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**UK Regional Connectivity on the North Atlantic: Hub-Bypassing
or just changing hubs?**

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UK Regional Connectivity on the North Atlantic: Hub-Bypassing or just changing hubs?

1.0 Introduction

Connectivity is one of the primary benefits of air travel, and one that continues to grow in importance as globalisation develops. The reasons for this are varied and include stronger links between commercial enterprises (both at the intra and inter-continental levels), greater population mobility be it for temporary labour relocation or for permanent migration purposes, as well as tourism. These factors, amongst others, have combined to spur demand for increased air routes and frequency.

The challenge facing many countries in Europe, especially in the UK, is growing hub congestion. The country's largest airport, London Heathrow (LHR) has been at near capacity for decades, and the second largest airport, London Gatwick (LGW), is only marginally less so. Despite numerous government enquiries (the first was in 1968), the possibility of a full sized runway being built in the southeast of the country remains years away from completion – at the very best. In order to maximise passenger throughput, LHR has implemented landing charge tariffs that promote the utilisation of larger aircraft – a strategy that encourages long-haul traffic whilst placing some routes from regional airports at risk (CAA, 2007). Whilst this has promoted more inter-continental traffic through LHR and solidified the airport's position as a global hub, its position as 'the' UK hub is more questionable.

Although there is a lack of available connections to LHR, this in itself does not mean that a regional airport is isolated. In order to maintain and to even develop connectivity there are two options available: 1) develop links to another hub airport or 2) develop point to point services that bypass hub airports altogether.

Within most European nations, including the United Kingdom (UK), aviation services were provided initially by government owned airlines who were tasked with not only providing international services from the country but to regions within the nation as well. These airlines evolved into today's full service carriers (FSC), and even after being privatised and no longer government owned, are often the main provider of services to regional airports. The most common operational network utilised by these airlines is the hub and spoke model which tends to divert traffic from regional airports into the airline's hub airport instead of providing point to point or direct service which would bypass the hub airport.

Connectivity was established and maintained through the provision of direct services from regional airports to hub airports which in turn allow for connections to other airports. From an airline perspective, this is an efficient model which allows for efficient passenger transfer to other routes as well as sufficient numbers to support long-haul services. Even in situations where there may be sufficient passenger numbers to support long-haul traffic from regional airports, many FSC prefer to feed hub airports and to maintain more frequent services than to dilute their passenger numbers with point to point services.

The link between economic development and air transport connectivity has been researched and well-documented over the years, and has been one of the criteria used in establishing new routes or increasing service between airports. The necessity of air travel is such that even when governments have been prohibited from supporting airlines, they still retain the capacity to provide financial support for routes that are not economically viable if they deem them to be in the national interest (PSO routes).

The aim of this study is to investigate whether UK regional airports have increased direct services to North Atlantic destinations or to other European hub airports in response to the lack of air services to the London area.

The rest of this paper is structured as follows: Section 2.0 provides the industry background and relevant literature. In section 3.0, the study methodology will be outlined. In section 4.0, the findings are presented according to the route typology: 4.1, flights from UK regional airports to London airports; 4.2, flights from UK regional airports to selected EU hub airports; and 4.3, flights from UK regional airports to North American airports; 4.4 summary. Finally, the findings are presented in the conclusion in section 5.0.

2.0 Background

There have been inter-continental services between the UK and North America for decades, made viable through its relative geographic proximity to one another and supported through historical ties and centuries of immigration (Maertens, 2010).

Limited by the technological capabilities of early aircraft, some initial flights required stopovers with popular points being Gander (Newfoundland), Greenland, Prestwick, and Shannon (Ireland). Once this challenge was overcome, the majority of flights from North America to the UK were landing in the London area.

The Bermuda Agreement of 1947 between the US and the UK was one of the first bilateral agreements signed after the Chicago Convention (1944). Despite provisions in the agreement to allow for equal opportunities for air carriers, the utilisation of the hub and spoke systems focusing on 'gateway' airports in the US gave US carriers an advantage on the trans-Atlantic market (UK Parliament, 2000). These conditions led the UK Government to renegotiate the terms of the bilateral, and the Bermuda II Agreement replaced the initial agreement in 1978. Although subsequent amendments allowed for the provision of services to any UK regional airport¹, operations on the New York-London route to only two carriers from either country (UK Parliament, 2000; Button, 2009). Despite this provision, the majority of US services continued to operate to either Heathrow or Gatwick.

