direct on-airport	320	73	15	408
Direct off-airport	54	12	2	69
Indirect	243	55	11	310
Induced	170	39	8	217
Total GVA	788	179	36	1,004

Source: Economic Impact of MAG Airports: Update Report, York Aviation, 2008[42]

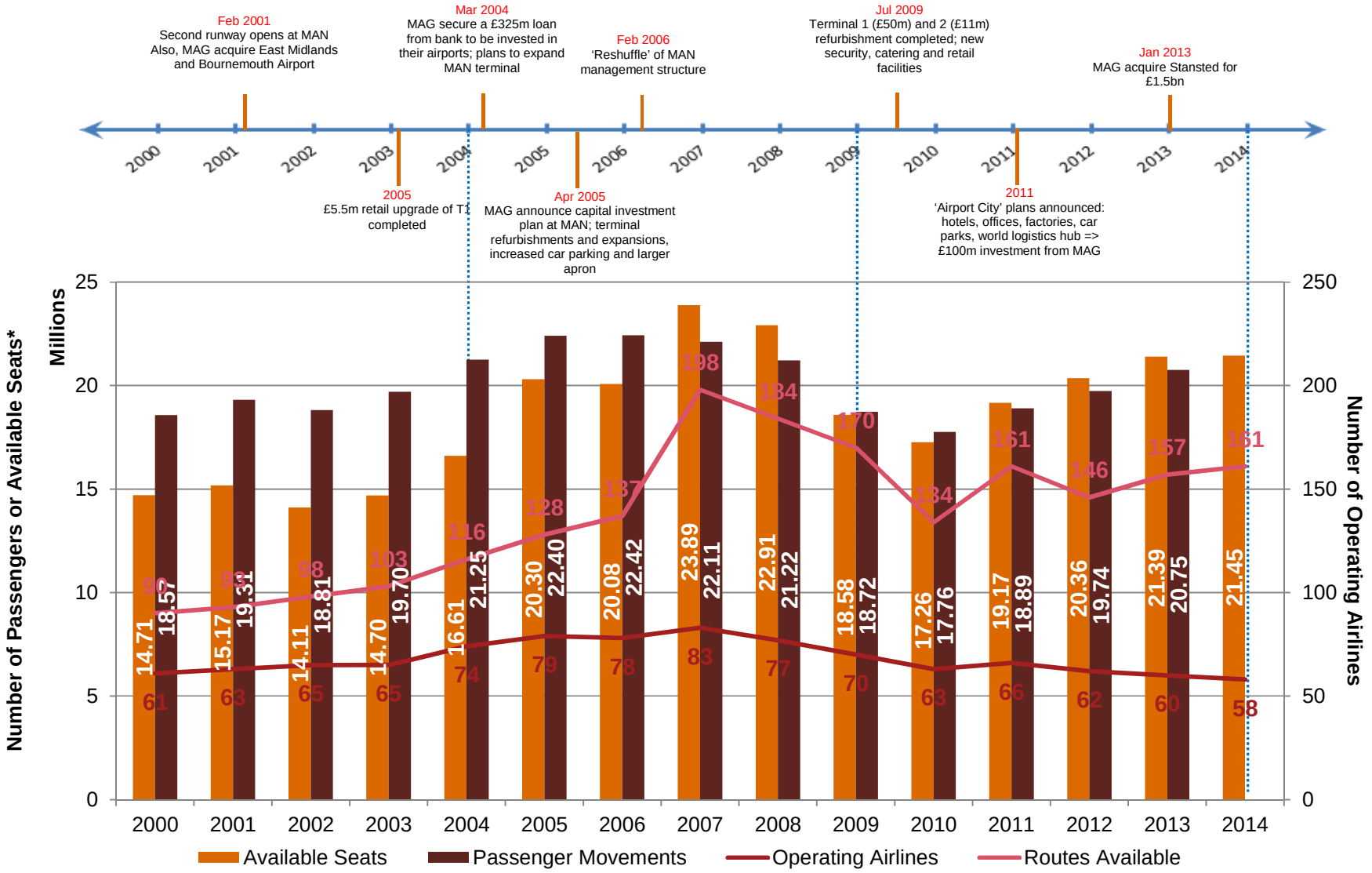
[39] CAA Statistics http://www.caa.co.uk/docs/80/airport_data/2013Annual/Table_10_3_Terminal_Pax_2003_2013.pdf

[40] Employment figures are rounded to the nearest 10 and GVA is rounded to the nearest £1 million

[41] The York Aviation report estimates direct GVA elsewhere in the North West despite there being no direct employment.

[42] York Aviation (2008), Economic Impact of MAG Airports: Update Report http://www.manchester.gov.uk/download/downloads/id/15427/economic_impact_of_the_mag_airports_update_report

Figure 52: Manchester Airport timeline



NOTE: Available seats (SABRE) does not count for charter flights, hence why pre-2007, before the rise of low-cost carriers, passenger numbers appear to be greater than the number of available seats

*Available departing seats multiplied by 2

Sources: Available seats, operating airlines and routes available obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

The focus is on the impacts in the surrounding area (i.e. Greater Manchester, Cheshire and the rest of the North West), rather than the national level. The estimates are based on the results of a survey at Manchester Airport in 2005/06 which have then been extrapolated to provide the results shown above by assuming that:

- Productivity growth on-site is 1.8% per annum (the historical growth rate between 1997 and 2005, and the lower band of growth found at large European airports43); and
- A growth rate of 2% per annum for the economy in the North West of England based on Cambridge Econometrics' regional forecasts from the time.

In 2007, services and employment at Manchester Airport were at their peak. The available seats and routes supported over 41,000 jobs and contributed over £1 billion in GVA to the regional economy in the North West (see Table 18). York Aviation also forecast Manchester Airport's future impact on the economy based on the 'high' and 'low' growth passenger forecasts taken from its Master Plan[44]. These forecasts were generated before the financial crisis and assume a consistent growth rate: in the 'high' growth case, 38 million passengers are estimated by 2015 compared with 17 million in 2013. The passenger forecasts were then used to project the economic impact of Manchester Airport in 2015 and subsequently 2030. The forecast employment (in FTEs) is shown in Figure 53 and the corresponding GVA in Figure 54.

[43] ACI Europe and York Aviation (2004), The Social and Economic Impact of Airports in Europe https://www.ryanair.com/doc/news/2012/ACI-Report.pdf

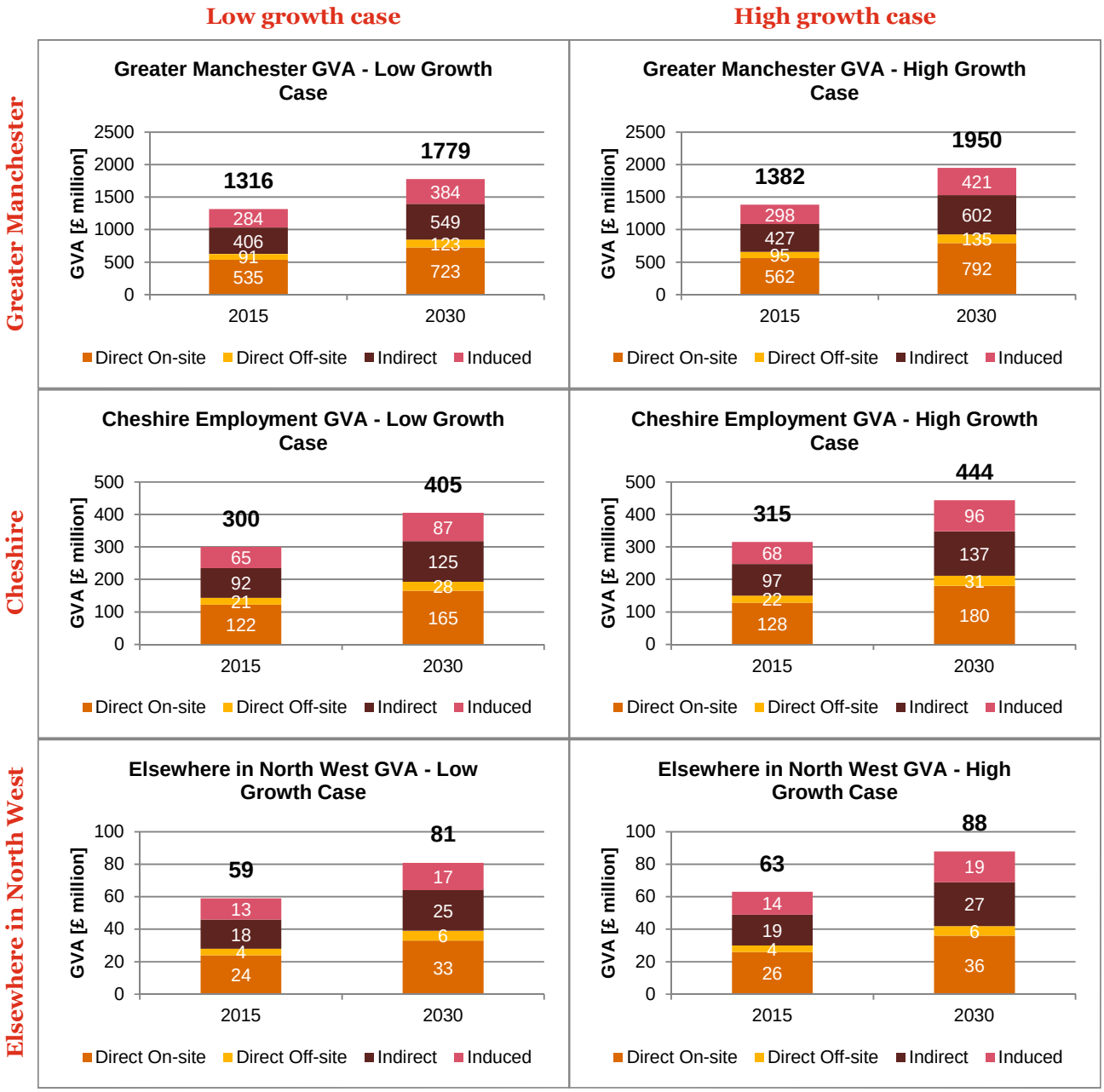
[44] Manchester Airport Master Plan http://www.manchesterairport.co.uk/manweb.nsf/alldocs/10F56C819A51454E8025739300388C1D/$File/Masterplan.pdf

Figure 53: Employment forecasts for Manchester Airport (2015 and 2030)

Source: Economic Impact of MAG Airports: Update Report, York Aviation, 2008

The forecasts continue the trend seen in the 2007 estimates. The effect of the Airport diminishes with distance from the airport. The ratios between direct, indirect and induced employment are consistent across the different areas. Perhaps the most significant result is the difference between the low and high growth cases; high growth is predicted to contribute 4,350, 540 and 100 more jobs in Greater Manchester, Cheshire and the North West respectively by 2030 than the low growth case. Comparing the GVA forecasts individually in Figure 54 shows similar trends and ratios to those seen in Figure 53. Once again, the comparisons between the low and high growth scenarios show significant differences in the impact on GVA.

Figure 54: GVA forecasts for Manchester Airport (2015 and 2030)[45]



Source: Economic Impact of MAG Airports: Update Report, York Aviation, 2008

[45] Forecasts are based on low-growth (left hand plots) and high-growth (right hand plots) by direct, indirect and induced full-time equivalents in the Greater Manchester, Cheshire and North West regions

Appendix D. - *New York*

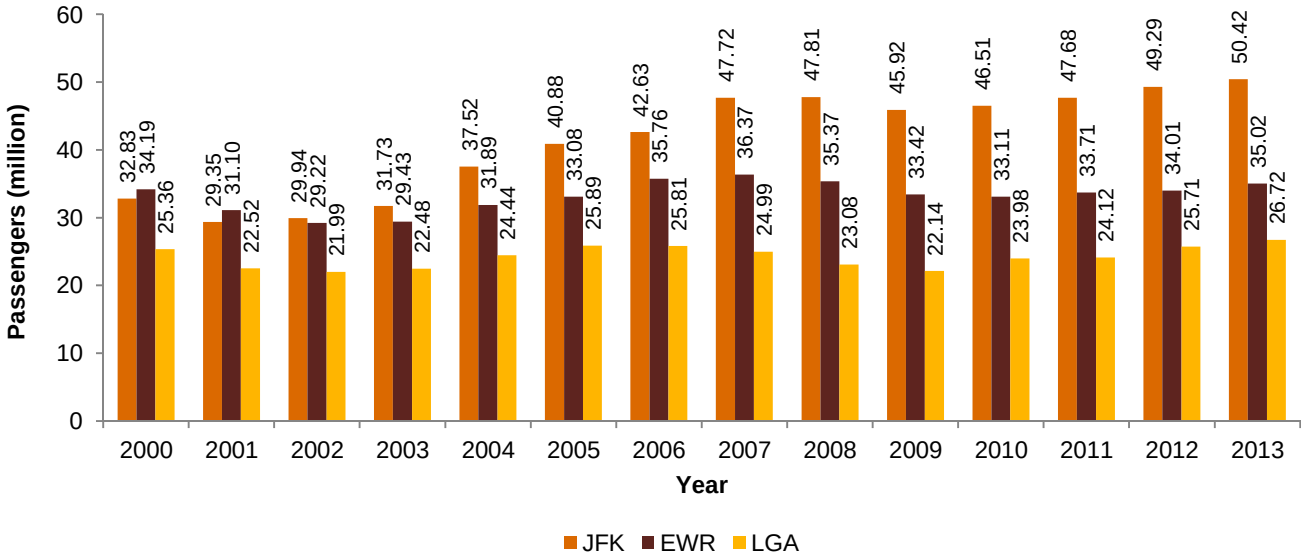
D.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to the New York airport system. We start by providing background information about the development of the airport system since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing.

D.2. *Background*

New York has one of the world's premier transport systems with two of the world's 50 busiest airports in terms of passenger traffic. Taken together, the three main commercial airports in the region served over 112 million passengers in 2013. Figure 50 shows the historical passenger numbers at John F. Kennedy Airport (JFK), Newark Liberty International Airport (EWR) and LaGuardia Airport (LGA). JFK has grown to dominate in terms of passengers served, despite EWR having served more annual passengers prior to 2002.

Figure 55: Passenger traffic at major airports in New York (2000-2013)



Source: Port Authority of New York and New Jersey[46]

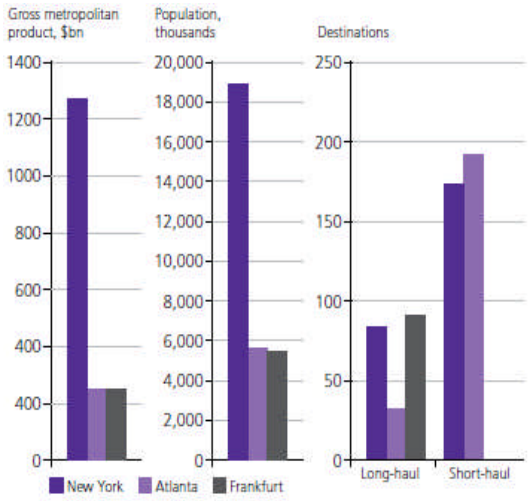
LaGuardia Airport mainly serves domestic flights, allowing JFK and Newark to operate international and long-haul routes. This approach was devised to allow New York to become a connection point across the Atlantic.

