

Airports Commission Discussion Paper 02: Aviation connectivity and the economy

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This document is Heathrow's response to the Airports Commission's second discussion paper on aviation connectivity and the economy (Airports Commission, March 2013) – hereafter referred to as the 'Commission's Paper'. Our response will follow a structure similar to the Commission's own paper:

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Overview

Aviation connectivity (a combination of direct routes served, frequency, timing and capacity of flights) is vital to the UK economy. For example:

- Direct and frequent connectivity allows a businessman to fly direct to his destination at the best time (avoiding the need for a transfer). Passengers and businesses tell us that direct flights are significantly more valuable than indirect routes;
- Direct and frequent connectivity allows critical freight (both imports and exports) to be delivered at the optimal time;
- More generally it encourages trade and investment leading to a more productive economy. There is empirical evidence, which we discuss, to demonstrate the bi-directional nature of the relationship between air connectivity and a country's economic performance;
- High value businesses have clustered around large hub airports in Europe, America and increasingly the Middle-East, bringing agglomeration benefits to their host regions. In Europe these include the Thames Valley, Ile de France and areas around Frankfurt Airport. To avoid an unprecedented risk to the health of thriving industry clusters in the Thames Valley, new hub capacity needs to be located to the West of London;
- Aviation connectivity opens up the UK to the global tourism market, with inbound visitors spending almost £19bn in the UK economy.

A single hub maximises aviation connectivity:

- It allows maximum use of transfer traffic which provides passenger volume to make a greater range of direct routes and frequencies commercially viable, especially at times in the schedule when demand for direct connectivity is low;
- It provides a geographical focal point for businesses that want to cluster around a hub supported by aviation connectivity.

The UK's hub at Heathrow directly connects to around 32% of world GDP. This is a slightly lower percentage than at other major European hubs (34% at Charles de Gaulle and 36% at Frankfurt). Crucially, however, Heathrow's percentage will fall unless new hub capacity can keep pace with growing GDP in the world's emerging markets.

A third runway would enable the UK to keep pace with world growth, directly connecting with an additional £2tr¹ of world GDP. The benefits of a fourth runway, were the demand available, are more uncertain with declining marginal benefits. The UK urgently needs a three-runway hub.

¹¹ Estimated based on Heathrow analysis

1. How aviation connectivity contributes to the UK economy

The importance of aviation

- 1.1. Aviation makes significant direct, indirect and induced contributions to the UK economy – see Table 1. In particular intercontinental aviation connectivity brings about wider economic benefits of trade in services and goods, tourism, investment, productivity and innovation.

Table 1: Contributions of aviation to the UK economy

Benefit	Example
Direct passenger and freight benefits	
More journeys	A businessman flies who would otherwise not
Direct journeys	A businessman flies direct, rather than via Frankfurt
Convenience	A businessman is able to fly at the best time
Cargo volumes	Time critical freight is more likely to arrive at the optimal time
Airlines, airports and supply chains	
Airline GVA	Local staff employed by an airline
Airport GVA	Local resident hired to work as a baggage handler
Supply chain GVA	Heathrow Express buys extra carriages
Wider economic benefits	
Trade	Rolls Royce wins more orders from China because of more direct contacts
Investment	A Chinese firm bases its European headquarters in west London
Inbound tourism	A tourist spends a week at a hotel in central London
Government revenues	Corporate tax revenues increase
Business clusters and productivity/innovation	HP and CISCO have HQs in Thames Valley, and benefit from each other's presence as a catalyst to further productivity and innovation

- 1.2. Below we show how the wider economic benefits of additional hub aviation connectivity are particularly significant, even when compared to other large infrastructure projects such as HS2.²

Trade

- 1.3. Evidence shows that aviation connectivity plays a critical role in facilitating international trade, benefiting the UK by expanding export markets and providing greater import choice for UK consumers and businesses. In particular:

- **Aviation is used to carry high value goods:** This underpins the Government's 'Innovation and Research Strategy for Growth' which aims to support a rebalancing of the economy through developing the UK's high value manufacturing sector. According to the Government's Aviation Policy Framework, £116bn worth of goods was shipped by air freight between UK and non-EU countries in 2011 – i.e. 35% of the UK's extra-EU trade by value.³
- **Many services depend on fast, timely business travel:** Particularly high value services in finance and consultancy professions.
- **Most importantly, aviation connectivity facilitates business relationships on which foreign direct investment and trade depends – for both goods and services:** According to the CAA passenger survey, 50m business passengers were welcomed by UK airports in 2011. The CBI estimates that £1bn of potential new annual trade could be created by additional daily routes to the eight high-growth markets alone (CBI, 2013).

- 1.4. Previous research has focused on the relationship between overall trade (in goods and services) and aviation connectivity⁴. Figure 1 illustrates the relationship between flights to/from the UK to non-OECD countries and the value of trade between the two countries, each dot representing the number of flights to that country from the UK and related UK trade. The line of best fit indicates that a 10% increase in flight connectivity is associated with a 7% increase in trade to that country. Very similar relationships can be seen for other European Countries, albeit

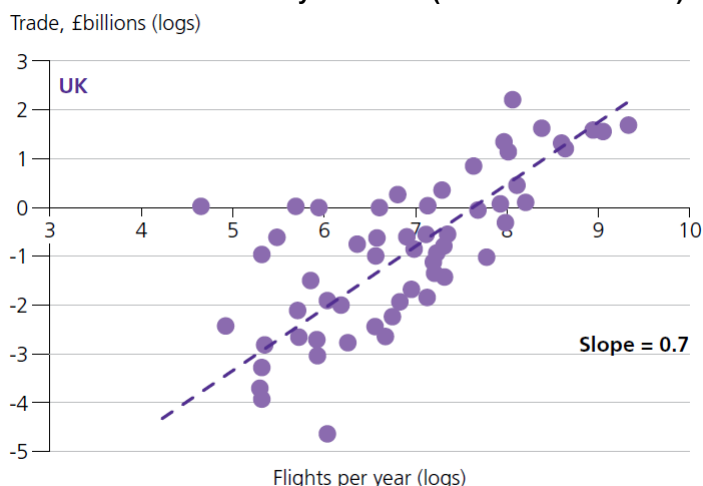
² Wider economic benefits of HS2 are estimated to be £6-12bn on capital investment of £34.5bn. See www.hs2.org.uk/about-hs2/facts-figures/economic-benefits-jobs. This sets an interesting comparison for the benefits of aviation capacity expansion.