This was further reinforced with the final stage of implementation of the EU-US Open Skies Agreement of 2008. With restrictions lifted, US airlines moved en masse from

¹ In 1995, the UK and U.S. governments signed an amendment permitting flights between any UK regional airport and the United States as of 1996. The amendment defined both Luton and Stansted airports as UK regional airports (UK Parliament, 2000).

London Gatwick (LGW) to London Heathrow (LHR) leaving only limited services at LGW (Humphreys and Morrell, 2009; OAG).

As congestion increased at LHR, connections from UK regional airports remained stagnant; options to connect, however, continued to be available at other European airports. This was further strengthened with the introduction of the European Open Skies agreement, which spurred the development of LCCs (low cost carriers) and created opportunities to develop and increase links between UK regional airports and other national hubs.

There has also been the provision of direct services between regional airports and North American airports. Although the majority of these services bypass hubs in Europe, they do connect into hub airports in North America like Chicago, New York and Toronto. In the mid-2000s, there were also a number of services that developed between non-hub airports on either side of the Atlantic; the majority of these services connected to Canadian airports rather than in the United States (OAG, 2007).

Changes in the aviation industry have made the possibility of connections between non-hubs more feasible. Technological developments have resulted in the production of aircraft like the B-787, B-737Max, A-350, and the A-321neo – all capable of providing long-range service on relatively thin routes, thus opening up the possibilities of hub to non-hub connections, or possibly even non-hub to non-hub services.

Coupled with near capacity at Heathrow, regional airports are left with the option either to connect to other hub airports or to seek direct services to North America.

Both Graham and Guyer (2000) and Suau-Sanchez et al (2016) have examined the UK aviation network examining regional connectivity. Both have identified the importance of London Heathrow for connections within the UK, but have also highlighted the reliance of UK regional airports on foreign hubs.

The CAA also published a time-series analysis of regional airport connectivity looking primarily at trends from 2000-2005, but also included data from earlier (CAA, 2007). The study found that from 2000-2005, that whilst the number of passengers flying from regional airports to London airports to connect had fallen, the number of passengers flying directly from regional airports to international destinations or to European airports to connect on long haul services had increased. The drawback is that the study was undertaken prior to a number of factors that have since impacted North Atlantic air travel: the EU Open Skies Agreement (2008), the recession (2008), the mergers in the U.S. industry (2008-2013), the spike in jet fuel prices (2008), and the purchase of British Midland by British Airways (2012).

Within the UK, London's Heathrow Airport has long been identified as a global hub. Ongoing congestion issues have, however, limited its capacity to grow. Although many airlines would prefer to have links to Heathrow, the lack of available slots restricts both possible network expansion and London's connectivity growth (UK Government, 2013). Research by Gudmundsson et al (2014) found that congestion factors at Heathrow led to spillover to Gatwick and Manchester Airports, and to a lesser extent Birmingham Airport. This was also suggested by Hanlon (2007) who cited the growing

practice of avoiding congestion issues at London Heathrow by using European hubs instead to transfer to regional airports in the UK. Evans and Schafer (2014) supported this with their supposition that airlines would select alternatives to congested airports if possible.

While most intercontinental routes are operated by full service carriers (who rely upon their hub and spoke networks), some airlines complement their hub to hub intercontinental routes with point to point services that exclude a hub at one end (Oum and Zhang, 2001). Some studies have examined the dispersion of inter-continental services, and both Swan (2002) and O'Connor (2003) noted a growing trend toward hub to non-hub linkages on long-haul routes, although this pattern seemed to have been suspended in the post September 11, 2001 period (Dennis, 2005). Studies of European connections from 2004-2008 by Bel and Fageda (2010) and of Asian-Australian connections from 2000-2013 by O'Connor and Fuellhart (2015) have indicated that inter-continental flights are once again trending toward dispersion rather than toward consolidation.

Connectivity is one of the most discussed aspects of aviation. Its economic benefits at both the regional and national level have been examined in the literature (Brueckner, 2003; Bel and Fageda, 2008).