A lot of discussion relating to airport development in London uses New York as an example of how a major city can have more than one large airport; however, the main difference between London and New York is that New York has three national network airlines – Delta and American Airlines are based in JFK and United Airlines operates from Newark – whereas London only has one, British Airways. For this reason, aviation in New York is able to function under a two-hub system and why it may be more difficult for London to do the same. A report by Heathrow Airport Limited in 2012, 'One hub or none: The case for a single UK hub airport', suggests that New York's two large hub airports result in poorer connectivity than one would expect (see Box). Despite New

[46] www.panynj.gov

York being four times the size of Atlanta and Frankfurt, it has direct access to fewer short haul flights than Atlanta and fewer long haul flights than Frankfurt.[47]

Box 7: Comparison of connections at New York, Atlanta and Frankfurt



Source: One hub or none: The case for a single UK hub airport, Heathrow Airport Limited, 2012

Many of the airports controlled by the Port Authority of New York and New Jersey (PANYNJ) make the management and maintenance of their terminals the responsibility of the main airlines which operate from them. For example, Terminal 2 at JFK is exclusively used and operated by Delta Airlines which also operates from Terminal 4. Delta has a $1.4 billion development plan for Terminal 4, despite the fact that it also used by other international airlines including Singapore Airlines, Emirates, Etihad and KLM. Terminals 5, 7 and 8 at JFK are operated by JetBlue, British Airways and American Airlines respectively. Similarly, at Newark, Terminals A and C are operated by United Airlines and at LaGuardia Terminals C, D and most of A are under the control of Delta Airlines. This type of airport operating model results in ongoing infrastructure developments at these airports, and JFK in particular. Having separate terminals maintained and managed by different airlines encourages airlines to compete with each other to provide the best passenger experience. As a result, construction is continuous at the PANYNJ airports, as can be seen from the timeline for the three airports (see Figure 57). In the figure, available seats on flights and the number of operating airlines have been plotted in sequence with the timeline to see how these indicators were affected by infrastructure developments; note how at the turn of the century JFK utilised 10 terminals and now only operates 6, despite an increase in the scale of operations. This is a result of large expansions and developments of the terminals over the years and the desire to expand even further by demolishing old terminals to make way for newer, modern facilities.

All three New York airports suffered a substantial impact to their operations following the 9/11 attacks in 2001, with significant decrease in available seats and operating airlines. Whilst Newark and LaGuardia have yet to return to the same level of operations that they experienced prior to the attacks (although they have surpassed the annual passenger figures), JFK has gained. It is now the busiest airport in PANYNJ's portfolio. One between JFK and the other two airports is the volume of developments that has taken place; since 2003, a new phase in development or part of an expansion has opened at JFK almost every year. This emphasises the airports plan for growth and ultimately allows room for that growth to occur. Another difference is that JFK serves three times as many airlines as LaGuardia and twice as many as Newark.

D.3. *Economic impact*

These large scale operations of the three airports have a major contribution to the local economy of the New York and New Jersey area. This is summarised in Table 19.

[47] Heathrow Airport Limited (2012), One hub or none: The case for a single UK hub airport http://mediacentre.heathrowairport.com/ImageLibrary/downloadmedia.ashx?MediaDetailsID=1105&SizeId=-1

A study of the economic effects of aviation in New York was carried out by PANYNJ in 2005. Its findings are summarised in terms of the jobs, wages and sales that were supported by operations at the airports, investments in the airports and tourism that resulted from people visiting the area via the airports. Whilst jobs are equivalent to employment as an impact metric (and thus similar to the other case studies), wages represent only a component of GVA and sales do not take into account the cost of sales (and thus will overstate the value added by the airports).

Table 19 incorporates all three of the PANYNJ case study airports together. Operations and tourism have the biggest economic impact on the region, but investments are the focus of the study. Table 20 shows the breakdown of the investment figures by airport both directly and as a whole. These demonstrate that together the three airports contribute nearly half a million jobs to the local economic area; this is substantially larger than comparative studies for other airports. This primarily occurs because the study covers an entire airport system, rather than an individual airport, and therefore captures the impact of a larger number of passengers (94 mppa) and cargo. In addition, the study area considered is very large, with a resident population of 19.7 million people. As discussed in Chapter 3, this will limit the amount of leakage from the local economy studied, and therefore increase the magnitude of the indirect and induced multipliers.

Table 19: Economic impact of aviation in New York City in terms of operations, investments and tourism from JFK, EWR and LGA (2004)

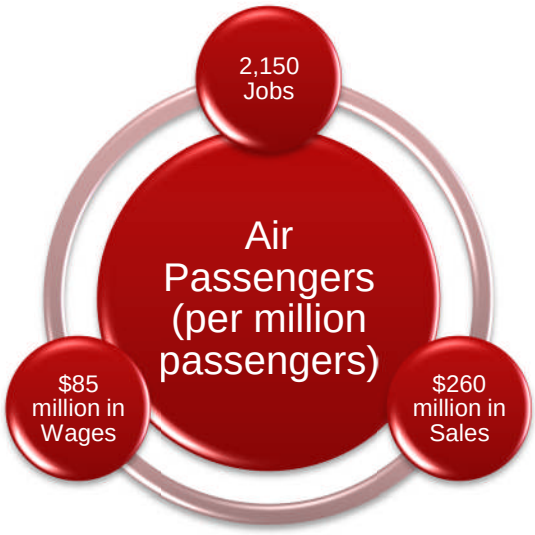
Impact	Operations	Investments	Tourism	Total
Jobs	278,890	14,500	192,280	485,670
Wages ($ billion)	13.1	0.724	6.6	20.5
Sales ($ billion)	37.1	2.4	17.6	57

Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005[48]

PANYNJ has analysed the economic impacts of the airports relative to the number of air passengers (per million) as shown in .

Figure 56.

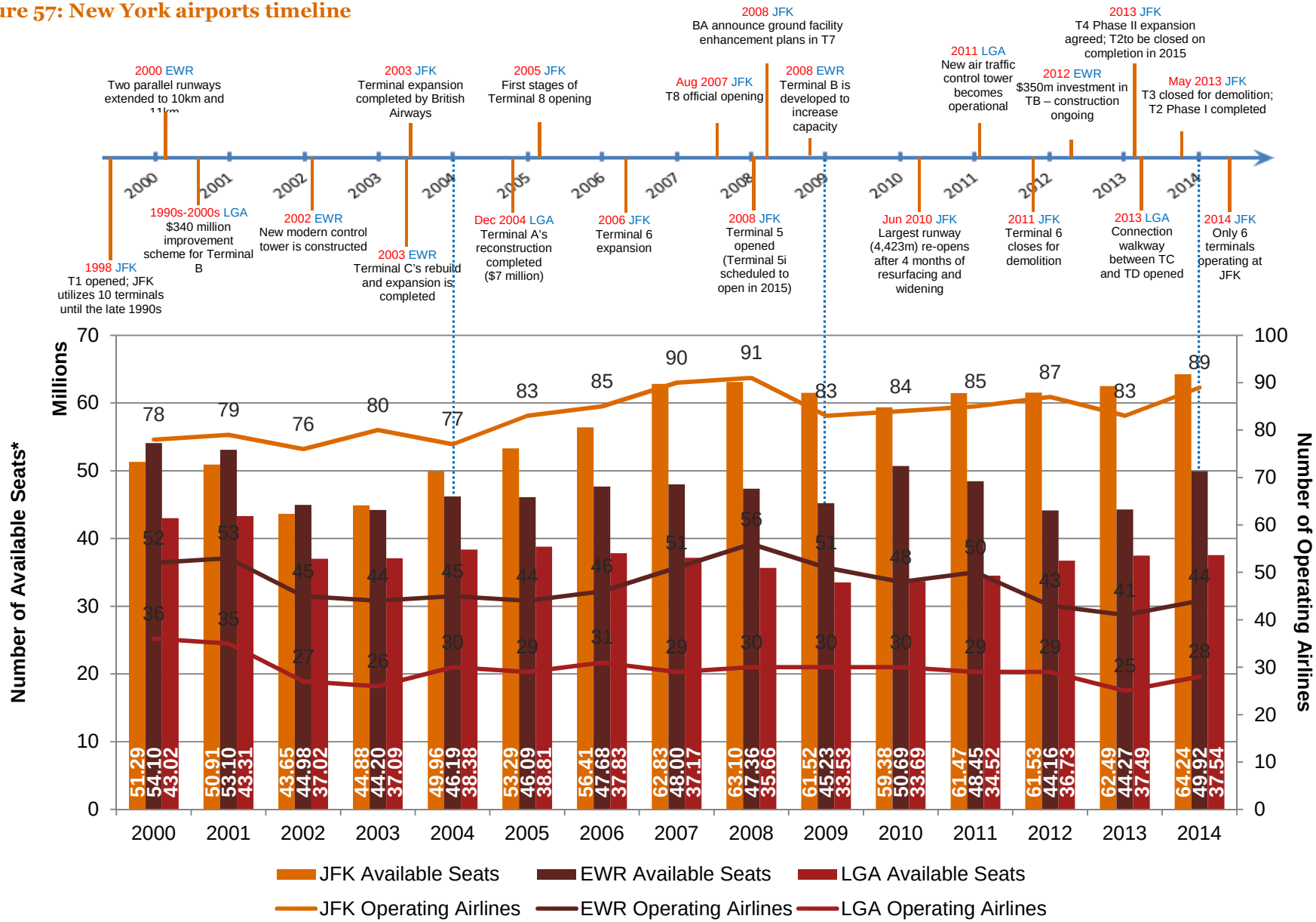
Figure 56: Economic impact per million passengers (connecting and non-connecting) (2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

[48]PANYNJ (2005), The Economic Impact of the Aviation Industry in the New York – New Jersey Metropolitan Region http://www.panynj.gov/about/pdf/reg-in-aviation-economic-impact.pdf

Figure 57: New York airports timeline



*Available departing seats multiplied by 2
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence

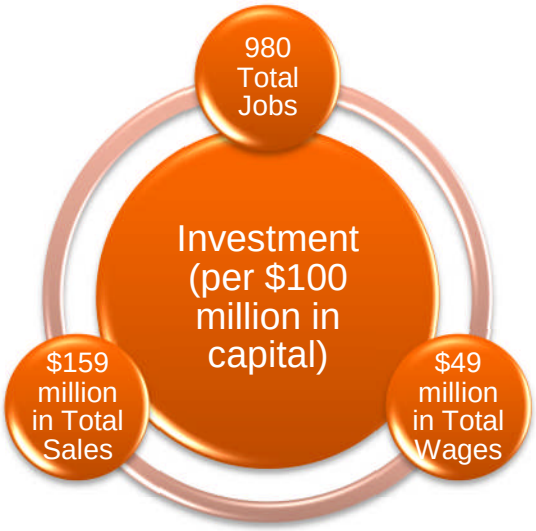
Table 20: Direct and total economic impact of all investments in airport infrastructure regionally in New York (2000-2004)

	EWR	JFK	LGA	Total
Direct impact				
Jobs	1,920	3,650	260	5,830
Wages ($ million)	108	213	14	335
Sales ($ million)	499	914	69	1,482
		Total impact		
Jobs	4,850	8,970	680	14,500
Wages ($ million)	240	451	33	724
Sales ($ million)	803	1,435	114	2,352

Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

As a result of ongoing infrastructure investment, JFK had a much larger economic effect than EWR and LGA; EWR contributed over 50% of the jobs, wages and sales that JFK supported between 2000 and 2004, and LGA contributed circa 7%. The study expressed the impact of each $100 million of capital investment (see Figure 58).

Figure 58: Economic impact per $100 million in capital spending (2000-2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

If this ratio has been maintained, this would imply that the $1.4 billion expansion programme for Terminal 4 at JFK (the first phase of which was completed in May 2013) will support 13,720 jobs, $0.7 billion in wages and over $2.2 billion in sales. It is evident that large infrastructure projects such as these have the potential for a significant impact on the local economy. This is before the developments are completed and the impacts of their operations are included. As Table 19 illustrates, these were many times larger between 2000 and 2004.

Table 21 provides a breakdown of the direct economic impact of EWR, JFK and LGA across different business sectors in 2004. It splits them into on-airport and off-airport impacts. On-airport operations have a larger impact. JFK contributes half of the combined impacts of the three airports (i.e. JFK alone supports roughly the same number of jobs and the same wages and sales as EWR and LGA combined).

Table 21: Direct impact of the aviation industry by airport by employment category (2004)

Impact	EWR			JFK			LGA		
	Jobs	Wages ($m)	Sales ($m)	Jobs	Wages ($m)	Sales ($m)	Jobs	Wages ($m)	Sales ($m)
On-airport									
Airlines	15,960	926	3,942	19,140	1,080	4,515	7,410	403	1,644
Tenants & Government	13,850	638	2,080	19,970	924	2,858	5,510	269	863
Sub-total	29,810	$1,564	$6,022	39,110	$2,004	$7,373	12,920	$672	$2,507
Off-airport									
Landside Access	3,710	156	461	4,280	176	513	3,230	131	403
Air Ticket Agencies	3,440	155	260	4,050	183	306	2,640	119	199
Truck Transportation	1,580	68	200	2,710	116	342	50	2	6
Banking & Insurance	580	44	196	740	56	252	360	27	121
Brokerage & Distribution	7,020	430	923	15,580	961	2,091	130	8	15
Airline Marketing & Government	2,000	126	356	2,930	169	416	1,010	64	188
Sub-total	18,330	$979	$2,396	30,290	$1,661	$3,920	7,420	$351	$932
Total	48,140	$2,543	$8,418	69,400	$3,665	$11,293	20,340	$1,023	$3,439
% of Industry	35%	35%	36%	50%	51%	49%	15%	14%	15%

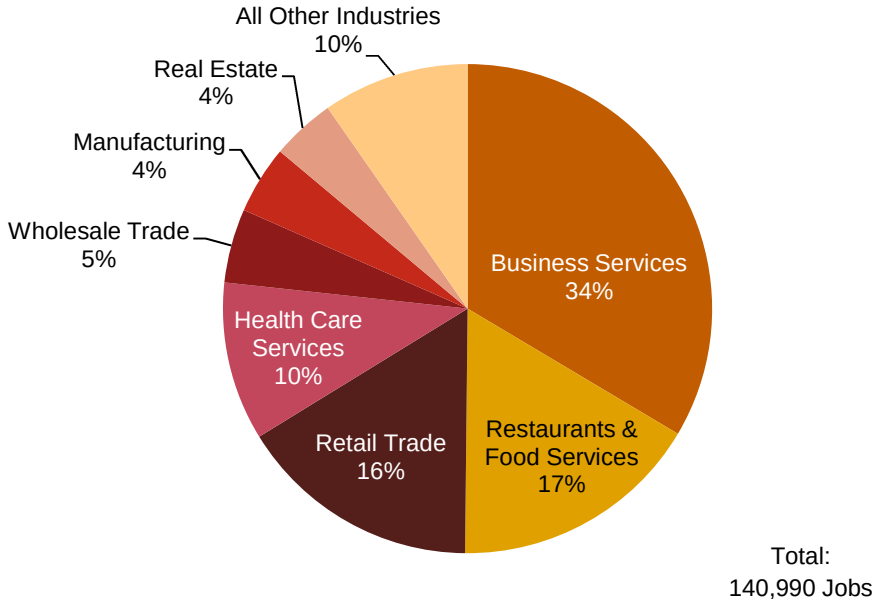
Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

Table 22: Total impact of the aviation industry by employment category (2004)

Impact	Jobs		Wages		Sales	
	Number	%	($m)	%	($m)	%
On-airport						
Airlines	96,360	57%	4,628	59%	14,108	61%
Tenants & Government	72,850	43%	3,174	41%	9,057	39%
Sub-total	169,210		$7,792		$23,165	
Off-airport						
Landside Access	21,930	20%	940	18%	2,640	19%
Air Ticket Agencies	18,280	17%	821	15%	1,721	12%
Truck Transportation	8,860	8%	392	7%	1,114	8%
Banking & Insurance	5,200	5%	302	6%	1,007	7%
Brokerage & Distribution	42,330	39%	2,196	41%	5,661	41%
Airline Marketing & Government	13,080	12%	671	13%	1,788	13%
Sub-total	109,680		$5,322		$13,931	
Total	278,890		$13,114		$37,096	

Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

Figure 59: Indirect jobs resulting from the aviation industry in New York by sector (2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

Figure 59 shows the types of jobs are generated (i.e. the main industries that benefit from aviation in New York) are business services, restaurant & food services and retail trade.