³ Aviation Policy Framework, Presented to Parliament by the Secretary of State for Transport, March 2013, Cm 8584.

⁴ Distinguishing between goods and services is useful, but as we suggest above, aviation connectivity is important to both.

with correlations showing a range of slope steepness from 0.5 for Spain, through to 0.7 for France, 0.8 for the Netherlands and 1.0 for Germany (Frontier Economics, November 2012).

Figure 1: Aviation connectivity and trade (non-OECD countries)



Source: Frontier Economics 2012. Each dot represents a non-OECD country

1.5. Flight/trade relationships such as these indicate the role of aviation connectivity as a ‘facilitator of business opportunities’. However, they do not indicate any precise direction of causality. To do this requires a more sophisticated analysis, which can be approached in a number of ways – for example:

- **Recently published work commissioned by the CBI**

This addresses the issue of causality by introducing lags into the relationship. Does trade influence air connectivity in subsequent years? And, similarly, does air connectivity influence trade once it is expanded? The CBI reports that:

‘By analysing the data for lagged effects (a change in one variable having an impact on the other in subsequent years), our sample indicates that causality in this relationship runs both ways. This means that direct flights and trade fuel and feed each other, creating a virtuous circle of activity.’ (CBI, 2013).

- **Work by Heathrow analysts using econometric methods**

This models the endogenous relationships between trade and air connectivity. It shows how the requirements of international trade (alongside tourism and other effects) not only influence air connectivity, but also how air connectivity at London’s major hub airport (Heathrow) influences international trade patterns. Although there is further analytical work to do, results so far indicate a statistically significant influence of air connectivity (particularly at London’s major hub airport – Heathrow) on international trade patterns (Sandbach & Ardila, 2013).

1.6. We can also observe the change in export patterns in countries where new capacity has been added to major hub airports. This demonstrates the causal impact of aviation connectivity on trade – for example:⁵

- **Amsterdam: 26% rise in exports linked to 15 new country routes.** Over the five years following new capacity, exports from the Netherlands to newly connected countries grew by an additional 26% – over and above the growth of exports to the newly connected countries from the rest of Western Europe.⁶
- **Istanbul: 12% export rise linked to 18 new country routes.** Over the five years following, exports from Turkey to newly connected countries grew by an additional 12% – over and

⁵ Research conducted on behalf of Heathrow by a leading global strategy consultancy based on published sources. We can provide further details if required by the Commission.

⁶ “Schiphol Airport is of vital importance to the Dutch economy. We are an open economy and we earn a large part of our income with trade and exports. In order to reach...markets we need Schiphol Airport.”, *Minister of Economic Affairs, Dutch government.*

above the growth of exports to the newly connected countries from other non-EU eastern European countries.⁷

- 1.7. At both an analytical and anecdotal level there is strong evidence to support a bidirectional relationship between aviation connectivity and international trade. Frontier Economics have estimated that a lack of direct connections could already be costing the UK up to £14bn of lost trade a year, 0.9% of UK GDP. This figure could rise to £26bn a year by 2030.

Tourism

- 1.8. Aviation connectivity opens up the UK to the global tourism market, with inbound visitors spending almost £19bn in the UK economy (TourismAlliance, 2013). Currently, most tourists visiting the UK originate from Europe and North America, and, similarly, most UK tourists visit European and North American destinations. Looking ahead, the number of tourists that may consider visiting the UK from emerging economies is set to rise significantly – as Table 3.2 of the Commission’s Paper clearly illustrates. According to Tourism Economics, this shows that whereas the number of tourists visiting the UK from France is forecast to grow by 38% over the 10 years to 2020, the numbers visiting from India and China are forecast to grow by 107% and 121% respectively. Although starting from a much lower base, if these growth rates were to continue for the duration of the Commission’s review period, it represents a material (and quantifiable) source of additional spending in the UK economy.
- 1.9. There are, however, potential blockages – such as UK visa issues – that are well known. Once these are resolved, however, the availability of direct aviation connectivity to these emerging markets will be an essential prerequisite for their access. If this potential can be realised, the debate about a ‘tourism deficit’ would become less relevant as inbound tourism has great potential to grow and turn a surplus.

Investment

- 1.10. Foreign Direct Investment (FDI) is a recognised benefit of greater aviation connectivity, with some estimates suggesting that FDI increases by 50% after a first direct connection to a foreign region (Bannò, Mutinelli, & Redondi, September 2011).⁸
- 1.11. It is no coincidence that cities with the most long haul flights have the most international headquarters. The Commission’s Paper cites the European Cities Monitor survey showing transport links are an essential factor in the location decision of 52% of companies. This is backed up by numerous empirical studies, ranging from simple surveys to statistically rigorous

⁷ “We give a special importance to aviation sector which is an important angle for economic social development of the country as well integration with the rest of the world”, *Transport Minister, Turkish government*.

⁸ The authors also provide a useful summary of selected research papers on the relationship between FDI and aviation connectivity

Authors	Findings	Sample
McCann and Acs, 2011	Size of a city is much less important than its level of global connectivity in determining international investments.	Large MNE, global cities
Carod et al., 2010	Among others, infrastructures are key determinants of investment location.	National and foreign firms, regional and municipality level
Sellner and Nagl, 2010	Air accessibility has positive impact on GDP and investment growth.	Investment rate, country level
Xu et al., 2009	A sound foundation in traffic infrastructure, in particular in airfreight network, attracts more FDI.	FDI, provincial area
Bel and Fageda, 2008	The availability of direct non-stop flights is a major determinant in the location choices of large European firms’ headquarters.	Large firms’ headquarters, metropolitan area
Hong, 2007	National investors, when making location decisions, value market size, while foreign ones emphasize cheap labour and convenient airway transport.	Foreign logistic firms, metropolitan area
Basile et al., 2005	Italian regions attracted significantly less than their potential and this could be explained, among others, by the low level of infrastructures.	FDI, regional level
Strauss -Kahn and Vives, 2005	Among other factors, headquarters relocate to metropolitan areas with good airport facilities.	Headquarters, metropolitan area
Doeringer et al. 2004	The presence of an international airport influences the location choices of both multinational and domestic plants.	National and foreign firms, regional level
Brueckner, 2003	Frequent service to a variety of destinations, reflected, among others, in attracting new firms for service-related businesses.	Employment, metropolitan area
Hoare, 1975	The geography of FDI in UK is related to the accessibility to airports.	Foreign firms, provincial area

(Bannò, Mutinelli, & Redondi, September 2011)

econometric analyses. The former include surveys to measure the impact of air connectivity on industrial location and local economic activity (Brathen, Johansen, & Lian, 2006). The latter study the relationship between air connectivity and urban economic development measured by employment (Brueckner, July 2003), and firm locations (Bel & Fageda, 2008). The latter also use econometric methods that adjust for the endogenous both-way relationships between aviation connectivity and local economic performance.