Graham and Guyer (2000) noted the importance of air services for regional economic development as well as the need for stability and continuity of air services, whilst Maertens (2010) examined the link between local GDP and the provision of direct intercontinental air services. This was also noted by Button and Taylor (2000) who found that intercontinental services to Europe were of economic benefit to U.S. cities and that improved international connections were likely to stimulate further growth in the economy.

Given the ongoing congestion issues in the southeast of the UK, it is reasonable to believe that there will be continued pressure to increase plane size, thus reducing the economic viability of flights from regional airports, a trend noted in many congested and some non-congested airports (Berster et al, 2015). In order to maintain and improve regional economic conditions, it is posited that regional airports will either develop more connections or improve existing, be it to non-UK hub airports to directly to North American destinations.

3.0 Methodology

Connectivity of UK regional airports has been analysed on a snapshot basis (Graham and Guyer, 2000; Suau-Sanchez et al, 2016), and on a time-series basis (1990-2007) by the CAA (CAA, 2007). This study builds upon this research with a time series analysis of connectivity from 1997 to 2017 using flight schedules from July 11-17 from 1997, 2007 (OAG Data) and 2017 (Brussels Airport, Innovata).

First, flight schedules for the study were compiled from UK regional airports² to that of London airports to determine if direct connections existed during the study week. Secondly, flight schedules were compiled from UK regional airports to Amsterdam (Schiphol Airport, AMS), Brussels (Brussels National Airport, BRU), Dublin (Dublin Airport, DUB), Frankfurt (Frankfurt Airport, FRA), Paris (Charles de Gaulle Airport, CDG), and Reykjavik (Keflavik Airport, KEF)³. The third step was to examine flight schedules from the study week from UK regional airports to airports in North America (Canada and the United States).

This initial analysis seeks to quantify the connections available from UK regional airports to 1) the London airports of Gatwick and Heathrow⁴; 2) other European hub airports; and 3) North American airports.

As such, only UK regional airports that have 1) a connection to a London airport; or 2) a connection to one of the European hub airports; or 3) a connection to a North American airport will be considered to be part of the study. This is to eliminate the presence of small airports, many of whom have physical restrictions limiting the type of aircraft permitted and thus negate the possibility of long-haul aircraft.

Although a number of studies use connectivity measures that incorporate connections at hub airports and indirect connections (Burghouwt and Redondi, 2013), this study focuses upon the presence of direct connections. In order to avoid the possibility of double-counting on multi-stop flights, the origin and destination of each flight was deemed to be the last point from within the UK and the first point of entry in either the U.S. or Canada. As such, if a flight was from Exeter to Manchester to Toronto to Vancouver will have been designated as having Manchester as its origin, not Exeter, with the destination being Toronto, not Vancouver.

It should be noted that although the text will often indicate that a flight was from one city to another, it is implicit that a return service is always paired with the initial flight.

Although numerous flights operate as codeshares, each flight was assigned to the operating carrier regardless of the various airlines codes associated with the flight. The exception to this was when the flight was operated under a lease or franchise agreement; in those cases, the flight was assigned to the marketing carrier.

As with the identification of codeshares to the operating carrier, this was done in order to avoid any possible duplication or double-counting of services. It also allowed for a more solid foundation of comparison as airline partnerships and alliance membership was not static during the time period being studied.

² For the purposes of this research, a UK regional airport is defined as an airport that is not in the London area. London area airports are defined as: Heathrow (LHR), Gatwick (LGW), Luton (LTN), Stansted (STN), Southend (SEN) and London City (LCY).

³ All six airports are hubs for European FSC: Amsterdam (KLM), Brussels (currently SN Brussels Airlines and previously Sabena), Dublin (Aer Lingus), Frankfurt (Lufthansa), Paris (Air France) and Reykjavik (Icelandair).

⁴ Only Gatwick and Heathrow have operated, or continue to operate as a hub for British Airways. None of the other London area airports can be considered hub airports.

The secondary aspect to be considered is the quality of the connection. Whereas some will refer to 'quality' from a passenger perspective (less travel time, better connections, etc.), quality within this context refers to the strength of that connectivity. The premise here is that more frequent service between two points reflects greater economic ties and is the foundation for future economic growth and development, and as such is of greater quality and benefit.