D.4. *Tourism*

Table 23 shows more recent estimates of the direct and indirect economic impacts of JFK and LaGuardia airports. Both sets of estimates are significantly larger than those provided earlier by PANYNJ – in part this is because the PANYNJ estimates do not take into account all off-site employment, for example freight.

Table 23: Economic impact of JFK and LaGuardia airports (2009)

JFK International	Direct	Indirect	Total
Employment	132,610	92,011	224,621
Income ($m)	$6,127	$4,756	$10,883
Output ($m)	$19,344	$10,970	$30,314
State and Local Taxes ($m)			$2,852

LaGuardia	Direct	Indirect	Total
Employment	55,142	39,225	94,367
Income ($m)	$2,200	$2,078	$4,278
Output ($m)	$7,120	$4,625	$11,745
State and Local Taxes ($m)			$1,105

Source: New York State Economic Impacts of Aviation, New York State Department of Transportation, 2010[49]

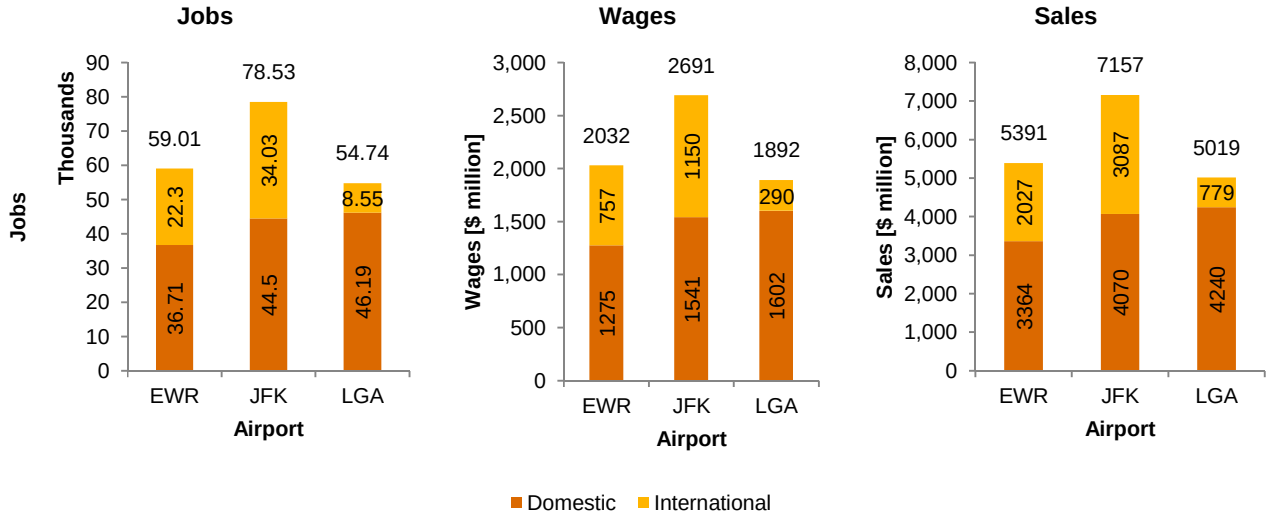
[49] New York State Department of Transportation (2010), New York State Economic Impacts of Aviation https://www.dot.ny.gov/divisions/operating/opdm/aviation/repository/NYS%20Economic%20Study%202010%20Technical%20Report_0.pdf

NOTE: EWR data were unavailable as EWR is in New Jersey

Another key economic impact of the airport system in the New York area is on tourism. Some indication of the economic impacts of tourists visiting New York can be seen in Figure 60. The main points to note are that:

- Domestic visitors add more to the local economy than international visitors at all airports;
- LaGuardia contributes more from domestic passengers than JFK and EWR, despite only providing 15% of the operational impacts (see Table 14); and
- JFK is significantly ahead when it comes to international tourism.

Figure 60: Economic impact of visitors to New York by airport by origin (2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

It is clear that tourism from these airports has an important economic impact, creating over 190,000 jobs between 2000 and 2004 – 13 times that generated from airport investments in the same period – and $6.6 billion and $17.6 billion in wages and sales respectively across the same period.

D.5. *Economic impact of aviation in the USA*

Table 24 shows the economic impact of aviation as a whole in the USA in 2009. Comparing the economic impact of JFK and LGA to the USA as a whole suggests that these two airports contributed 3.3%, 4.1% and 3.4% in total USA jobs, wages and sales from the aviation industry.

Table 24: Estimated output, earnings and jobs attributable to the aviation industry in the USA (2009)

Description	Output ($bn)	Earnings ($bn)	Jobs ('000)
Airline operations	296.6	91.9	2,007
Airport operations	78.9	27.5	614
Civilian aircraft manufacturing	84.3	21.5	418
Civilian aircraft engine and engine parts manufacturing	20.9	5.6	112
Civilian other aircraft parts and equipment	72.2	21.5	454
Air couriers	72	21.5	637
Visitor expenditures	597	178.8	5,329
Travel arrangements	12.8	4	118
Sub-total – Commercial	1,234.8	372.2	9,690
General aviation operations	38.8	12	262
General aviation aircraft manufacturing	25.8	6.6	128

Description	Output ($bn)	Earnings ($bn)	Jobs ('000)
General aviation visitor expenditures	11.9	3.6	106
Sub-total – General Aviation	*76.5*	*22.1*	*496*
Total impact	1,311.2	394.4	10,186

Source: The Economic Impact of Civil Aviation on the U.S. Economy, U.S. Department of Transportation, Federal Aviation Administration, 2011[50]

[50] U.S. Department of Transportation, Federal Aviation Administration (2011), The Economic Impact of Civil Aviation on the U.S. Economy
http://www.faa.gov/air_traffic/publications/media/faa_economic_impact_rpt_2011.pdf

Appendix E. - *Frankfurt am Main*

E.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to Frankfurt am Main airport. We provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing. Finally, we review the available evidence on the impact of the development of the airports intermodal connections on its role and impact.

E.2. *Background*

Aviation is an important industry in Germany, with 66,000 people employed at airports (0.16% of the total workforce in Germany)[51]. Fraport operates and manages a number of airports globally, including Frankfurt am Main. Frankfurt am Main Airport is the largest airport in Germany in terms of passenger numbers, third in Europe after London Heathrow and Charles De Gaulle and ninth in the world. This case study focuses on its economic impact on the local region of Hessen (see Figure 61).

Figure 61: Location of Frankfurt am Main Airport

Source: http://en.wikipedia.org/wiki/File:Flugh%C3%A4fen_in_Deutschland.png

Frankfurt Airport has shown significant growth over recent years, with passenger numbers increasing by almost 9 million since 2000 (see Figure 63). Annual passenger numbers fluctuated slightly until the economic crisis of 2008; however, since the beginning of construction of the new runway in 2009, through its completion in 2011, to the most recent statistics of 2013, the number of passenger has grown significantly as have load factors. This is despite the decline in the number of airlines operating from Frankfurt; the airlines that have maintained a presence have focused on their most profitable routes and the airport has benefitted from this as a whole.

[51] Friedrich Ebert Stiftung (2003), Wachstum trotz Strukturwandel und Luftverkehrsteuer http://library.fes.de/pdf-files/wiso/10252.pdf

The construction of the Airbus maintenance stand between 2005 and 2007 has allowed the airport to accommodate A380 aircraft, permitting wide-body aircraft and serving more passengers with fewer take-offs and landings, but the major development that has spurred this growth is the construction of the international train station. Although the Airport station was completed pre-2000, improvements in the technology of the trains has allowed for a faster and more efficient schedule of trains to and from the Airport. The long-distance station now operates, on average, 170 Inter City Express daily trains which travel across Germany and the short-distance station offers 400 S-Bahn trains and buses on a daily basis which serve the Rein-Main region – a journey to Frankfurt city takes only 15 minutes by these trains. These developments have allowed Frankfurt Airport to expand its catchment area for German passengers whilst maintaining its status as a connection point between Europe, the Middle East and the Americas.

E.3. *Economic impacts*

A study was carried out by INFRAS and BAKBASEL (both economic research and consultancy firms) for Fraport, the airport owner, in 2013 to investigate the economic impact of Frankfurt Airport on the surrounding region; this was then updated in February 2014. In this study, the effects of airport operations were measured by considering the number of jobs generated and the value added, both directly and indirectly and using broadly the same definitions of 'direct', 'indirect' and 'induced' as in the other case studies. The induced effect was also calculated using multipliers. The measures were produced every four years starting in 2000 and ending in 2012. Hence, they provide some indication of how the Airport's impact has changed over time.

The total impact can be seen in Figure 62. It shows that Frankfurt Airport's economic impact has increased steadily over the period between 2008 and 2012. It also shows that the induced impact is significantly larger than the direct and indirect impact.

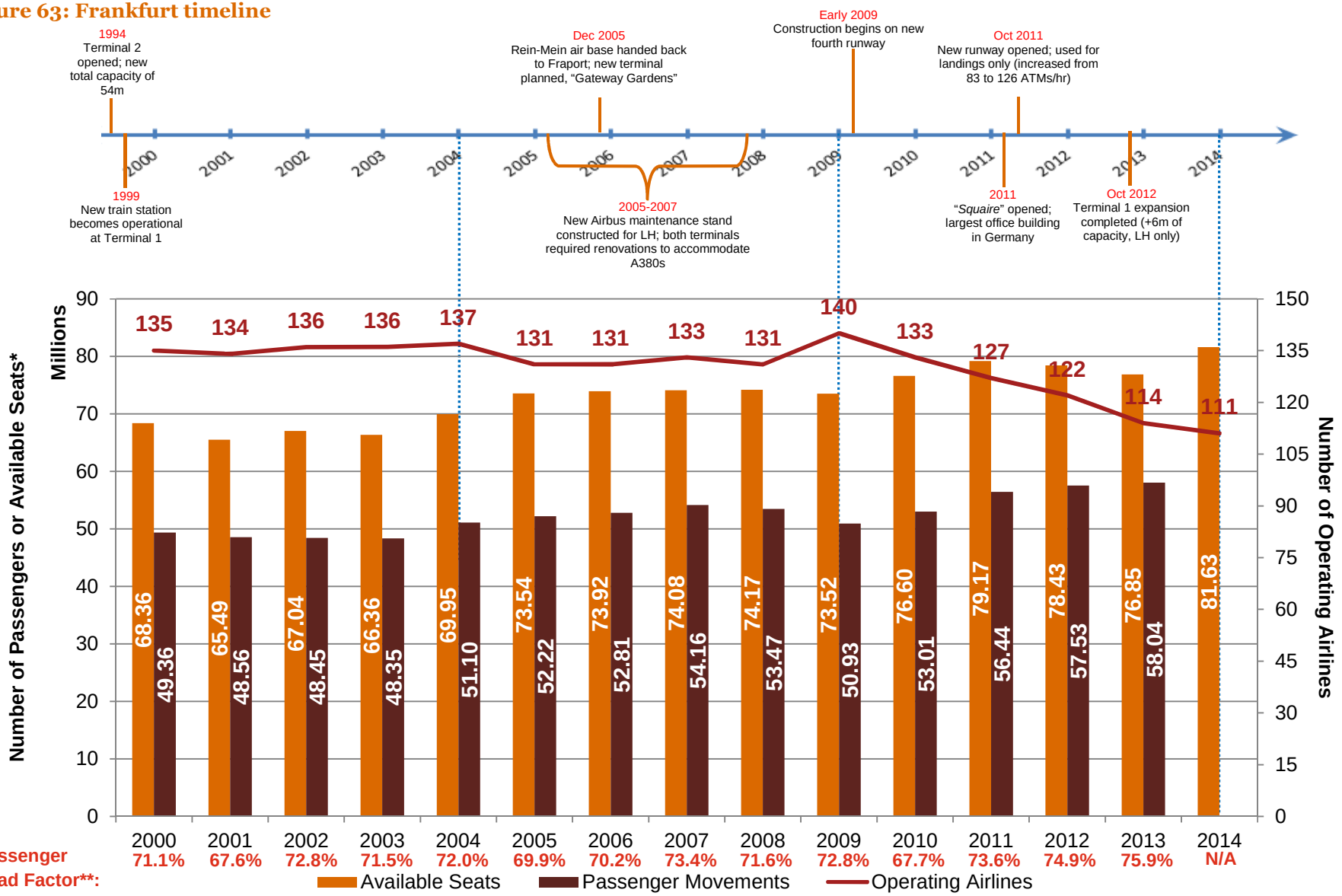
Figure 62: Economic impact of Frankfurt Airport

Year	2000	2004	2008	2012
Employment ('000 employees)				
Direct	*62.5*	*68.0*	*71.0*	*78.0*
Indirect	*38.1*	*38.2*	*36.8*	*38.3*
Induced	*93.9*	*76.8*	*46.6*	*39.2*
Total	*194.5*	*183.0*	*154.4*	*155.5*
Of which wages and salaries	*65.1*	*60.1*	*53.0*	*58.8*
GVA (€ billions)				
Direct	*5.65*	*5.89*	*6.31*	*6.63*
Indirect	*1.98*	*2.15*	*2.26*	*2.51*
Induced	*2.48*	*2.25*	*0.9*	*1.05*
Total	*10.11*	*10.29*	*9.47*	*10.19*
Of which wages and salaries	*3.39*	*3.38*	*3.25*	*3.85*

Source: Regional und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013[52]

[52] INFRAS (2013 – Updated Feb. 2014), Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt http://www.fraport.de/content/fraport/de/misc/binaer/konzern/flughafen-und-region/regionale--und-volkswirtschaftliche-bedeutung-des-flughafens/jcr:content.file/regional--und-volkswirtschaftliche-bedeutung-des-flughafen-frankfurts--aktualisierter-schlussbericht-februar-2014.pdf

Figure 63: Frankfurt timeline



*Available departing seats multiplied by 2
** Passengers divided by available seats
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

The study also splits the impacts on employment between:

- Airline related (i.e. airlines, providers of general aviation, catering, technical operation (technology, maintenance, servicing of airplanes)) - see Figure 64;
- Airport related (i.e. airport operations, police/customs/further authorities, security and cleaning companies) - see Figure 65; and
- Non-aviation services on airports like stores, kiosks, banks, restaurants, travel agencies, car rentals, barber shops, consulting companies - see Figure 66.

Airlines make the largest economic contribution (an average of 66% of the direct and indirect jobs at Frankfurt Airport and 73% of the direct and indirect value added. The non-aviation companies, however, have a large impact, contributing €850 million and supporting almost 15,000 jobs in 2012. We note the development of each impact over time, particularly between 2008 and 2012. Within this period, passenger numbers increased, after an initial decline due to the global economic crisis, and each sector showed growth, even when the number of operating airlines was in decline. Importantly, non-aviation employment almost doubled and GVA did double in this period. These trends are reflected in Figure 67 and Figure 68.