- 1.12. A paper by the IESE and INSEAD business schools states that airport availability is highly relevant in a headquarters' decision to move away from a metropolitan area. The probability of relocating decreases by 40% if the current location offers a large hub airport, compared to a location with no hub (Strauss-Kahn & Vives, 2006).
- 1.13. The more a firm relies on international flights, the more likely it is to locate in the immediate area of an airport with excellent connectivity. There are numerous specific examples of such decisions including:
- **KPMG** – which moved its European Headquarters from Canary Wharf, London and Marie Curie Strasse (north of Frankfurt) to a location adjacent to Frankfurt Airport (south of Frankfurt)
 - **Major companies locating at the world's largest airport: Hartsfield-Jackson Atlanta International** – these include:
 - Sany Heavy Industries (the largest concrete-pumping equipment company in China) which located its American HQ in Atlanta in 2007, citing convenient transportation
 - NCR which relocated its HQ from Ohio to Atlanta in 2009, citing logistics and infrastructure
 - Baxter (US healthcare company) which located to Atlanta in 2012, citing logistics
 - Porsche – which is planning to build its new 2014 base next to Hartfield Jackson Airport.
- 1.14. In the UK, we see similar effects in the Thames Valley which, compared to the UK average, has:
- 50% more European businesses (Heathrow provides strong European connectivity)
 - 60% more foreign companies (Heathrow provides majority of UK long haul connectivity)
 - 100% more US companies (Heathrow provides a large majority of UK connectivity to the US)
 - 260% more Japanese companies (Japan is only accessible from Heathrow).
- 1.15. We estimate that expanding Heathrow and its connectivity, by adding the third runway, might generate up to £18bn of NPV from new foreign investment.⁹

Productivity and innovation

- 1.16. Finally, aviation connectivity impacts the productivity of the economy generally. Econometric research commissioned by IATA quantifies the link between aviation connectivity (along with a number of other explanatory factors such as investment and R&D) and labour productivity (as a proxy for productivity more generally). The statistically significant finding was that a 10% increase in connectivity to a country would boost labour productivity by 0.07%. Although no causality direction could be determined, the results do indicate a synergistic relationship (IATA, July 2007).
- 1.17. There are a number of mechanisms at play here – for example:
- **Access to wider markets** – allowing economies of scale in production
 - **Access to a greater range of suppliers** – offering more competitive input materials and components, and improving the efficiency, robustness and timeliness of the supply chain
 - **Clustering of related businesses around a hub supported by aviation connectivity** – acting as a spur to innovation by allowing greater networking and collaboration between companies.

⁹ Research conducted on behalf of Heathrow by a leading global strategy consultancy based on published sources. We can provide further details if required by the Commission.

- 1.18. There is good reason to believe this effect is more pronounced in the immediate vicinity of the aviation hub. The Aviation Policy Framework notes that the “excellent connectivity [provided by hub airports] helps sustain clusters of specialised high-value industries in the UK... which are knowledge intensive and increasingly global in operations”. Clusters are defined by the co-location of interrelated companies, some of which are part of a common value chain. These clusters are supported by government agencies, trade associations or a knowledge base community (e.g. research firms, training centres and universities).
- 1.19. The strongest clusters typically grow organically, improving productivity by boosting competition, improving access to resources and enabling collaborations (Porter, Clusters and the New Economics of Competition, 1998), (Lyon, 2000). Industries participating in a strong cluster register higher employment growth, as well as higher wages growth, office expansion and increased patenting. Industry and cluster level growth also increase with the strength of other related clusters in the region and with the strength of similar clusters in adjacent regions (Porter, Clusters, Convergence and Economic Performance, 2011).
- 1.20. Similar industrial clusters already exist in the Ile de France (Paris) and Darmstadt (Frankfurt). These are established locations – as opposed to any new green field location in the UK – and would be the natural beneficiaries of any loss of connectivity at Heathrow. Industrial clusters are also developing around Middle Eastern international hub airports and will provide further competition to the UK (Dubai World Centre, 2013).