Connectivity, by its very meaning implies the ability to connect; however, LCCs do not sell tickets with connecting flights (or have codeshare or interline services with other airlines), thus discouraging passengers from using their services if they require travel beyond the point to point service being offered. Unsurprisingly, the CAA found in 2006 that traffic on LCC carriers to Amsterdam or Paris have almost no connecting passengers, whereas traffic on FSC carriers to their hubs have a high number of connecting passengers (CAA, 2007). The CAA likewise found that although regional air carriers often have some form of interline arrangement with FSC carriers, only about 5-15% of all passengers connect. As such, only FSC operations were included for intra-UK and intra-European services. As one of the aims of this study is to determine whether UK regional airports have developed either links to other European hubs due to weaker access to LHR, then passengers would only use services from UK regional airports to European hubs that allowed them to connect to other services, something that is less likely with LCC or even interlining regional carriers.

Airlines that are included in determining the quality aspect of UK regional connectivity are: Aer Lingus (EI), Air France (AF), British Airways (BA), British Midland (BD), Icelandair (FI), KLM Royal Dutch Airlines (KLM), Lufthansa (LH) and SN Brussels Airlines (SN)⁵. Fifth freedom services operated by Cathay Pacific (CX) and Singapore Airlines (SQ) were also included. Flybe (BE) and AirUK (UK) services were also included when operating a codeshare service, as were other airlines like Loganair or CityJet when the marketing airline was one of the airlines listed above. Subsidiaries of AF and BA, Hop! and BA CityFlyer respectively, were also included when their parent company was the marketing airline.

All airlines were included in the analysis of direct services on the North Atlantic.

In order to measure 'quality', the frequency of service will be used. The frequency of services can be considered a good metric as it is not influenced by either the aircraft capacity or aircraft utilisation (Allroggen and Malina, 2014). Although not utilising the term 'quality', the CAA did categorise connections into three categories for short-haul flights (including to the EU): less than daily, daily, and more than daily. They likewise used three categories for long-haul flights to the U.S.: less than six flights per week, six-eight flights per week, and more than eight flights per week (CAA, 2007).

As proven in any gravity model, there is a greater likelihood of stronger connections between places which are situated closer geographically, although rail services may be more important than air connections between cities which are located within a certain time threshold. Nonetheless, geographic proximity is a key factor in the provision of air services.

⁵ SN Brussels Airlines was founded following the demise of the Belgian national flag carrier, Sabena in 2001. Both airlines used the code, 'SN'. In this study, data for SN in 1997 refers to Sabena flights, and in subsequent years SN Brussels Airlines.

Given the differences in distance from UK airports to other destinations within the UK and to European hub airports Vis à Vis trans-Atlantic services to North America, two metrics were devised to measure the quality of the connection.

For flights within the UK and to European destinations, route frequency has been divided into five categories: 1) Very Weak (0-3 flights /week); 2) Weak (4-6 flights per week); 3) Moderate (7-13 flights / week); 4) Strong (14-20 flights / week) and 5) Very Strong (21+ flights / week).

For flights from the UK to North American destinations, route frequency has been divided into four categories: 1) Very Weak (0-3 flights /week); 2) Weak (4-6 flights per week); 3) Moderate (7-13 flights / week); and 4) Strong (14+ flights / week).

The 'Very Weak' category reflects limited service that it unlikely to be beneficial to business travellers, whilst the 'Weak' category indicates service that may be of some benefit to business travellers, as it often reflects services that operate weekdays, or daily service less either Saturday or Sunday. The 'Moderate' category provides a consistent link with a minimum of daily service that is often deemed a necessity for business travellers. The 'Strong' and 'Very Strong' categories with its multiple flights per day provide the flexibility required for business traffic and reflects strong economic links. Given the difference in geographic distance, the 'Strong' and 'Very Strong' categories were collapsed into one category ('Strong') for inter-continental travel on the North Atlantic.

4.0 Results

4.1 Services from UK regional airports to London airports

The nature of air service between UK regional airports and London airports has changed from 1997 to 2017 with a trend toward fewer routes and reduced frequencies by full service carriers from both Heathrow and Gatwick.

Only two airports, Edinburgh and Glasgow, had FSC service to both LHR and LGW in 1997 and still have that service at present (see Table 1). Despite having connections that were Very Strong, the frequency between the two airports and LHR declined by over 37% from 1997-2017, and by over 28% to LGW.