Figure 64: Economic impact of Frankfurt Airport – Airline

Year	2000	2004	2008	2012
Employment ('000 employees)				
Direct	*38.57*	*43.28*	*44.25*	*47.22*
Indirect	*28.69*	*28.99*	*27.84*	*28.40*
Induced	*73.04*	*64.74*	*41.79*	*35.44*
Total	*140.30*	*137.01*	*113.88*	*111.06*
GVA (€ billions)				
Direct	*4.01*	*4.38*	*4.61*	*4.66*
Indirect	*1.49*	*1.63*	*1.71*	*1.86*
Induced				
Total	*7.29*	*7.71*	*6.98*	*7.28*

Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Figure 65: Economic impact of Frankfurt Airport – Other airport

Year	2000	2004	2008	2012
Employment ('000 employees)				
Direct	19.70	21.38	23.68	24.87
Indirect	7.64	8.04	8.08	7.82
Induced	18.69	11.18	5.23	4.91
Total	46.03	40.60	36.99	37.60
GVA (€ billions)				
Direct	1.41	1.33	1.56	1.70
Indirect	0.40	0.45	0.50	0.51
Induced	0.58	0.5	0.21	0.25
Total	2.39	2.28	2.27	2.46

Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Figure 66: Economic impact of Frankfurt Airport – Non-aviation

Year	2000	2004	2008	2012
Employment ('000 employees)				
Direct	4.24	3.33	3.07	5.92
Indirect	1.74	1.14	0.92	2.04
Induced	2.24	0.91	-0.45	-1.08
Total	8.22	5.38	3.54	6.88
GVA (€ billions)				
Direct	0.23	0.17	0.14	0.27
Indirect	0.09	0.06	0.06	0.13
Induced	0.11	0.07	0.02	0.05
Total	0.43	0.30	0.22	0.45

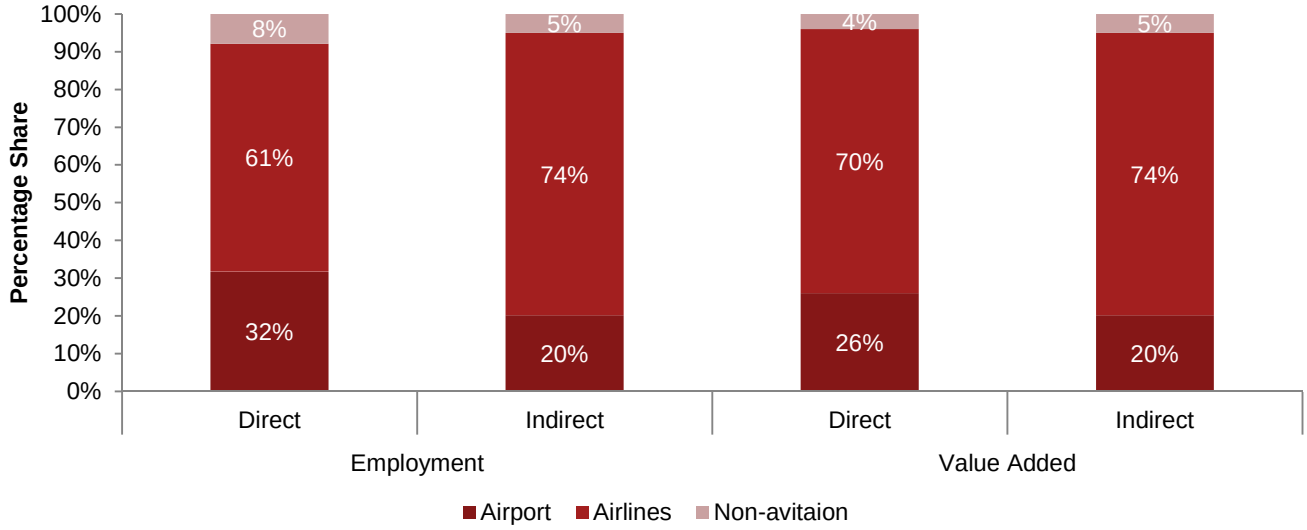
Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Of approximately 500 employers, the five biggest at Frankfurt am Main Airport are:

- Deutsche Lufthansa AG;
- Fraport AG;
- LSG Sky Chefs;
- German Federal Police; and
- International Mail Centre[53].

Figure 67 shows the distribution of direct and indirect employment and value added arising from Frankfurt Airport in 2012. The biggest contribution to value added is provided by airlines whose share is even greater if the indirect impacts are included. This is because airlines buy more services from outside the airport than airport related services. Airlines also account for the greatest proportion of the workforce. In the direct impact the proportions of airport and non-aviation services are bigger than their value added. This is because their activities are more labour-intensive (e.g. cleaning services, security, sales jobs, restaurant etc.).

Figure 67: Distribution of employment sectors in 2012



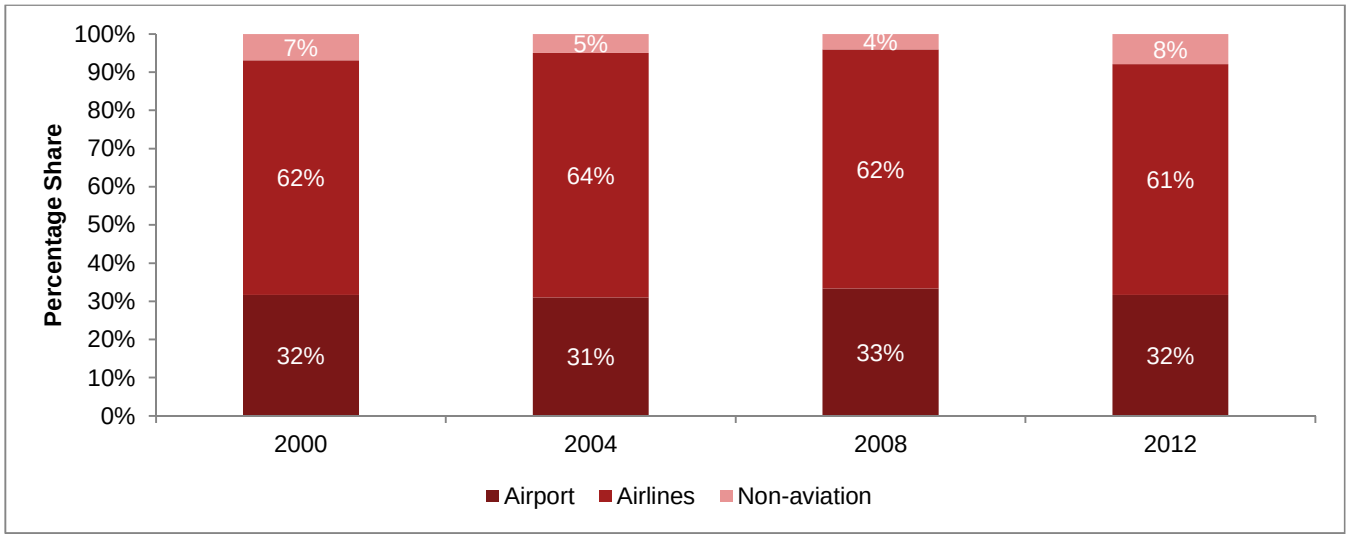
Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Note: Percentages may not total 100% due to rounding

[53] Fraport AG, '2012 Facts and Figures on Frankfurt Airport'

Figure 68 suggests that airlines have slightly less impact on employment as time progresses and in recent years non-aviation has grown thanks to the opening of Squaire and Gateway Gardens. These effects are consistent across indirect effects and induced effects.

Figure 68: Development of direct employment sectors (2000-2012)



Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Note: Percentages may not total 100% due to rounding

Figure 69 illustrates the age composition of employees and compares it to the region (Hessen) and the whole of Germany. Information on the age of those employed in Germany was unavailable on the same level as was known for Frankfurt so two of the groupings (25-50 and 50-55) have been plotted together to form a new group, 25-55. Frankfurt employs fewer people younger than 25 and older than 55 compared to the national average. The second part of

Figure 69 (top-right) shows the split of employment across the three locations by gender, foreign nationality and whether employed on a temporary contract. It shows that Frankfurt Airport has:

- A smaller proportion of female staff than the surrounding region of Hessen and Germany as a whole;
- A higher portion of staff who are foreign nationals (probably due to airlines from other countries having staff based at the airport for check-in services, along with tourist companies and businesses requiring multi-lingual staff); and
- A smaller percentage of staff on temporary contracts than the national average, implying that the jobs at the airport are more secure and less time-structured than the rest of Germany.

The last plot in

Figure 69 (bottom) shows the duration of employment at Frankfurt Airport compared to the rest of Germany and similar industries in Germany ('Transportation & Storage' and 'Hotel, Restaurant & Commerce'). The proportion of employees at Frankfurt Airport who have been employed for over 10 years is more than in the rest of Germany. This suggests that workers at Frankfurt Airport are more likely to make a career of their role and stay for more than 10 years than the rest of Germany and comparable sectors across Germany.

Figure 69: Characteristics of employees at Frankfurt Airport in comparisson to other regions

Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

**Statistical adjustment of Frankfurt Airport – some of the companies surveyed in the study did not respond so it is assumed that all of their employees (8,500) have been employed for less than 1 year*

Some 60% of the airport employees live within approximately 35 km of Frankfurt am Main airport:

- 16% in the city of Frankfurt;
- 16% in the Gross-Gerau area;
- 12% in the Offenbach area;
- 8% in the Mainz and Wiesbaden areas; and
- 6% in the Darmstadt area[54].

[54] Fraport AG, '2012 Facts and Figures on Frankfurt Airport'

E.4. *Intermodal connections at Frankfurt am Main*

E.4.1. Background

Frankfurt am Main Airport has seen the steady growth of its rail connections over the last 40 years (see Table 25). As a consequence, it now has two rail stations:

- The first regional train station (opened in 1992) is served by around 225 commuter and regional trains per day which carried 3.5 million passengers in 2013; and
- The more recent long-distance train station (opened in 1998) is served by around 180 high-speed distance trains per day which carried 5.6 million passengers in 2013 and provided connections through existing, improved or newly built high speed railway links.

The long-distance station cost €225 million to construct with €97 million coming from the Federal Government and the remaining €128 million from Fraport AG, the company which runs the airport. Above the railway station is the Frankfurt AirRail Centre (known as The Squaire) which was built by a private investor at a cost of about €1 billion (and opened in 2011)[55].

The two stations enable Frankfurt am Main Airport to offer integrated transport services to airport users.

Table 25: History of development of intermodal links at Frankfurt am Main Airport

Year	Developments
1972	• First airport in Germany to have own railway station and adjacent terminal –served only by local trains
1978	• Rail services extended to include infrequent semi-fast trains to wider catchment but no long distance trains
1980	• Local trains replaced by high frequency commuter trains from Frankfurt via the airport to Mainz – Wiesbaden • Airport regular stop for inter-city trains along the River Rhine to Nuremberg and Munich
1982	• Special trains run for Lufthansa connecting Dusseldorf, Cologne and Bonn: later extended to Stuttgart • Used exclusively by air travellers connecting in Frankfurt to/from flights of Lufthansa and co-operating airlines
1993	• Special trains ceased following merger of railway company • Partly replaced by a few public inter-city trains
1995	• Public inter-city trains stopped due to low demand • Lufthansa and Deutsche Bahn started the project which became AirRail in 2001
1999	• Second railway station opened dedicated to long-distance trains with three IC-routes as well as additional regional services on medium distances
2001	• Lufthansa and Deutsche Bahn started project which became AirRail
2002	• High-speed link opened to Cologne and Bonn in less than an hour • Additional InterCityExpress (ICE) routes enable Lufthansa to cease flights between Cologne and Frankfurt

Frankfurt am Main Airport was particularly suited to the development of inter-modal connections with long distance trains because it (already) served a large number of destinations, especially with inter-continental flights, some of which it was unique in Europe in offering. For that reason, a large proportion of passengers were transferring at Frankfurt to another flight.

Lufthansa, Deutsche Bahn and Frankfurt am Main Airport developed and implemented AirRail as a competitive airline product using high speed trains as a feeder for flights. It made regular trains with designated compartments for air travellers. The service is considered part of the air travel offered by Lufthansa (and the STAR Alliance) and is booked via the airline. It overcomes two challenges:

[55] INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

- Long-distance trains run exclusively for air passengers are not viable (especially where competition exists with other carriers for high yield passengers); and
- Very short-haul flights (e.g. between Cologne and Frankfurt) are typically loss-making for the airline as there are insufficient origin-destination passengers to generate enough income to supplement the limited revenue from inter-continental ticket sales assigned to these short flights from transferring passengers.

Nonetheless, in developing its rail links, the Airport and its partners have needed to address some key barriers:

- Monopolistic structures which limit incentives on the supply side: for example, Deutsche Bahn and Lufthansa compete on some short haul routes which affects their willingness to co-operate in areas where they do not compete;
- Airport capacity constraints, reinforced by regulations (e.g. slot allocation, grandfather rights), which encourage Lufthansa to replace its short haul flights with train services so that it can start new intercontinental flights; and
- Split responsibilities for infrastructure provision between different tiers of government (i.e. Federal Government and Länder).

E.4.2. Expected benefits

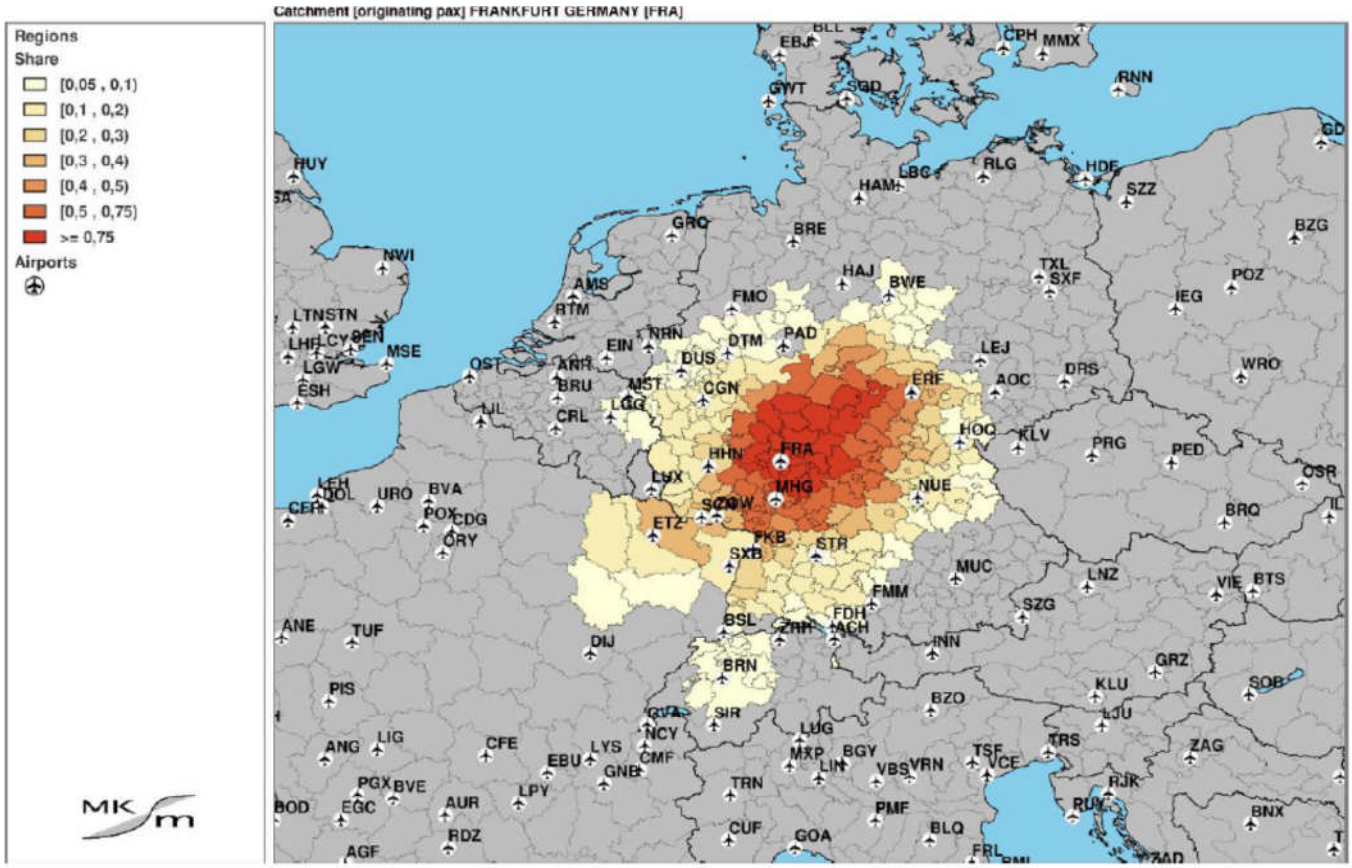
The expected benefits of the enhanced intermodal connections at Frankfurt am Main Airport are summarised in Table 26.