2. Defining and measuring connectivity objectives

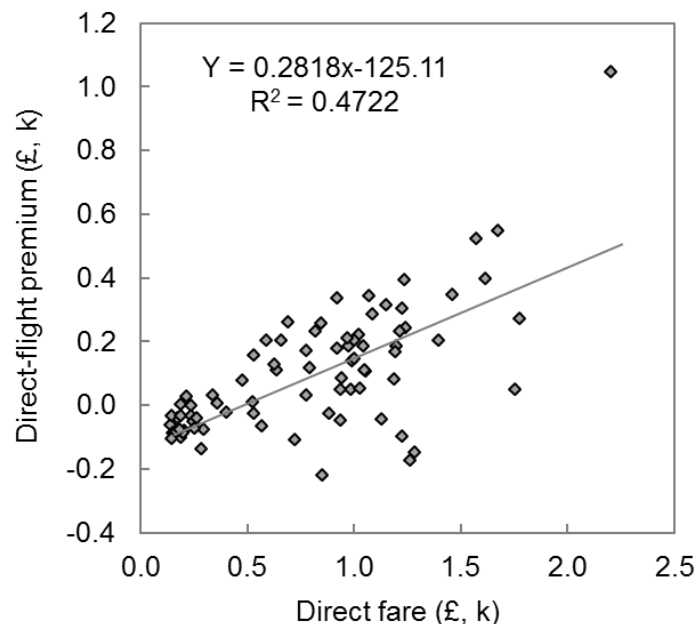
- 2.1. Aviation connectivity is a combination of destinations served and the frequency, timing and capacity of flights.
- 2.2. The timing and capacity of flights are two important components of connectivity not referenced by the Commission. The following example illustrates the contribution flight timing makes to connectivity. Twelve flights per day to a particular destination – timed to depart according to the spread of demand – represent better connectivity than twelve flights per day that all depart at a similar time. This is because the former scenario provides far more scope for passengers to choose a time that is best for them (assuming they don’t all want to travel at the same time) – a feature that is particularly important for time critical freight, and business travellers with a high valuation of time. Although airline schedules emphasise arrivals at the start of the working day and departures at the end – services throughout the day are also important. As an example, on a typical route through Heathrow, in the morning approximately 80% of passengers may fly direct. During the core hours of the day, the airlines reduce fares to attract transfer passengers in order to feed long haul services but there remains a core of business passengers that are reliant on an hourly schedule for flexibility to reach business meetings (40% transfer passengers by late morning). In the evening the number of business passenger returning increases significantly shown by an increase in direct passengers to about 80%.
- 2.3. A second example illustrates the contribution of flight capacity to connectivity. Three flights per day to a particular destination all operated by an aircraft with 200 seats represent better connectivity than three flights per day to the same destination all operated by 100-seat aircraft.
- 2.4. Both passengers and business tell us that direct connectivity is significantly more valuable than indirect. 84%¹⁰ of passengers choose to fly direct when there is a choice, and pay more to do so. According to the CAA Passenger Survey, only around 10% of passengers at UK airports choose to make their journeys via airports abroad. Formal economic modelling also supports strong passenger preference for direct flights (Koppelman, Coldren, & Parker, 2008).¹¹

¹⁰ Heathrow analysis of 2011 Heathrow departing passengers based on IATA Pax IS data. Note: Heathrow has been capacity constrained for several years, consequently the underlying preference for direct services may be much higher.

¹¹ See Table 2 of the cited paper where values are estimated for passenger preferences for direct non-stop, single connect non-stop, double connect non-stop, and indirect flights (in markets where direct routes are available). The authors comment that their result ‘...confirms the widely held belief that passengers prefer to avoid stops and connections.’ (p.265).

- 2.5. Those passengers that do fly indirect typically only do so when the travel time is marginally greater. Indirect connectivity, referenced by the Commission's Paper as a measure, is in itself not particularly useful. This is because there are so many potential indirect routings that it is theoretically possible to travel indirectly from any global airport to any other global airport. Indirect connectivity is not a differentiator – everyone has it.
- 2.6. Business also places great emphasis on direct connectivity. UK businesses trade 20 times more¹² with emerging markets that have a direct daily flight connection as they do with countries that have poor connectivity. On a day to day basis this reflects that a company may accept a contract to work in an overseas country if it can be sure that the service frequency is sufficient to get personnel to and from the site quickly and efficiently. A high frequency direct route is therefore considered essential. Similarly, a professional service company will be able to be more competitive in export markets where it can deploy its personnel as quickly as possible using direct connections.
- 2.7. Pricing evidence supports the conclusion that air passengers gain significant benefit from direct flights compared to indirect alternatives. Figure 2 details the direct flight fare premium for the most popular 80 flights out of Heathrow (accounting for 80% of revenue). The chart shows that the direct flight premium increases with the overall fare and length of flight. For a fare of £1,000, the average direct fare premium is £157 (or 16%).

Figure 2: Correlation between premium paid by passengers to fly direct and overall ticket cost



- 2.8. This leads us to focus on two critical concepts:
- **Route connectivity** – the availability of direct routes
 - **Frequency connectivity** – the frequency of flights on that route.

Measuring connectivity

- 2.9. Having defined connectivity, we next need measures of connectivity. For **route connectivity**, we believe this is valuably done by measuring the proportion of the world's GDP that can be directly connected to an air connection.¹³ For **frequency connectivity**, we determine the average frequency of flights to each destination.
- 2.10. Figures 3 and 4 show each of these measures for Heathrow, Charles de Gaulle and Frankfurt respectively. In the first chart we have ranked the world's 250 largest cities in GDP order and