A number of airports (ABZ, LBA, MAN, and NCL), had Very Strong connections to both LHR and LGW in 1997; by 2017, all four airports had ceased FSC operations to LGW. However, all retained a Very Strong quality of connection to LHR with the exception of LBA that currently has a Strong connection. Manchester saw an increase in services from 1997-2007, but has since had its frequencies reduced by more than half. This is perhaps the result of the completion of new rail links in 2007 between London and Manchester.

Inverness had a Very Strong connection to LHR in 1997. In 2007, this was reduced to a Moderate quality of service but complemented by a Strong service with LGW.

However, by 2017 the service to LGW was discontinued leaving only a Moderate connection with LHR.

Durham/Teesside Airport (MME) had a Very Strong connection with LGW in 1997 that was replaced with a Very Strong connection to LHR in 2007. By 2017, however, the service between MME and LHR had been discontinued.

Belfast had a Very Strong connection between LHR and BFS (Belfast International). In 2007, a Very Strong connection was still present, but was operational between LHR and BFD (George Best Airport). In 2017, only a Moderate service existed between LHR and BFD. There is still service from BFS to London, but it is provided by LCC Easyjet to Luton and Stansted airports.

There was a Very Strong service between JER and LHR in 1997. This became a Strong service in 2007, but was complimented by a Very Strong service to LGW. The transition from LHR to LGW was evident in 2017 as service to LHR no longer operated. Although often linked with Jersey, Guernsey has not had direct FSC service to either LHR or LGW during the time periods being examined.

The Isle of Man, like Guernsey, does not have an FSC connection to London in July 2017. Both the Channel Islands and the Isle of Man have however had air service to London over the years provided by regional carriers like Aurigny Air, Flybe and Manx Airlines.

Both NQY and PLH had connections to LGW in 1997 (Very Strong and Strong respectively) which have since been discontinued.

Of note is the lack of FSC service from both Luton and Stansted⁶, reinforcing their position as LCC oriented airports. Likewise, there is neither FSC nor LCC service from Southend, leaving UK regional airports with connections to LHR, LGW, and in more recent years, LCY. Although there is FSC service to LCY, it should be remembered that the airport does not function as a hub for any airline, and thus operates as a spoke airport for FSC carriers.

Whilst number of regional airports served by LHR in 2017 has only declined slightly from 1997 (nine to eight), the number of flights has decreased by over 36%. The greatest decline in both connections and frequencies is that of LGW. From nine and eight connections in 1997 and 2007 respectively, LGW only had FSC scheduled services to three regional airports in July 2017. The number of flights has also decreased substantially from 278 flights/week in 1997 to 79 scheduled flights/week in July 2017, a drop of 71.6%. This decline is in a part a reflection of the change in British Airways' strategy to use LGW as a hub for its UK operations.

Insert Table 1

4.2 Services from UK regional airports to European airports

⁶ With the exception of a 15 flights / week service from STN to MAN by British Airways in 1997, there have not been any FSC service from LUT or STN during the periods being examined in this study.

This area has seen the most dynamic change in regards to UK regional connectivity, especially as it pertains to FSCs. This in part due to changing network structures, but also due to the rise in LCCs and the presence of regional airlines which promote point to point service, thus diluting the passenger traffic of the larger FSC carriers. In addition to new routes being added and the cessation of others, some airports have seen changes in their connection quality.

Manchester Airport had Very Strong connections to AMS, BRU, DUB, FRA, and CDG, as well as a Very Weak connection to KEF in 1997. Despite a reduction in overall flights from 1997 to 2017 of over 40% (see Table 2), MAN maintained their Very Strong connections with the exception of BRU that decreased to a Strong connection; service to KEF improved to a Weak connection.

Three airports (all based in Scotland) saw improvements in their EU hub connections, in terms of both destinations and quality: ABZ, EDI, and INV. ABZ had one Very Strong connection to AMS in 1997; by 2017, this improved with the addition of Moderate service to DUB, Strong service to both FRA and CDG, and Very Weak service to KEF. EDI had two Very Strong connections in 1997 (AMS and DUB) and Moderate service to BRU; by 2017, the airport also had connections to FRA (Strong), and CDG (Very Strong). Inverness, which had no service to any of the European hubs examined in either 1997 or 2007, now has a Strong connection to AMS.