Table 26: Expected benefits of intermodal connections at Frankfurt am Main Airport

Beneficiary	Impact
Frankfurt Airport	• Faster access by high speed trains and alternative access mode to road • Improved competitive position compared to other gateway airports in continental Europe • Enlarged catchment area enabling more passengers to be handled: Figure 70 shows Frankfurt am Main Airport's (modelled) share of total demand for air transport in each area (excluding those where the market share is below 5%) and illustrates that, in addition to the Rhine-Main area, the catchment covers parts of Southwest Germany and Eastern France down to Switzerland in the South and the Ruhr area and parts of Belgium in the North West • Better (more profitable) use of constrained slots by long-haul instead of short-haul flights: and airport with capacity constraints prefers to increase the number of arriving and departing passengers in favour of twice counted transfer passengers because it allows an increased catchment, more destinations and more retail business
Railway:	• Greater share of passengers travelling to the airport compared to other feeder modes • Improved loads on long distance trains
Lufthansa:	• Stronger market position against competing airlines by offering a seamless transport chain to the traveller • Improved loads on own flights • Greater scope for cutting less commercially attractive short haul flights to hub and more scope for profitable use of slots with long-haul flights.
Other airlines	• Feeds additional passengers into long-haul flights where Frankfurt is spoke end of network and they do not have any (alliance) partner airline
Policy makers:	• Sustainable growth of the airport business in Germany meaning more jobs, more direct and indirect income • Improved accessibility of regions (not only close to airports) leading to time savings and more attractive regions for investments, employment and tourism

Source: PwC analysis

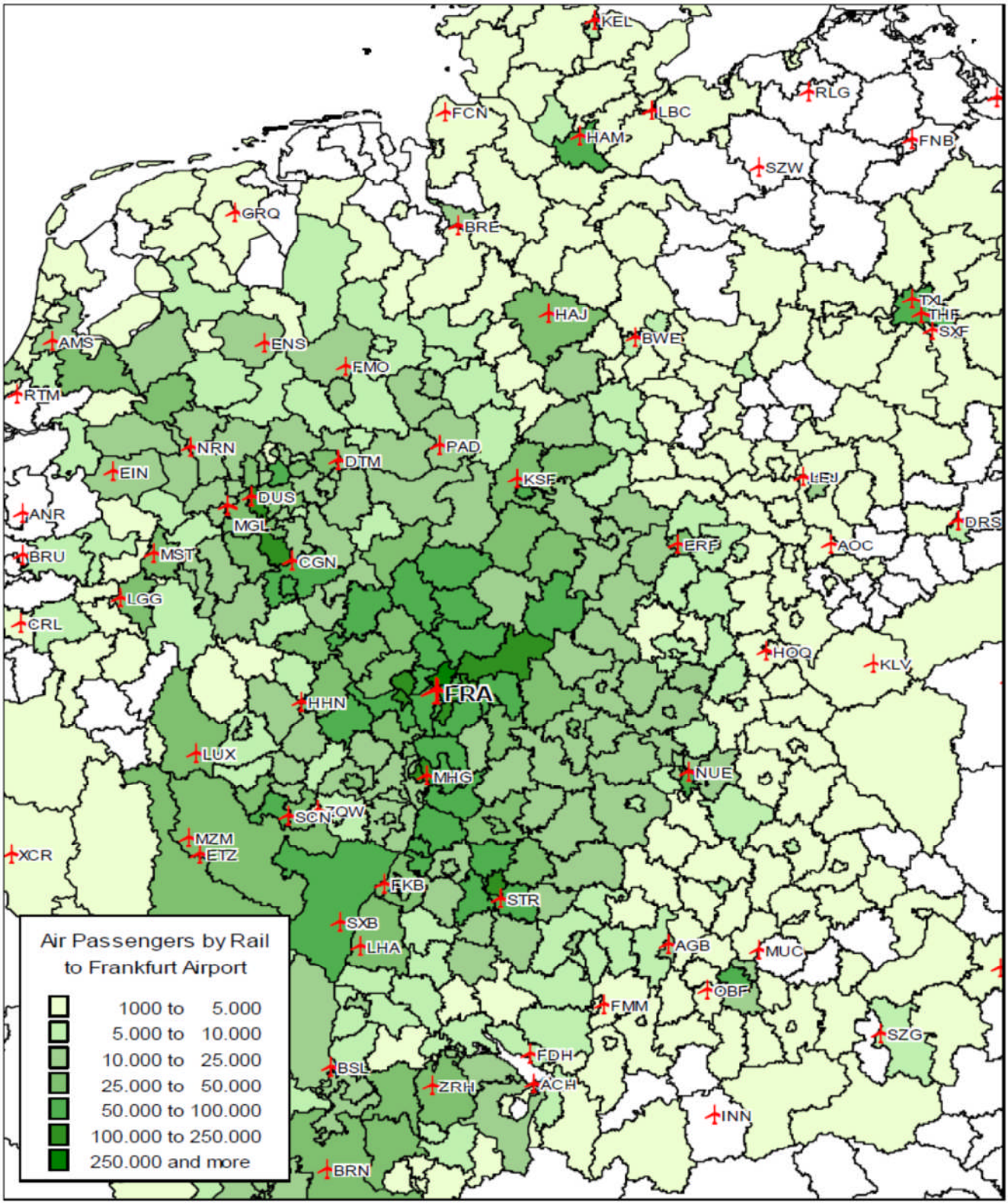
Figure 70: Catchment of Frankfurt airport



Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

Figure 71 shows the (modelled) origins of passengers expected to use public transport as a feeder mode at Frankfurt am Main Airport. Several highly populated areas, some distant from the Airport, show significant numbers of rail passengers, including Hamburg, Berlin, Hanover and Kassel in the north, the Dusseldorf / Cologne area in the west and the area of Mannheim, Karlsruhe and Stuttgart in the south.

Figure 71: Spatial distribution of air passengers using public transport as feeder mode



Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

Table 27 shows the (expected) mode of surface transport to and from Frankfurt am Main Airport based on data collected as part of the planning process for capacity enhancements at the Airport. It is evident that many rail passengers are not air-travel related (e.g. they are airport employees).

Table 27: Expected mode and purpose of surface transport to Frankfurt am Main Airport ('000 passenger movements per working day, 2005)

	Private / rental car	Taxi	Coach	Public transport	Total	Share of public transport (%)
Air passengers	29.7	11.5	2.9	21.0	65.1	36.7
Employees	55.0	0	0	29.1	84.1	34.6
Attendants	35.3	0	0	1.8	37.1	4.7
Visitors/customers	17.6	0	0	3.2	20.8	15.5
Rail passengers not airport related	1.9	0.6	0	2.3	4.8	48.2
Total	139.5	12.1	2.9	57.4	211.9	27.1

Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

E.4.3. Impact

Shows the change in the composition of air passengers at Frankfurt am Main Airport between 2000 and 2008. Although many (external) events affected this pattern (e.g. 9/11 and the emergence of low cost carriers), the number of passengers on domestic flights to and from Frankfurt decreased, while the number of European and Intercontinental passenger increased. This is significant given that the total number of passengers on domestic flights within Germany increased over the same period.

Table 28: Changing composition of air passengers at Frankfurt am Main Airport (2000-2008)

Type	2000	2008	Change 2000 - 2008
Domestic	8.8	6.38	-27.5%
European	22.94	25.24	+10,0%
Intercontinental	26.42	28.23	+6,9%
Total	49.36	53.47	+8,3%

Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

The introduction of AirRail led to many passengers choosing the train to connect for their (long-haul) flights at Frankfurt instead of using an ultra-short haul feeder flight. The rail capacity offered increased whilst the capacity on the equivalent flights decreased. Table 29 shows the number of air passengers in 2000 (before the opening of AirRail) and 2008 and the change over the period.

Table 29: Passenger figures for selected years at Frankfurt airport

Passengers from Frankfurt to ('000)	2000	2008	% change 2000 – 2008
Stuttgart	445.6	203.3	-54.4%
Cologne	316.9	0.9	-99.7%
Total	762.5	204.2	-73.2%

Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

Not all the effects outlined (50% reduction on the Stuttgart route and 100% on Cologne route since 2000) can be assigned to AirRail as other factors also influenced the development of demand on these links:

- Some of the passengers arriving or leaving Frankfurt by rail do not use the AirRail concept, but travel with rail tickets issued by Deutsche Bahn;
- A change in route choice of passengers who refuse to use trains by transferring at Munich instead of Frankfurt to/from their connection flights; and
- A change in route choice or airport choice due to the increased number of destinations at the airports of Cologne or Dusseldorf (40 km from Cologne) within the last 10 years.

More generally, whilst the number of long-distance rail passengers at Frankfurt am Main Airport rose significantly following the development of the inter-modal connections, this masks several diverse effects:

- Some passengers travelled to/from the airport by long-distance train instead of:
  - A private car
  - A transfer connection from Frankfurt central station and a commuter train to the airport
  - A short haul feeder flight;
- Other passengers chose to use the new airport station as a starting point for their rail trips instead of other rail stations (e.g. Frankfurt Central, Mainz and Wiesbaden);
- Some passengers changed the routing of their travel (e.g. using a train to Frankfurt am Main Airport before flying to New York instead of flying on another route such as Dusseldorf – New York nonstop or Cologne – Amsterdam – New York);
- Some air passengers took additional flights because of the improved accessibility of Frankfurt am Main Airport whilst others substituted rail journeys for flights; and
- Employees took up a job at Frankfurt am Main Airport because it was easier for them to commute from their existing residence.

E.4.4. Conclusions

Although the evidence from Frankfurt am Main Airport needs to be interpreted with caution, it suggests that:

- To justify the costs of providing rail services, the airport needs to be attractive to passengers:
  - By offering a good enough range of services to attract sufficient passengers from a large catchment areas; and
  - By enabling them to use the rail network to access the airport without extending the travel-time.
- Providing through-ticketing solutions for intermodal travel with rail and air improves the attractiveness and effectiveness of the option, especially if the train segment is fully integrated with the air travel (like AirRail).
- Connecting airports to the railway network enables long-distance rail services to replace short haul flights: the number of air passengers on long-distance trains at Frankfurt am Main Airport more than doubled within a few years whilst the number of passengers on (short-haul) domestic flights decreased by more than a quarter (contrary to the wider trend in Germany).
- Switching from air to rail releases runway slots no longer needed for feeder flights for use by additional (long-haul) flights at the capacity constrained airport.

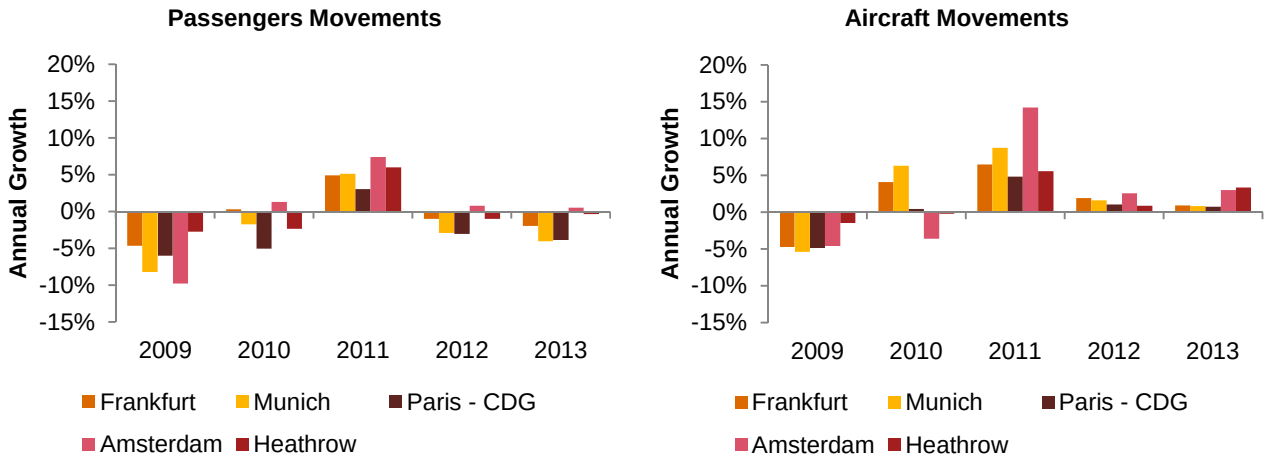
The transferability of concepts like AirRail to other airports depends on several conditions being met:

- Existing demand for rail travel is sufficient to make the rail service viable as trains operated exclusively for air passengers are not viable at the frequency level needed to provide attractive transfer times to/from connecting flights;
- Potential demand comes largely from passengers transferring at the airport (rather than local demand);
- The airport is connected to the railway network with its own railway station which is served by fast long-distance trains without transfers; and

- The travel-time on trains is not significantly more than 90 minutes, the typical elapsed time of a short-haul flight allowing for check-in time.
- Capacity constraints at the airports push airlines towards the substitution of short-haul flights.

Finally, with the additional runway completed in 2011, we compare the growth of Frankfurt am Main Airport with other European hub airports and others in Germany. Figure 72 shows that Frankfurt am Main has followed the same general trend as the other main European hubs, growing with the aviation industry.