¹² Frontier Economics 2011

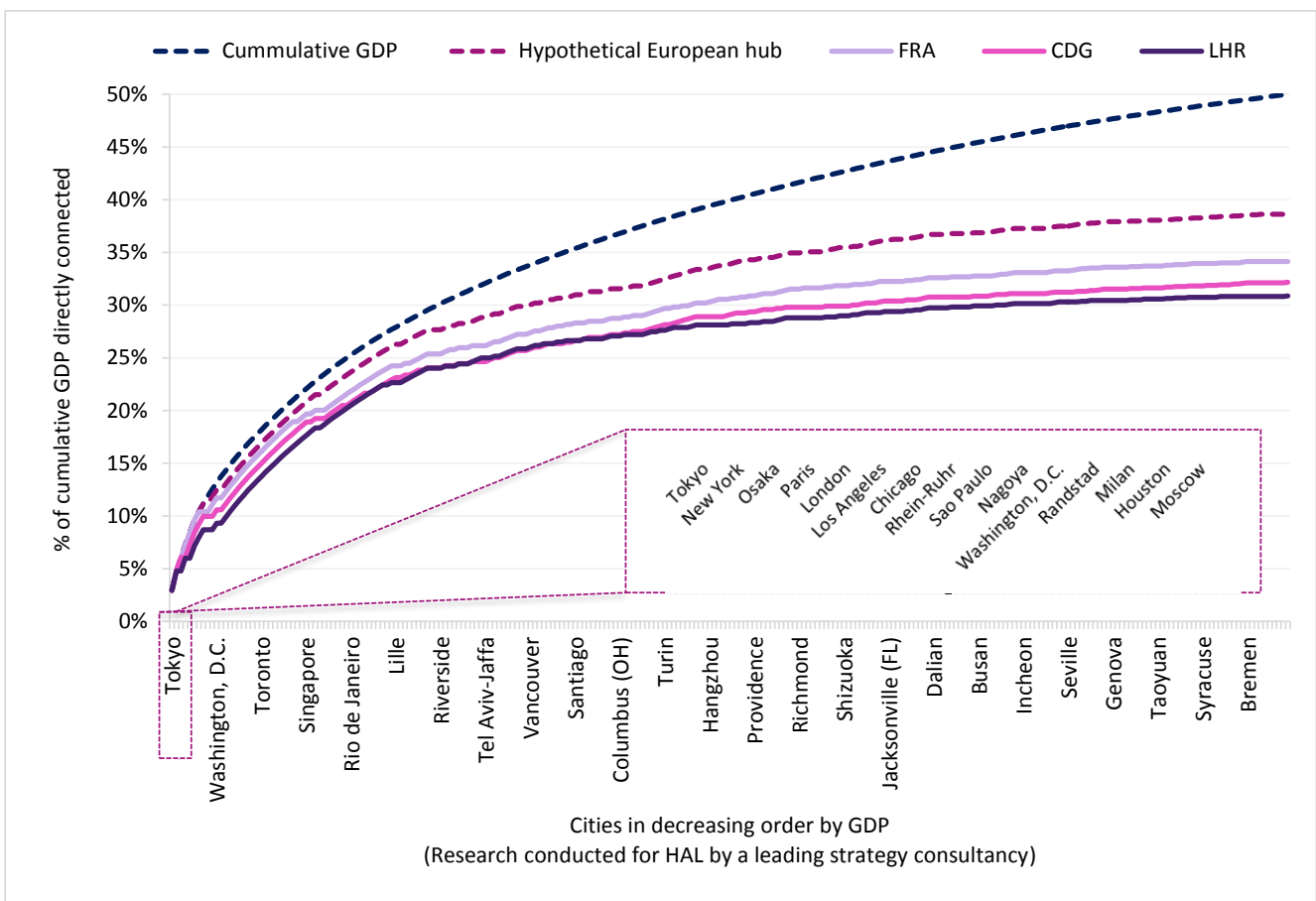
¹³ Clearly GDP is not the only important factor. For example, because of historical links, connectivity to New Zealand is more important to the UK than it is to France. However, for the purposes of the broad measures that the Commission will be seeking at this stage of its work, we believe it is sufficient to order the importance of destinations in terms of their GDP.

shown the cumulative proportion of world GDP captured by each airport's route network – starting with Tokyo (the largest), followed by New York (the second largest), and so on. Cities will become increasingly important for global growth, where urbanisation will drive a greater concentration of global GDP. In turn, this means that aviation connectivity between these cities will become increasingly valuable.

2.11. In Figure 3 we also show the proportion of GDP that could be captured by a hypothetical European hub combining all routes operated by the three main European hubs. Since all three are relatively close to each other (in intercontinental terms), and their home national economies are all relatively similar, it is not unreasonable to assume that they compete with each other on all routes. We can, therefore, regard this hypothetical hub as providing an indication of the connectivity that ideally Heathrow would have today.

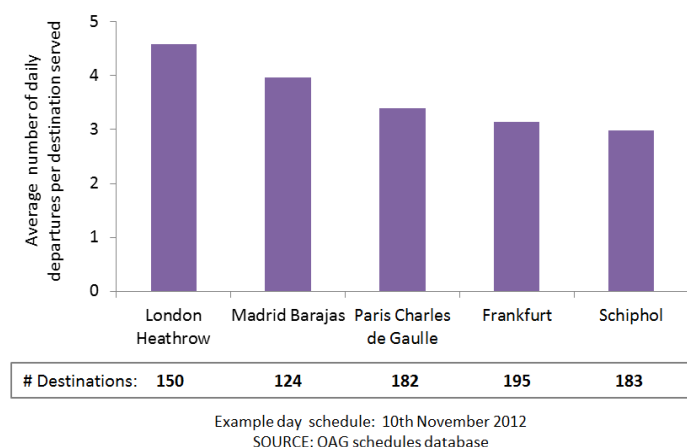
2.12. We immediately see from Figures 3 and 4 that although Heathrow has better frequency connectivity than either of the other two hub airports, its route connectivity is worse. This reflects the fact that Heathrow has excellent frequency depth – particularly on North Atlantic routes – but is unable to provide the same range of destinations as the other European hub airports due to its constrained capacity.

Figure 3: Route connectivity (cumulative) of Heathrow against benchmarks, 2011



Note: only a sample of the 250 cities are named on the horizontal axis.

Figure 4: Heathrow frequency connectivity against benchmarks, 2012



Connectivity objectives

2.13. As we have seen, we can measure the connectivity of Heathrow and the other European hub airports, and consider Heathrow’s potential for growth. For absolute route connectivity this is most obviously done by comparing the proportion of GDP connected by the routes of each airport to global GDP. This has already been shown in Figure 3, with precise numerical values now shown in Table 2, clearly showing that Heathrow’s route connectivity is the lowest of the three main European hubs at 32% of global GDP.

Table 2: Route connectivity to global GDP

	Heathrow	Charles de Gaulle	Frankfurt	Combined hypothetical hub
All countries				
Year 2011 (actual)	32%	34%	36%	41%
Year 2030 (projected)	29%	31%	34%	39%

2.14. Critically, we also need to consider how this position may change in the light of the relative growth rates in developed and emerging economies, given existing capacity constraints. The second line of Table 2 projects route connectivity to 2030¹⁴ on the assumption that existing route networks remain unchanged. The table shows that, due to a rebalancing of world GDP in favour of emerging markets, route connectivity falls in terms of connectivity to world GDP for all three hubs. This is because emerging market routes are, in general, less well connected. The effect is marginally less pronounced for Frankfurt, which already serves a relatively higher percentage of routes to emerging Asiatic economies.

2.15. The major concern to draw from this analysis is that, while other European hubs have capacity to open up new routes to maintain their overall connectivity as world GDP rebalances – so that their connectivity does not decline to the levels indicated by Table 2 (which assumes unchanged route networks) – Heathrow will be unable to do this.

2.16. **Therefore, in the absence of additional capacity within the next 10 years, the shortfall in Heathrow’s route connectivity to that of major European hubs will widen beyond that projected in Table 2. This shows the critical importance of a third runway at Heathrow.**

¹⁴ This is based on the assumption that the route network remains unchanged, but the economies grow according to the IMF’s forecasts.