GLA had Very Strong connections to AMS and DUB, as well as Moderate service to BRU, Weak service to KEF, and Very Weak service to FRA in 1997. In 2017, the Very Strong connections to AMS and DUB were still in operation, and the service to BRU was replaced with service to CDG (Moderate); service to FRA had ceased by 2007.

Both ABZ and EDI have seen a continuous increase in services over the time period being examined with ABZ witnessing a threefold increase in flights to the European hubs, and EDI nearly doubling its FSC flights to the European hubs as well. Although there was an overall decrease in flights from GLA to EU hubs from 1997 to 2007 (-39.5%), the number of flights in 2017 has since increased to 1997 levels.

Birmingham on the other hand, had a Very Strong connection quality to AMS, BRU, DUB, FRA, and CDG in 1997. Although it continues to have connections to all five European airports, both BRU and CDG decreased to Strong connections by 2017; however, service to KEF was added with a Very Weak connection. Overall, the total number of FSC flights to the European hubs from BHX has decreased by 20.3% from 1997 to 2017, despite an increase in flights in 2007.

Other airports like Durham (MME) and Southampton (SOU) which had Very Strong connections to AMS in 1997, has seen their quality of service diminish to Strong and Moderate respectively.

Nottingham⁷ (EMA) had Very Strong connections to both AMS and CDG, Strong service to DUB, and Moderate service to BRU in 1997. By 2017, EMA had only

⁷ East Midlands Airport (EMA) was listed separately 1997, but came to be listed under Nottingham by 2007. In this study, the city of Nottingham is used alongside the airport code, EMA.

Moderate service to BRU. Service to AMS and DUB continued in 2017, but was provided by Flybe and Ryanair, a regional airline and LCC respectively.

Amsterdam Schiphol has provided consistent and frequent services to many of the UK regional airports between 1997 and 2017, and has remained the most important European hub for UK regional airports despite a 1/5 reduction in flight frequency to the UK . Whilst the number of flights to DUB and FRA increased from 1997 to 2017, services to BRU and CDG declined by almost half (49.2% and 49.5% respectively).

Services by full service carriers from UK regional airports to the European hubs being examined has undergone a fundamental change from 1997 to 2017. Whilst it was common to have British FSCs like BA or BD provide services in 1997 and 2007, in 2017, only the European FSC to whose hub the service was being flown provided any connectivity to the airport. This withdrawal of competition is indicative of the concentration of services at hub airports.

Insert Table 2

4.3 Services from UK regional airports to North American airports

Birmingham has had continuous service to only two North American destinations from 1997 to 2017: Toronto (YYZ) and New York (EWR) airports. Whilst service to YYZ has decreased from a moderate to a weak connection, service to EWR has changed in the opposite direction. Birmingham also had a moderate connection to Chicago (ORD) but this was discontinued by 2007.

Edinburgh had no service of any kind to North American airports in 1997 (see Table 3). In 2007, the airport had established links to Atlanta (moderate), New York (strong) as well as to Toronto and Hamilton (both very weak). By 2017, both the number of connections and their quality continued to increase. Service to both Atlanta and Hamilton had been discontinued, but this was replaced by service to Chicago and New York (SWF) (moderate), Providence (weak) as well as to Hartford and Orlando (very weak). In addition, service to Toronto improved from a very weak connection to a weak connection. Whilst service to EWR retains a strong quality of connection, when examining the combined New York airports (EWR, JFK and SWF), Edinburgh actually has a very strong connection.

Services from Glasgow to North American destinations has also increased over the last 20 years. In 1997, the airport had a very weak connection to Orlando, weak connections to both Chicago and Toronto as well as moderate service to New York (JFK). In 2007, there was also service to Boston, and Hamilton (moderate) as well as Calgary and Ottawa (very weak); none of these four cities had service in 2017. In contrast, services that were introduced to Halifax, Philadelphia, and Vancouver were still in operation in 2017. The airport also saw the introduction of new service to Las Vegas in 2017. However, no single airport has better than a moderate quality connection to Glasgow. Only when the New York airports (EWR and JFK) are examined in tandem does a strong quality connection to Glasgow exist.

In 1997, Manchester Airport had six services to North American airports: ATL, ORD, JFK, EWR, MCO and YYZ. These services were still operational in 2017. Whilst the quality of service to Atlanta has decreased from moderate to weak, the connection quality to Chicago, Newark and Toronto is the same, and the quality of service to New York JFK and Orlando has increased to very strong.