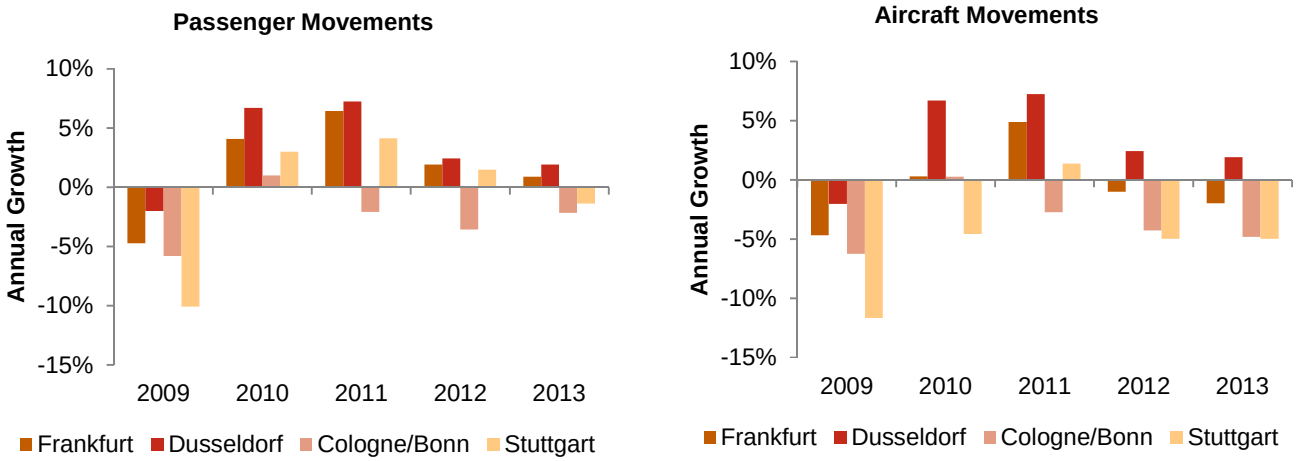
Figure 72: Growth of European hubs over time



Source: CAPA Centre for Aviation http://centreforaviation.com/

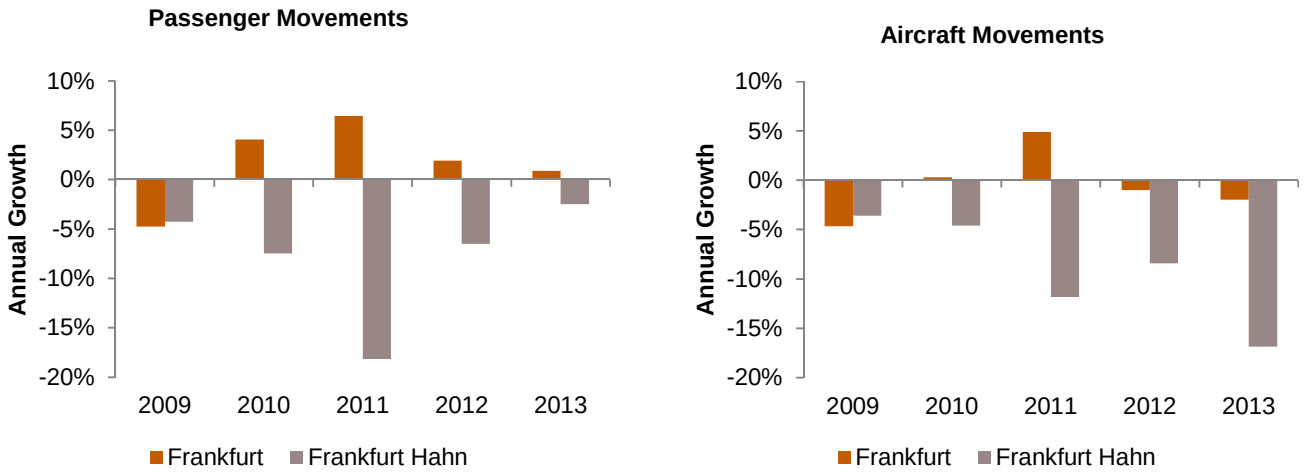
Of the four German airports considered in Figure 73, Dusseldorf has shown the most growth year-on-year and Cologne/Bonn generally has the least in terms of both passenger and aircraft movements. Frankfurt is in the middle following the general trend across these airports.

Figure 73: Growth of middle-sized neighbour airports over time



Source: CAPA Centre for Aviation http://centreforaviation.com/

Figure 74: Growth compared to Frankfurt Hahn over time



Source: CAPA Centre for Aviation http://centreforaviation.com/

Frankfurt Hahn operates on a much smaller scale than Frankfurt Main, serving 2.6 million passengers in 2013 compared to 58 million at Main. Since 2010, however, Frankfurt am Main has consistently grown in passenger numbers whereas Hahn has decreased each year. This suggests that expansion at Main has affected another airport – some of the new passengers utilising Main may have previously used Hahn if the new runway expansion had not been completed.

Figure 75: The Squaire

Source: http://www.thesquaire.com/GridFS/uploads/header_picture/picture/4eef754dd70a596b430000fc/display_mde_CGahl_thesquaire_36292.JPG

Another important attribute of Frankfurt Airport that sets is aside from others is the construction of 'The Squaire' (see Figure 75), the largest office space in Germany and is located on site as part of the long distance train station. There is 140,000 m² of useable space; 94,500 m2 of office space, 34,500 m2 for restaurants, cafes and bistros, 34,500 m2 for hotels (two Hiltons with a total of 583 rooms) and there are an additional 250 stores in Airport City – another development at Frankfurt which is separate from the Squaire. Such investment in business near an airport will appeal to a number of companies and draw businesses to relocate to the airport for convenient transport options; KPMG and Lufthansa are some of the main tenants. Between the Squaire and Airport City there are a number of services available, including a conference centre, a concierge service, doctors, fitness, cleaning services, day-care centres and barbers among others.

Appendix F. - *Paris (Charles de Gaulle)*

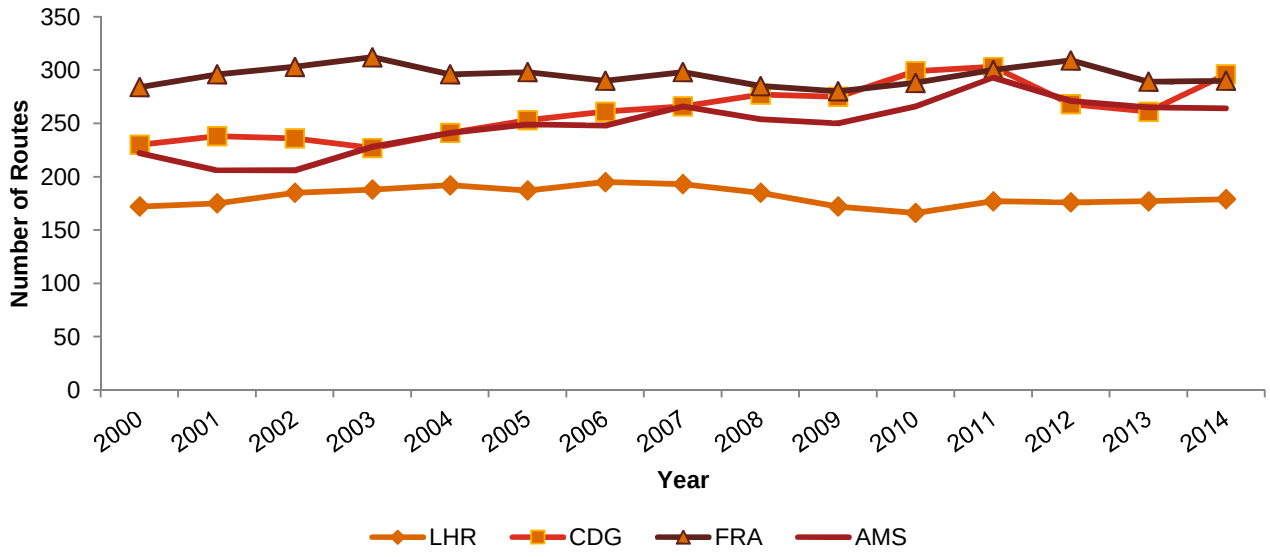
F.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to Paris (Charles de Gaulle) airport. We provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing.

F.2. *Background*

Charles de Gaulle Airport (CDG) is the largest in France and the second largest in Europe in terms of passenger numbers, after Heathrow. Also, around 30% of CDG passenger traffic is connecting passengers[56]; Paris is in an attractive location for a hub between Europe, America and Africa. Figure 76 shows the number of available routes at CDG compared to its main European hub competitors; we note that CDG has seen the largest growth of connections over the past 15 years compared to Heathrow (LHR), Schiphol (AMS) and Frankfurt (FRA). In recent years, CDG's operator, Aéroports de Paris, has turned its focus to establishing CDG as a major European hub. The trend supports this.

Figure 76: Number of routes available at the major European hub airports (2000-2014)



Source: SABRE Airport Data Intelligence

Not all airport indicators have grown; the number of airlines operating from CDG has dropped since 2007 (see Figure 78) although this is consistent with operators choosing to focus on airlines that they benefit from (i.e. carriers from countries and regions that they wish to expand their network to). It can also be seen from Figure 78 that CDG handled more passengers in 2013 than ever before (62.05 million) whilst also achieving its highest load factor (80.4%). This implies that the airlines using Aéroports de Paris have become more efficient in their operations and have recovered from the situation in 2010 when scheduled capacity increased without the passenger demand leaving the load factor at 64.1% (see Figure 78).

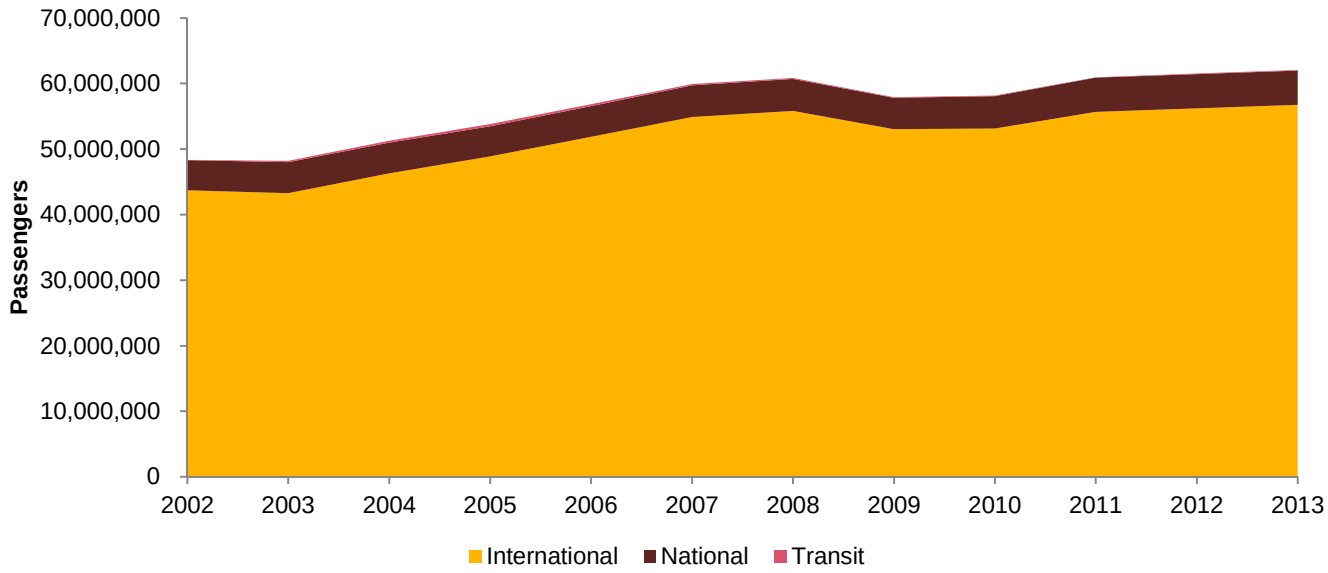
Figure 78 also shows the major infrastructure changes and developments at CDG. It provides an insight into how terminal capacity has changed over the years although it is difficult to attribute the change in available

[56] Charles de Gaulle Focus 2013 - http://www.aeroportsdeparis.fr/ADP/Resources/86ba4eb2-7daa-411f-bb96-5745ba410362-PARISCHARLESDEGAULLETERMINAUX.pdf

seats or passengers served to infrastructure changes without considering wider market trends (which also reflect world-wide trends rather than individual airport developments).

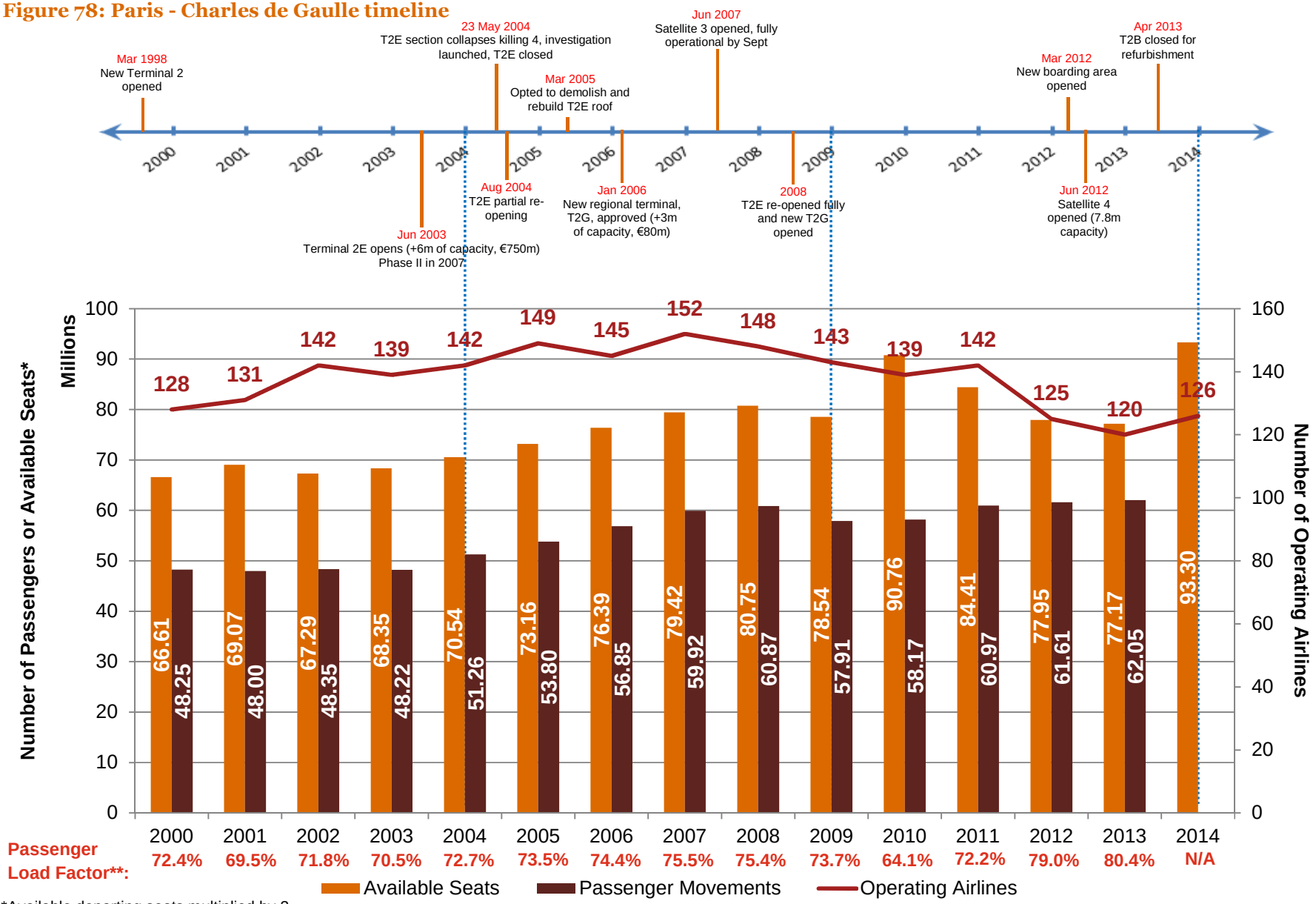
Figure 77 shows how the composition of passengers at Charles de Gaulle has changed since 2002. Over the period, the total number of passengers using the airport increased by 28%, with the number of national (i.e. domestic passengers growing at less than half the rate of international passengers – 14% compared to 30%).