3. Delivering aviation connectivity

- 3.1. It is important to note that Heathrow provides the majority of the UK's connectivity to emerging markets. Of all scheduled flights departing to the BRIC countries from the UK in 2012, 96% were from Heathrow. The CBI notes that the UK hub has recently grown more slowly than its European competitors and that UK has a particularly low share of new flights to emerging economies. Its recent report ranked the UK 4th in the EU for its share of new flights to Brazil and China and commented on the damaging implications of having to sacrifice existing routes to provide new destinations (CBI, 2013). Figures from OAG confirm this. The Compound Annual Growth Rate (CAGR) of flights departing to BRIC countries from Heathrow was 20% from 2003 to 2007 and 1% for the period 2007 to 2012. Aside from Frankfurt this was the lowest of all European Hubs. This situation is resulting in increasingly acute dissatisfaction amongst UK business leaders.
- 3.2. Frontier Economics found that:
...new connections to countries such as the Philippines, Kazakhstan, Peru and Vietnam, among others, represent more than half of this foregone trade. We also find that the UK hub could easily sustain further connectivity with countries such as China, Brazil, Mexico and Russia, among others. China alone represents close to 30% of the estimated foregone trade due the lack of hub airport capacity to deepen connectivity. (Frontier Economics, 2012)
- 3.3. Heathrow's high density schedule provides maximum opportunities for arriving transfer passengers to connect onto departing flights. While Figure 4 shows that Heathrow serves relatively fewer destinations at a higher frequency than Paris, Frankfurt or Amsterdam Schiphol, the number of 'sensible'¹⁵ transfer opportunities it can provide is higher than its competitors. A comparative analysis of the airline schedules shows that a transfer passenger has, on average, an opportunity to take nearly four different flights onto the next leg of their journey at Heathrow compared to just over two at Paris, Frankfurt and Amsterdam Schiphol.
- 3.4. Adding connectivity at the UK's hub airport would have a much greater impact on the UK's economic performance than increasing connectivity at primarily point-to-point airports – for a number of reasons.
- 3.5. Only a single UK hub can provide the intercontinental connectivity the UK needs to compete and succeed. A simple illustrative example brings life how a single hub maximises aviation connectivity: two hubs each serving 100 destinations have less connectivity than one hub serving 200 destinations. The number of city pairs, or connectivity, across each of the two smaller hubs is a quarter of that across the single hub and their combined connectivity is half that of the single hub. These city pairs generate the transfer passengers needed to enable airlines to fly to more destinations more frequently than could be supported by local demand alone. In practical terms, if London had two hubs both hubs would struggle to maintain the same connectivity to European cities needed to seed transfers to their respective intercontinental destinations, not to mention the loss of intercontinental transfers.
- 3.6. This will be especially true of the 'thinner', more marginal routes and is key to establishing greater connectivity with emerging economies. For example, Heathrow offers 1,203 daily city pair connections to or between the BRIC economies compared to Gatwick's 51. It also offers more than 3,400 sensible connections¹⁶ to and between the BRICs, compared to Gatwick's 70.

¹⁵ Sensible connections are those air routes that can be taken through a hub that can be considered 'sensible' in terms of how circuitous the final route becomes in its great circle distance compared to flying direct from origin to destination. Analysis of CAA passenger survey data shows that 95% of transfer passengers have journeys that are less than 130% circuitous – we have therefore used this value as the limit of how circuitous a 'sensible' connection can be. This analysis assumes a transfer passenger boards a flight departing between 45 minutes and 3 hours of the arrival time.

- 3.7. Secondly, expanding capacity at a hub airport is more likely to result in commercially viable new routes. Although capacity expansion at point-to-point airports may allow new routes to be added, without the additional volume of transfer passengers, it will be more difficult to make the full number of potentially available new routes commercially viable.
- 3.8. Related to this, transfer passengers, available only at a hub, also provide an essential pool of demand that may be tapped when required to fill capacity at times in the schedule when full fare demand is low (e.g. during the middle of the day, or off-peak seasons). This again enables routes with variable demand to be commercially sustainable throughout the year when operating from a hub.
- 3.9. Thirdly, the economic benefit of inbound tourists is facilitated largely by Heathrow. In fact, Heathrow handled 89% of all inbound long haul leisure/tourist passengers that used London's airports including Heathrow, Gatwick, Stansted, Luton and City (Civil Aviation Authority, 2012). Point-to-point airports, on the other hand, offer valuable short haul connectivity, enabling a mix of inbound and outbound leisure traffic. However their long haul routes are focused on outbound holiday traffic. For example, 82% of passengers on Gatwick's long haul routes are outbound tourists (Civil Aviation Authority, 2012).
- 3.10. Lastly, Heathrow research shows that it is only aviation connectivity at the UK's hub – Heathrow – that can contribute significantly to UK trade (Sandbach & Ardila, 2013).¹⁷ This is predominantly due to the more business-oriented routes that develop at a hub airport, rather than the more outbound leisure-orientated routes that develop at point-to-point airports.
- 3.11. Evidence to corroborate this conclusion is found in the existing pattern of intercontinental routes from the UK. Out of the UK's top 100 outbound intercontinental routes:
- 71 originate at Heathrow
 - 29 are either almost exclusively outbound leisure routes, or originate from airports outside of London (e.g. Gatwick to Orlando, Barbados, Las Vegas, Marrakesh, Toronto, Sharm el Sheikh, Dubai, Antigua, St. Lucia, Montego Bay, Tampa, Vancouver, Kingston, Havana).
- 3.12. Realistically, the level of connectivity required for the economy's maximum benefit can only be built at a single hub airport – as we have previously explained in our 'One hub or none' publication (Heathrow, November 2012). But more hub capacity is urgently needed to keep pace with the UK's trade potential with growing emerging economies. A third runway would enable the UK to directly connect with up to an additional £2tr of global GDP. However, benefits diminish after this - a fourth runway, were the demand available, would generate a much smaller and uncertain connectivity benefit. The UK urgently needs a three-runway hub.

4. Answers to specific Commission questions

Questions raised in Chapter 4

1. (Paragraph 4.11) – To which destinations are aviation connections most important and why?