Figure 77: Composition of passengers at Charles de Gaulle (2002-2013)



Source: www.aeroport.fr

Figure 78: Paris - Charles de Gaulle timeline

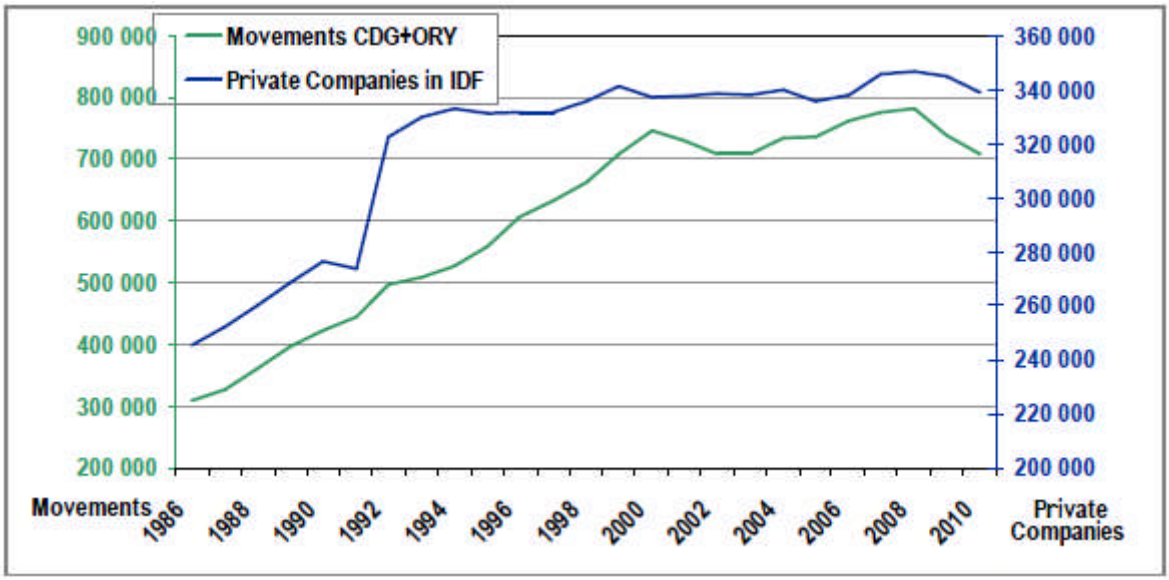


*Available departing seats multiplied by 2
** Passengers divided by available seats
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from ACI Statistics, http://www.aci.aero/Data-Centre/Annual-Traffic-Data/Passengers/2011-final

F.3. *Economic impacts*

Aéroports de Paris manages three Parisian airports, CDG, Orly (ORY) and Le Bourget (LBG), which contribute significantly to the economy of the Ile-de-France region. A study, in 2012 by BIPE, of the economic impact of these airports found that the number of private companies established in the Ile-de-France region had grown broadly in line with the growth in the number of aircraft movements at CDG and ORY (see Figure 79)[57]. Some care, however, is needed in interpreting this correlation as it does not indicate causality.

Figure 79: Aircraft movements at CDG and ORY and the number of private companies in the Ile-de-France region (1986-2011)



Source: Evaluation des impacts économique et social des aéroports Paris-Charles de Gaulle, Paris-Orly, Paris-Le Bourget pour l'année 2010, BIPE 2012

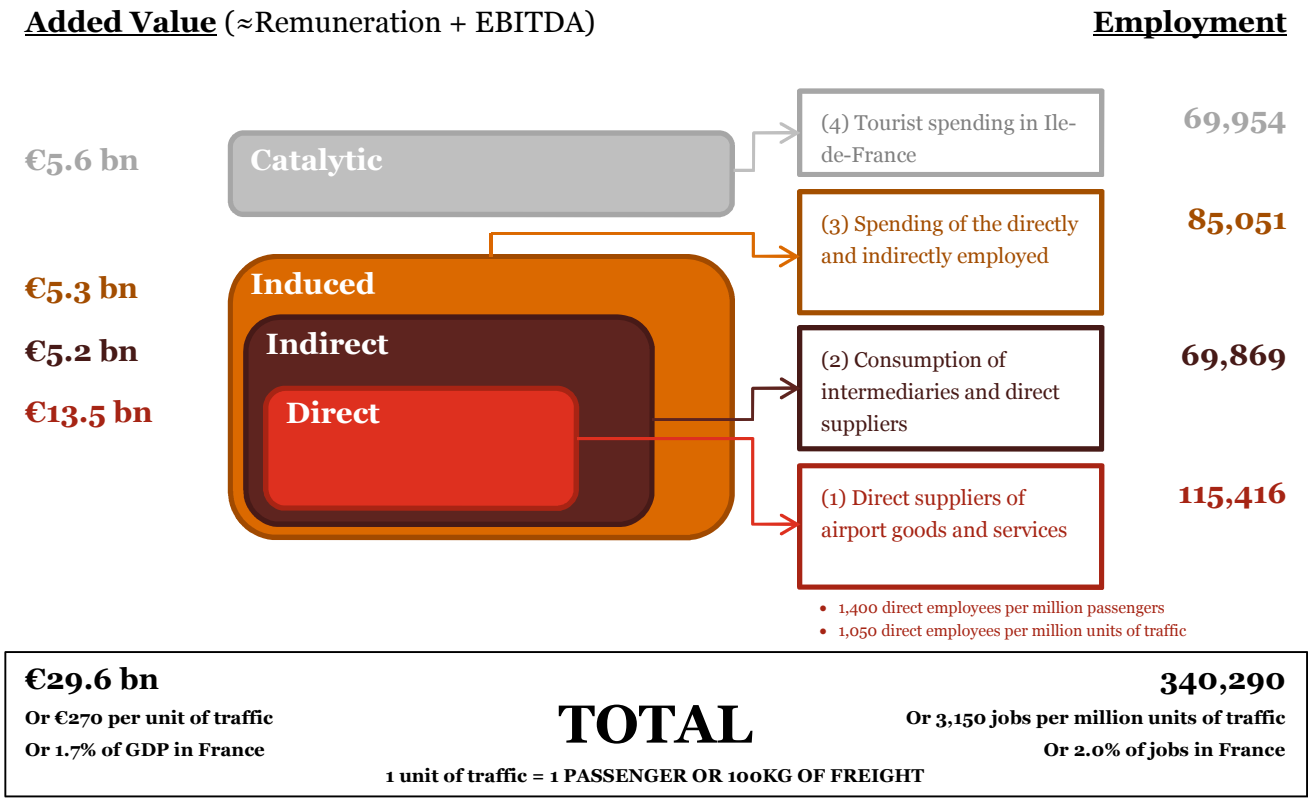
Figure 80 shows the direct, indirect, induced and catalytic value added value the employment created by the aviation industry in Paris in 2010. The €29.6 billion of added value generated from the Paris airport system represented 5.8% of the total GDP in the Ile-de-France and 1.7% of GDP in France. We estimate that every additional million passengers in the Paris airport system contribute an additional €354.2 million in value added to the economy.

The number of jobs arising from the Parisian airports over the 15 years prior to the study has grown at 3.09% per annum (seven times more than the average across the Ile-de-France); 20,591 direct jobs were created by CDG over this period and 18,450 jobs were created (direct, indirect and induced) by CDG in 2010 alone. The study estimates that across the Paris airport system every one million additional passengers per annum creates 4,100 new jobs of which 1,400 are directly employed. The total of 340,290 jobs in 2010 represented 8.3% of employees in the Ile-de-France and 2% of jobs in France. This implies that the airports as a whole are less productive than the economy as a whole.

The Paris airports make a further impact through their influence on tourism. Between then, CDG and ORY serve 11.6 million international passengers each year (15% of the total international visitors to France) and spending by these visitors is estimated to support 70,200 jobs in the Ile-de-France region. This includes those visiting from other parts of France. Overall, CDG and ORY are linked with 14% of the jobs in the tourism industry in the Ile-de-France.

[57] CP Etude BIPE – Aéroports de Paris - http://www.aeroportsdeparis.fr/ADP/Resources/0800d383-60d8-44bb-8cfc-8aae6f6cacf3-CPEtudeBIPE.pdf

Figure 80: Total economic impact of Aéroports de Paris airports (value added and employment, 2010)



Source: Evaluation des impacts économique et social des aéroports Paris-Charles de Gaulle, Paris-Orly, Paris-Le Bourget pour l'année 2010, BIPE 2012

Figure 81 shows the economic impact of CDG in the Ile-de-France. It is evident that CDG contributes the majority of the economic impact of the Paris airport system in the Ile-de-France. Overall, CDG is responsible for 4.1% of the GDP in Ile-de-France and 1.2% of the GDP in France. Also, it is estimated that every one million additional passengers served annually by CDG generates an extra €364.1 million in total added value.

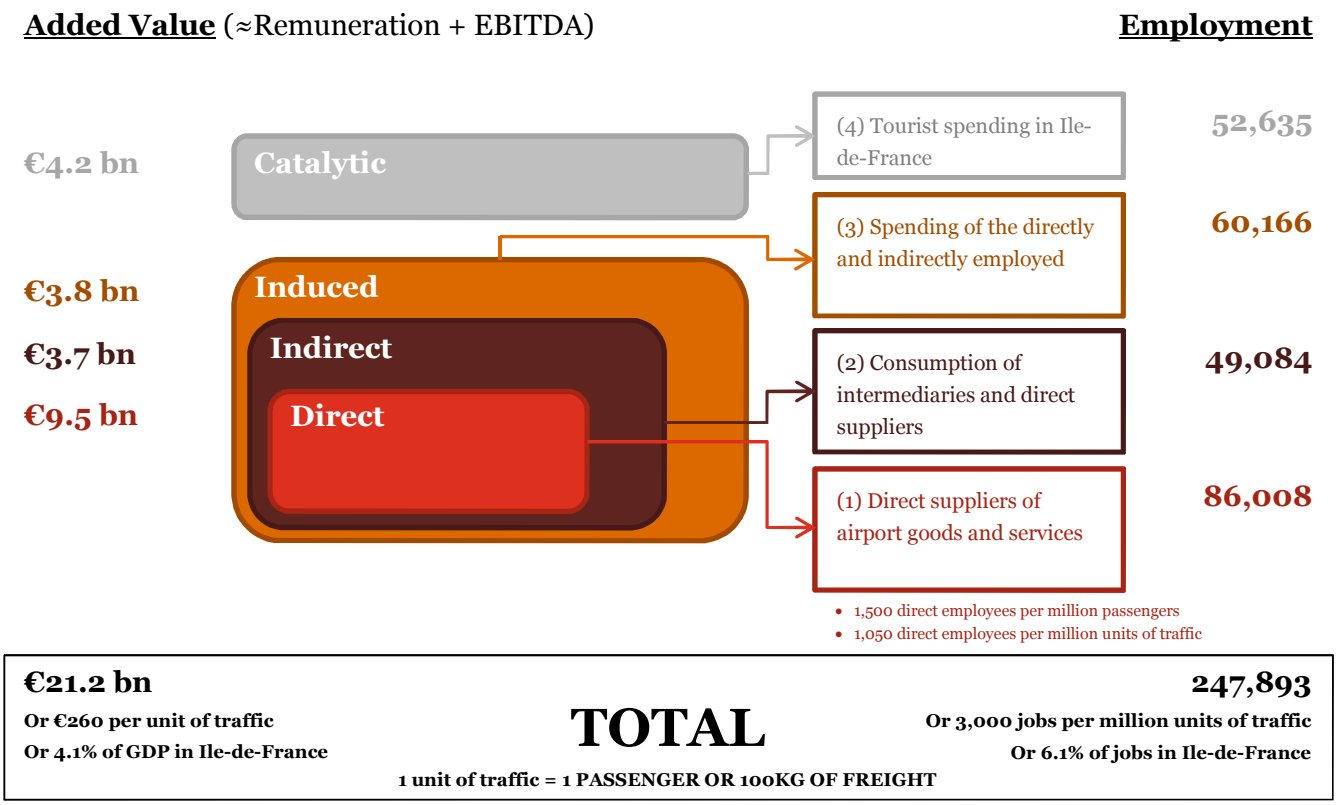
CDG is also responsible for 247,893 jobs (6.1% of employees in the Ile-de-France region) with 52,635 of these jobs engaged in meeting the needs of visitors to the region. Every one million additional passengers is estimated to support 4,300 jobs (of which 1,500 are directly employed by CDG). This is more than the average across the three Parisian airports.

We have not been able to find earlier studies of the economic impact of CDG to enable us to investigate how its economic impact has changed over time as Aéroports de Paris has changed the focus of its operations towards connecting passengers and improved the infrastructure of the airport by constructing new piers to Terminal 2.

Source:
http://www.holidayfrancedirect.co.uk/graphics/library/IledeFrance.jpg

Figure 81: Map of Ile-de-France with airports highlighted

Figure 82: Economic impact of Charles de Gaulle Airport (value added and employment, 2010)



Appendix G. - ***Bibliography***

The table below lists the reports which have been reviewed as part of our research alphabetically by author.

Title	Author	Year	Airport and/or geography covered	Link
Frankfurt Airport: Special Edition	ACI Europe	2011	Frankfurt	http://www.airport-business.com/wp-content/page-flip/frankfurt-airport-official-report-2011/
London Gatwick Airport: Special Edition	ACI Europe	2011	Gatwick	https://www.aci-europe.org/component/downloads/downloads/2985.html
London Heathrow Airport: Special Edition	ACI Europe	2011	Heathrow	https://www.aci-europe.org/component/downloads/downloads/2987.html
Economic Impact of Canberra Airport	ACIL Tasmin	2011	Canberra	http://www.acilallen.com.au/cms_files/ACIL_CanberraAirport_2011.pdf
Paris-Charles de Gaulle Focus 2013	Aeroports de Paris	2013	Paris	https://www.aeroportsdeparis.fr/ADP/Resources/86ba4eb2-7daa-411f-bb96-5745ba410362-PARISCHARLESDEGAULLETERMINAUX.pdf
ACI Airport Economics Report	Airports Council International	2012	Global	http://www.aci.aero/Publications/ACI-Airport-Statistics/ACI-Airport-Economics-Report-2012
Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line	Antoniou & Efthymiou	2013	N/A	http://link.springer.com/article/10.1007%2Fs13676-013-0030-4#page-1
Cologne-Bonn Airport as an economic and location factor (Translated)	ARC, Booz Allen Hamilton	2008	Cologne-Bonn	http://www.koeln-bonn-airport.de/uploads/tx_download/2008_Wirtschaftsfaktor_CGN_Oekonomische%20Bedeutung.pdf
Connecting the region to the world	Atlanta	2009	Atlanta	http://www.atlanta-airport.com/docs/NewsRoom/2009_Economic_Impact_Study_report.pdf
Developing tools to support complex infrastructure decision-making	Baker & Mahmood	2012	N/A	http://www.emeraldinsight.com/journals.htm?articleid=17035945
The Impact of Airport Noise on Residential Real Estate	Bell, Randall	2001	Global	http://www.eltoroairport.org/issues/AirportNoise.pdf
Wellington Airport Impact Assessment	BERL	2008	Wellington	http://www.wellingtonairport.co.nz/documents/Wellington-Airport-Masterplan-January-2010.pdf

Title	Author	Year	Airport and/or geography covered	Link
Employment Generation and Airports	BITRE	2012	Australia	http://www.bitre.gov.au/publications/2013/files/is_046.pdf
The Economic Catalytic effects of Air Transport in Europe	Britton, Cooper & Tinsley	2005	EU	www.abstracts.aetransport.org/paper/download/id/2088
GDP by Industry Data	Bureau of Economic Analysis	2014	USA	http://www.bea.gov/industry/gdpbyind_data.htm
Airport Office Developments: Assessing the Potential for New Schemes	CBRE	2013	N/A	http://portal.cbre.eu/portal/page/portal/RRP/ResearchReportPublicFiles/EMEA_VP_AIRPORT_OFFICE_DEVELOPMENT_JULY_2013.pdf
Impact of Vancouver Airport on commercial property values	Cohen & Brown	2013	Vancouver	www.aeaweb.org/aea/2014conference/program/retrieve.php?pdfid=1225
Agglomeration, Productivity and Regional Growth: Production Theory Approaches	Cohen& Paul	2008	USA	http://www.fmpc.uconn.edu/are/seminar/Cohen/cohen_morrisonpaul_agglomeration.pdf
The knowledge economy, hub airports and accessibility. A location based perspective. The Case of Amsterdam-Schiphol.	Conventz & Thierstein	2011	Amsterdam	http://www-sre.wu.ac.at/ersa/ersaconfs/ersa11/e110830aFinal01569.pdf
European Cities Monitor	Cushman & Wakefield	2011	Europe	http://www.cushmanwakefield.co.uk/en-gb/research-and-insight/2012/european-cities-monitor-2011/
Airport expansions and property values: the case of Chicago O'Hare Airport	Daniel P McMillen	2004	Chicago	http://www.sciencedirect.com/science/article/pii/S0094119004000099
The Heathrow Phenomenon	Deloitte	2007	Heathrow	http://www.westlondon.com/wp-content/uploads/2011/10/Heathrow_Phenomenon.pdf
Economic Impact of a Western Sydney Airport	Deloitte	2013	Sydney	http://www.nswbusinesschamber.com.au/NSWBC/media/Misc/Lobbying/Thought%20leadership/FINAL-Thinking-Business-Western-Sydney-Airport.pdf
Job density, productivity and the role of transport	Department of Transport	2012	N/A	http://www.transport.vic.gov.au/__data/assets/pdf_file/0005/74228/Job-density-productivity-and-the-role-of-transport.pdf

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Stakeholder management and path dependence in large-scale transport infrastructure development: the port of Antwerp case	Dooms et al.	2013	Antwerp	http://www.sciencedirect.com/science/article/pii/S0966692312001524
The economic impact of the Budapest Airport on the local economy	Dusek, Lukovics & Bohl	2011	Budapest	http://www-sre.wu.ac.at/ersa/ersaconfs/ersa11/e110830aFinal01228.pdf
2013 Economic Impact Study of San Francisco International Airport	EDRG	2013	San Francisco	http://media.flysfo.com.s3.amazonaws.com/default/downloads/reports/SFOEconomicImpactReport2013.pdf
Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line	Efthymiou, Dimitrios and Antoniou, Constantinos	2013	Greece plus some global observation, including Manchester	http://link.springer.com/article/10.1007/s13676-013-0030-4/fulltext.html#Bib1
Economic and social analysis of potential airport sites	Ernst & Young	2012	Sydney	http://www.infrastructure.gov.au/aviation/scopingstudy/files/Ernst_and_Young-Economic_and_social_analysis_of_potential_airport_sites.pdf
The Impact of Airport Noise and Proximity on Residential Property Values	Espey, Molly and Lopez, Hilary	2002	US plus global observations	http://onlinelibrary.wiley.com/doi/10.1111/0017-4815.00135/abstract
2012 Facts & Figures on Frankfurt Airport	Fraport	2012	Frankfurt	http://www.frankfurt-airport.com/content/frankfurt_airport/en/misc/container/facts-and-figures-2011/jcr:content.file/zadafa-2012_e_lowres.pdf
The London Plan	GLA	2011	London	http://www.london.gov.uk/priorities/planning/london-plan
Economic Evidence Base	GLA Economics	2010	London	http://www.london.gov.uk/sites/default/files/evidence-base-2010-final-low.pdf
Regional, sub-regional and local gross value added estimates for London	GLA Economics	2014	London	https://www.london.gov.uk/priorities/business-economy/publications/gla-economics/regional-sub-regional-and-local-gross-value-added-estimates-for
Agglomeration, Productivity and Transport Investment	Graham	2007	N/A	http://www.ingentaconnect.com/content/lse/jtep/2007/00000041/00000003/art00003
The Regional Economic Impact of an Airport: The Case of Amsterdam Schiphol Airport	Hakfoort et al	2001	Amsterdam	http://dspace.ubvu.vu.nl/bitstream/handle/1871/22163/theregionaleconomicimpact.pdf;jsessionid=6369F93D3A3C116EED1F5794912DABE9?sequence=2
Heathrow: On-airport Employment Survey	Heathrow	2008/09	Heathrow	http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Employment-survey.pdf

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A Focus on the Economy: Towards a sustainable Heathrow	Heathrow	2011	Heathrow	http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Afocusontheeconomy.pdf
Sea-Tac International Airport impact mitigation study	Helmuth, Obata & Kassabaum	1997	Seattle	http://airportnoiselaw.org/study912.html
Airline Network Benefits	IATA	2006	N/A	http://www.iata.org/whatwedo/Documents/economics/airline_network_benefits.pdf
Economic Impact Study for Colorado Airports	ICF SH&E	2013	Colorado	http://www.coloradodot.info/programs/aeronautics/PDF_Files/2013EIS_TECHRPT
Minneapolis- St.Paul International Airport	InterVISTAS	2012	Minneapolis -St. Paul	http://www.metroairports.org/documents/MSP-Economic-Impact-Study-2012-FINAL-REPORT_march2.aspx
John Wayne Airport Economic Impact Study	InterVISTAS	2014	John Wayne Airport, Orange County	http://www.ocair.com/reportspublications/EconomicImpact/JWAEconomicImpactStudy.pdf
City Momentum Index	Jones Lang LaSalle	2014	Global cities	http://www.jll.com/Research/City-Momentum-Index-January-2014.pdf?5fa7cce1-7f58-4872-b1b5-8bad50592d4f
High-level commercial and financial assessment of selected potential schemes	KPMG	2013	London & surrounding area	https://www.gov.uk/government/publications/airports-commission-interim-report
Economic Impact Study: Sacramento County Airport System	Leigh Fisher	2011	Sacramento	file:///C:/Users/899046/Downloads/SCAS_Economic_Impact_Study.pdf
Economic Impacts of Closure of Heathrow Airport	Leigh Fisher	2013	Heathrow	https://www.gov.uk/government/publications/airports-commission-interim-report
Economic Impact Study	Leigh Fisher	2011	Ottawa	http://ottawa-airport.ca/sites/default/files/yow/files/publications/2010_economic_impact_study.pdf
Supporting London business clusters	London Councils	2010	London	http://www.londoncouncils.gov.uk/policylobbying/economicdevelopment/boroughecdev/SupportingLondonbusinessclusters.htm
Auckland Airport – Future Economic Impact Assessment	Market Economics	2010	Auckland	http://www.aucklandairport.co.nz/~/media/Files/Corporate/AIAL%20EIA%20Report%202021%20and%202031%20final%20291010.pdf
Airport expansions and property values: the case of Chicago O'Hare Airport	McMillen, Daniel P.	2004	Chicago	http://www.oharenoise.org/news_page_files/Property_Values_OHare.pdf
Economic Impact: The Miami-Dade County Airport System	Miami-Dade Aviation Department	2009	Miami	http://www.miami-airport.com/pdfdoc/MDAD_2008_EconomicImpactBrochure.pdf

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Planning for Economic Infrastructure	National Audit Office	2013	UK	http://www.nao.org.uk/wp-content/uploads/2013/03/Economic-infrastructure-Exec-Summ.pdf
Economic Impact of Delhi Airport	National Council of Applied Economic Research	2012	Delhi	http://www.ncaer.org/downloads/Reports/NCAER_Airport%20Report_April_2012.pdf
Meta-analysis of airport noise and hedonic property values: problems and prospects	Nelson	2003	Canada & USA	http://econpapers.repec.org/article/tpejtecpo/v_3a38_3ay_3a2004_3ai_3a1_3ap_3a1-27.htm
New York State Economic Impacts of Aviation	New York State Department of Transportation	2010	New York State	https://www.dot.ny.gov/divisions/operating/opdm/aviation/repository/NYS%20Economic%20Study%202010%20Technical%20Report_0.pdf
JFK Air Cargo Study	NYC Economic Development Corporation	2013	New York City	http://www.nycedc.com/sites/default/files/filemanager/Projects/Air_Cargo_Study/07-JFK_Business_and_Financial_053012_MN.pdf
Tourism Satellite Account	ONS	2013	UK	http://www.ons.gov.uk/ons/rel/tourism/tourism-satellite-account/index.html
Heathrow related employment	Optimal Economics	2011	Heathrow	http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Heathrow-Related-Employment-Report.pdf
The Case for Agglomeration Economies	Overman, Gibbons & Tucci	2012	UK	http://www.parisschoolofeconomics.eu/IMG/pdf/Overman3-PSE-MEEDM.pdf
The economic value of international connectivity	Oxford Economics	2013	World Cities	http://beta.tfl.gov.uk/static/-1566634829/cms/documents/economic-value-of-connectivity-oxford-economics-york-aviation.pdf
Economic Impact of Stansted Scenarios	Oxford Economics	2013	London Stansted	http://lscc.co/wp-content/uploads/2013/07/OXFORD-ECONOMICS-STANSTED-FINAL-REPORT-November-2013.pdf
The Economic Contribution of the Aviation Industry in the UK	Oxford Economics	2006	UK	http://www.gacag.org/images/gacag/pdf/The%20Economic%20Contribution%20of%20the%20Aviation%20Industry%20in%20the%20UK.pdf
Impacts of a new hub airport on upon local and national economy	Oxford Economics for Transport for London	2013/14	London	http://beta.tfl.gov.uk/cdn/static/cms/documents/impacts-to-the-local-and-national-economy.pdf
Impacts of the closure and redevelopment of Heathrow	Oxford Economics for Transport for London	2013/14	Heathrow	http://beta.tfl.gov.uk/cdn/static/cms/documents/impacts-of-closure-and-redevelopment-of-heathrow-airport.pdf

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Heathrow Employment Impact Study	Parsons Brinckerhoff and Berkeley Hannover Consulting	2013	Heathrow	http://www.hounslow.gov.uk/heathrow_employment_impact_study.pdf
Estimating the Costs and Benefits of Regional Airport Subsidies: A Computable General Equilibrium Approach	Peter Forsyth	2006	Australia	http://www.garsonline.de/Downloads/060629/Forsyth%20-%20Paper%20-%20Regional%20Airport%20Subsidies.pdf
Air Capacity for Sydney	Peter Forsyth	2013	Sydney	http://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201302.pdf
Modelling the effect of airport noise on residential property values: an examination of the Manchester Airport second runway	Pitt, Michael and Jones, Mark	2000	Manchester plus global trends	http://www.ingentaconnect.com/content/mcb/069/2000/00000018/f0020013/art00001
The London Project	Prime Minister's Strategy Unit	2004	London	http://webarchive.nationalarchives.gov.uk/20070402085917/http://strategy.gov.uk/work_areas/london/index.asp
The Impact of Airport Noise on Residential Real Estate	Randall Bell	2001	N/A	http://realestatedamages.com/pdf/AirportNoise.pdf
London Heathrow Economic Impact Study	Regeneris Consulting	2013	Heathrow	http://www.buckstvlep.co.uk/uploads/downloads%5CHeathrow%20Economic%20Impact%20Assessment%20%20-%20Regeneris%20-%20Final%20Report%2024%20Sep.pdf
Transport and its infrastructure	Ribeiro & Kobayashi	2012	Global	http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter5.pdf
A comparison of the multipliers of IMPLAN, REMI and RIMS II: Benchmarking ready-made models for comparison	Rickman & Schwer	1995	USA	http://link.springer.com/article/10.1007%2FBF01581882
Evidence on the Nature and Sources of Agglomeration Economies	Rosenthal & Strange	2004	N/A	Handbook of Urban and Regional Economics
Factors affecting the location of real estate	Rymarzak & Sieminska	2012	N/A	Journal of Corporate Real Estate, Vol. 14 No. 4, pp. 214-225
Aviation and the Economy	SDG	2013	UK	https://www.gov.uk/government/publications/airports-commission-interim-report
The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region	The Port Authority of NY & NJ	2005	New York & New Jersey	http://www.panynj.gov/about/pdf/reg-in-aviation-economic-impact.pdf

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Review of Heathrow Employment Impact Study	Transport for London	2013/14	Heathrow	http://beta.tfl.gov.uk/cdn/static/cms/documents/review-of-heathrow-employment-study.pdf
Airport Economic Impact Methods and Models	Transportation Research Board	2007	N/A	http://books.google.co.uk/books?id=NuF6lY48RRUC&lpg=PA24&ots=qVGIF2lGx2&dq=%22techniques%20used%20to%20regionalize%20national%20input-output%20coefficients%22&pg=PP1#v=onepage&q=%22techniques%20used%20to%20regionalize%20national%20input-output%20coefficients%22&f=false
Exploring Airport Employee Commute and Parking Strategies	Transportation Research Board	2012	USA/ UK	http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_036.pdf
The Economic Impact of Civil Aviation on the U.S. Economy	U.S. Department of Transportation Federal Aviation Administration	2011	USA	http://www.faa.gov/air_traffic/publications/media/faa_economic_impact_rpt_2011.pdf
Transportation and storage sector: skills assessment	UK Commission for Employment and Skills	2012	UK	https://www.gov.uk/government/publications/transportation-and-storage-sector-skills-assessment
Shaping the Competitive City	Urban Land Institute/ EY	2014	N/A	http://www.ey.com/Publication/vwLUAssets/EY_-_Infrastructure_2014:_shaping_the_competitive_city/$FILE/EY-infrastructure-2014-shaping-the-competitive-city.pdf
Vancouver International Airport 2010 Economic Impact Report	Vancouver Airport Authority	2011	Vancouver	http://www.yvr.ca/Libraries/2010_Annual_Report/2011_05_12_Economic_Impact_Summary_FINAL.sflb.ashx
Inbound Visitor Statistics	Visit Britain	2014	UK	http://www.visitbritain.org/insightsandstatistics/inboundvisitorstatistics/latestdata/
Overview of Land Use Transport Models	Wegener, Michael		Global	http://spiekermann-wegener.com/pub/pdf/MW_Handbook_in_Transport.pdf
The social and economic impact of airports in Europe	York Aviation	2004	Europe	https://www.ryanair.com/doc/news/2012/ACI-Report.pdf
The Economic Impact of Edinburgh Airport	York Aviation	2009	Edinburgh	http://www.scotlandsglobalhub.com/media/downloads/edinburgh-airport-economic-impact-
Economic Impact of the MAG Airports: Update Report	York Aviation	2008	Manchester	http://www.manchester.gov.uk/download/downloads/id/15427/economic_impact_of_the_mag_airports_update_report

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Economic Effects of Airports in Central Europe: A Critical Review of Empirical Studies and Their Methodological Assumptions	Zak & Getzner	2014	Central Europe	http://www.hrpub.org/download/20140105/AEB6-11802008.pdf