The importance of destinations reflects the UK's current and future economic links. These include trade in goods and services and inbound tourism. Although UK trade is currently weighted towards Europe and North America, over the next 10-20 years the country must be prepared for the growth of emerging Asiatic markets. IMF or other projections of GDP growth define the shape of important future trading partners.

2. (Paragraph 4.11) – What is the impact of providing indirect flights (i.e. flights involving a transfer) rather than direct ones on connectivity of the consumer/freight? Which consumers are most affected?

¹⁷ The patterns of trade and tourism do contribute to the composition of the flight schedule at other airports.

Clearly, indirect flights are acceptable to a proportion of passengers (particularly price conscious leisure passengers), and indirect connectivity is vitally important in providing transfer passengers to make routes commercially viable (see Section 3). However, the evidence shows that it is direct connectivity that is correlated with the wider economic benefits of aviation, and this is confirmed by the fare premiums paid for direct flights (see Section 2 and Figure 2). Increased connectivity at Heathrow would allow passengers to switch from an indirect to a direct route. We have shown that customers prefer and are willing to pay a premium for direct services. See Section 2.

3. (Paragraph 4.11) – How should connectivity for leisure passengers be valued?

Economic theory shows how connectivity for leisure passengers can be valued by the consumer surplus that accrues to passengers through the flights they take, i.e. the difference between the value they obtain from the flight and the fare they pay. This depends on (and can be estimated from) the fare price elasticity: more price sensitive passengers are likely to have a lower consumer surplus. Their value can also be seen in the increased spending of leisure passengers that access the country via Heathrow and in the growth potential for inbound tourist spending from growth markets.

4. (Paragraph 4.11) – How does providing flights at the right time of day and day of the week impact connectivity? Which consumers are most affected? What about freight?

A number of economic studies identify the frequency and timing of flights as being a key variable influencing the wider economic benefits of aviation connectivity (Koppelman, Coldren, & Parker, 2008; and Jacobs *et. al.*, 2010).¹⁸ Airline schedules emphasise morning and evening flights. However, in addition, flight frequency is also a key determinate of the route's suitability for just-in-time freight, as well as for some business travellers.

5. (Paragraph 4.11) – What is the impact of airport congestion on consumer connectivity? Should reliability be taken into account?

A high density airport operation provides the consumer with maximum connectivity. Such an operation is susceptible to congestion at key 'bottlenecks' in its system, for example the runways. This congestion reduces operational resilience and leads to lower flight reliability through delays, missed connections and cancellations. For most of a typical day Heathrow operates at or very close to its capacity limit. However, considerable effort goes to ensure a reliable airport. In fact, between 2007 and 2012, departure punctuality¹⁹ at Heathrow rose from 63% to 80%, and we aspire to take this to 90% by 2019 with the existing two runway airport. While additional capacity at a high density airport will improve resilience of the operation to sporadic shocks, the main benefit for the air transport consumer will be realised through improved day-to-day connectivity.

6. (Paragraph 4.11) – What is the impact of ticket costs to the consumer? How price-sensitive are business and leisure travellers? How can this be captured in measuring of connectivity?

The price elasticities estimated by the DfT econometric model show leisure passengers to be more price sensitive than business passengers (Department for Transport, 2013). This corroborates the greater economic value attributable to business compared to leisure passengers. As business passengers prefer to fly direct, this, in turn, corroborates the greater emphasis that should be placed on the value of direct rather than indirect connectivity.

Questions raised in Chapter 5

7. (Paragraph 5.4) – Do you agree with the definition of connectivity presented in the paper? What other factors, if any, should we take into account and how do they impact connectivity?

We have defined route connectivity and frequency connectivity. We believe these are the two crucial measures that best correlate with the economic benefits of aviation. The timing and capacity of flights are also important contributors to connectivity. See Section 3.

¹⁸ See section 2.4.6 of Jacobs *et. al.* text 'Time-of-Day Preferences Versus Schedule Delay Function'.

¹⁹ Measured to within +/- 15 minutes, Heathrow airside punctuality statistics,.

8. (Paragraph 5.4) – Do you agree with the assessment we have made of the UK’s current aviation connectivity?

Our analysis broadly aligns with that of the Commission’s Paper.

9. (Paragraph 5.4) – What factors do you think contribute to the fact that the UK is directly better connected to some regions of the world than others?

Our research shows that historical trade, language and tourist links, as well as geographical distance and cultural factors, all explain the current pattern of air connectivity to the UK. The UK continues to show the potential to be one of the world’s principal trading locations – but needs high quality aviation connectivity to achieve it.

10. (Paragraph 5.4) – Given connectivity trends in the UK versus other European countries, how much scope is there for route network available to UK residents to radically change over the coming years?

In the long run, route networks will change to reflect changing patterns of demand, especially where there is spare capacity. However, where capacity is constrained it will be difficult for new routes to replace existing ones, particularly where these form part of an established network. Given the capacity limit at Heathrow, it is difficult to see how a significant route network could be built to serve Asiatic markets. High slot prices at Heathrow give a clear indication of this constrained demand.

11. (Paragraph 5.4) – To what extent do you consider indirect connectivity to be an important part of presenting an accurate picture of the UK’s nature of connectivity?

Evidence shows that direct connectivity correlates with the wider economic benefits of aviation – a fact confirmed by the fare premium paid for direct flights. See Section 2. However, a proportion of passengers use indirect flights – particularly price conscious leisure passengers.

12. (Paragraph 5.5) – To what extent do you agree with evidence that aviation connectivity supports the UK’s economic growth through facilitating each of (1)-(5)?

Analytical and strong anecdotal evidence all points to aviation supporting the UK’s economic growth through the mechanisms described in the Commission’s Paper. See Section 1.

13. (Paragraph 5.5) – Are there other channels through which aviation connectivity might facilitate economic growth? What are they, and what evidence is there to support this?

Although the channels described by the Commission’s Paper are comprehensive, we would emphasise that the benefits to trade in goods is not restricted to better freight aviation. As with trade in services, aviation connectivity facilitates business relationships that aid trade in goods. See Section 1.

14. (Paragraph 5.5) – How effective do you consider that the aviation connectivity of the UK may facilitate economic growth now and in the future? What risks and opportunities does it present?

Given the particular importance of connectivity at a hub airport, the capacity constraints at the UK’s main hub airport are a clear risk. In particular there is evidence, as recognised in the APF, that they are forcing carriers to trade breadth of destinations for depth of connections.

15. (Paragraph 5.5) – How important do you consider connectivity for each of (1)-(5)?

Each of (1) to (5) is important. While the benefits to trade in goods and services, and even FDI, are relatively easy to appreciate, the more general benefits to investment and productivity are more difficult to identify. However, this is not to say they are less important – merely that their quantum is less clear cut.

16. (Paragraph 5.5) – Are there other relevant policy issues which should be taken into account?

The particular benefit of connectivity at a hub airport as the focus for international connectivity needs to be taken into account. See Section 3.

17. (Paragraph 5.5) – To what degree can causality between connectivity and (1)-(5) be established? Are there any particular research methods that we should be looking at and why?

There is empirical evidence to demonstrate the bi-directional nature of the relationship between air connectivity and a country's economic performance. A number of research methods can identify this, including: (1) econometric methods where both sides of the relationship are modelled, and estimators used that allow for the endogeneity of the air connectivity and economic performance variables; (2) econometric methods that allow for time lags in the relationships, for example an increase in air connectivity affecting trade in subsequent years; and (3) 'natural experiments' where we observe the impact of adding capacity at a particular airport on trade of that country against benchmark countries where no capacity has been added. We give examples of each of these methods, see Section 1.

18. (Paragraph 5.6) – What is the best approach to measuring the UK's aviation connectivity?

We have defined route connectivity and frequency connectivity. The timing and capacity of flights are also important to connectivity. These, we believe, are the crucial measures that correlate with the economic benefits of aviation. See Section 2.

19. (Paragraph 5.6) – Connectivity depends on many factors, such as number and frequency of flights and time and cost of travelling to passengers. Do you consider any of these factors to be of particular relevance to facilitating any of (1)-(5)?

Yes – the number and frequency of flights are the crucial factors. Cost of travelling is more likely to be an endogenous factor. If the number and capacity of flights to a destination is low, then the fare may be higher. Conversely, if there is capacity on a route, cheap fares will be available.

20. (Paragraph 5.6) – We have outlined a few different measures of connectivity in the paper. What alternative measuring approaches that we have not mentioned should we take into account?

We outline our preferred approach in this response. See Section 2.

21. (Paragraph 5.6) – What kinds of impact do you consider capacity constraints to have on the frequency and number of destinations served by the UK? And, if any, are any particular kinds of routes or destinations likely to be more affected than others?

Frontier Economics suggest that the lack of routes to countries such as the Philippines, Kazakhstan, Peru and Vietnam is resulting in the UK missing trade opportunities, as well lack of frequency to China, Brazil, Mexico and Russia, among others. It is reasonable to assume that these routes are most affected by capacity constraints (Frontier Economics, 2012).

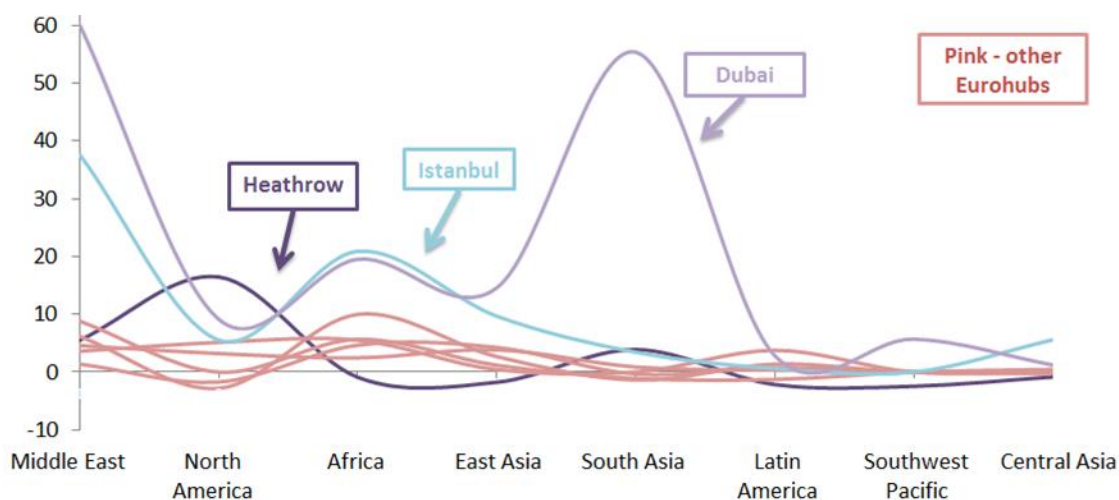
Where capacity is constrained it will be difficult for new routes to replace existing routes, especially where these form part of an established network. For example, the network from Heathrow is focused on routes to North America, whereas the network from Madrid is focused on routes to South America, and the network from France is focused on routes to Africa – see Table 3.

Table 3: Direct connection ATMs of major European hubs

	Heathrow	Charles de Gaulle	Madrid	Frankfurt
North America	1,500	619	198	627
Latin America & Caribbean	78	221	473	158
Asia	1,226	763	113	892
Africa	279	288	46	141

Figure 5 shows the number of new daily frequencies added at a selection of the world's major hub airports to different regions of the world. Heathrow clearly lags behind both non-European hubs for all regions other than North America, and also all the other European hubs for Africa, East Asia, Latin America, Southwest Pacific and Central Asia. This figure also demonstrates the rise of hubs at Europe's borders – Dubai and Istanbul.

Figure 5: New daily frequencies added at European hubs, Dubai and Istanbul – 2005-2012



Given capacity limitation at Heathrow and expansion at other hubs, it is difficult to see how a significant route network could be built to East Asia from a constrained airport.

22. (Paragraph 5.6) – To what extent do you consider that the need for additional connectivity may support the argument that additional capacity may be required?

Given the importance of connectivity at the UK's hub airport (see Section 3), and the capacity currently constraining this airport, it is clear that any substantial additional connectivity can only be achieved by increased hub capacity. The UK urgently needs a three-runway hub.

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