Although there was no service from BFS to North American destinations in 1997, in 2007, the airport had a Moderate connection to EWR⁸; BFS also had Very Weak connections to YHZ, YHM, SFB, YYZ, and YVR. The connection to EWR however was discontinued altogether in 2017⁹. The airport however retains a connection to New York, albeit a Very Weak one to SWF, a New York regional airport operated by Norwegian. The airline is also commencing a Very Weak connection to Providence, which could be considered a secondary airport in the Boston region. BFS also retains a Very Weak connection to Orlando, although the service operates to MCO as opposed to SFB.

Services introduced to the Canadian destinations of Calgary, Hamilton, Montreal and Vancouver in 2007 did not survive beyond that time period. In contrast, flights to both Boston and Philadelphia (moderate) continue to operate, although the service to Boston is now a weak connection. By 2017, five new services were introduced, leaving the airport with connections to Los Angeles and Miami (both weak), and moderate service to Houston, Las Vegas, and San Francisco.

Overall, Manchester has doubled its number of North American destinations from six airports in 1997 to 13 airports in 2017.

A number of smaller airports, (Doncaster, Exeter, Liverpool, and Newcastle) had Very Weak service to Hamilton, Canada in 2007. Newcastle also had service to Toronto and JFK (Very Weak and Weak respectively) whilst Bristol had Moderate service to EWR. None of these services survived the economic downturn of 2008.

Air Transat, flyglobespan and Zoom had provided a number of flights from UK regional airports to North America. Neither flyglobespan nor Zoom survived beyond 2009, and Air Transat survived the economic impact of the recession by retracting its previously expanding network (Deveau, 2012).

Insert Table 3

4.4 Summary

There are, broadly speaking, three types of UK regional airports: 1) those with only EU connections, 2) those with both London and European connections, and 3) those with London, European, and North American connections. The primary exception to this typology is Birmingham, which has both European and North American connections (but no London connections).

⁸ The BFS-EWR route was initiated through the Northern Island Route Development fund in May 2005 (CAA, (2007: 7-7).

⁹ Following poor economic performance on the route, the inability to obtain new government funds to maintain the route resulted in the cessation of services in January 2017 (BBC, 2017).

Airports who only have European connections (including BHX), are predominantly located in the southeast of the UK.¹⁰ The lack of connections to London airports is assumed to be due to their relatively close geographic proximity, thus negating any time savings in travel by air. All of the airports who rely solely upon EU connections have seen a reduction in the frequency of their service to EU hubs. There has been no development of new North American air connections, and BHX has seen a concurrent decline in their North American air connections.

Overall, airports who have connections to both London and the European hubs being examined have also seen a decline in their London frequencies and an increase in their frequency of service to the European airports, although insufficient to offset the decrease in London services. Airports like MME (which lost its London connection in 2017) and LBA both saw their European frequencies decline by nearly 50% from 1997-2007, have since remained stable. NCL also lost nearly half their London frequencies from 1997-2017, but their number of European frequencies has remained stable. In the case of NQY, a connection to European airports was present in 2017, replacing the London service lost during the same time period. ABZ, which had a 30.1% decline in their London frequencies, had a threefold increase in the number of frequencies to the European hubs being examined.

The three airports with all three types of connections are EDI, GLA and MAN. All three airports have seen a decrease in the number of frequencies to London airports. Edinburgh, which had no service to North American airports in 1997, now not only has numerous connections and frequencies, but has also almost doubled the number of frequencies to European airports. GLA has seen its European frequencies remain relatively stable whilst seeing their frequencies to North America almost double. In contrast, MAN, has seen their European connections almost decrease by half, but like GLA has seen a doubling of their frequencies to North America.

5.0 Conclusions

The aim of this study was to investigate whether the lack of air services to London airports has resulted in increased direct services to North Atlantic destinations or to other European hub airports.

This study has analysed the changing dynamics of the UK aviation network from 1997 to 2017 as it pertains to hub connectivity and North Atlantic services. Both the number of connections from regional airports and the quality of those connections, measured in terms of the frequency of direct air services, have been examined.

It is evident from the data that regional airport connectivity development is not homogeneous. The larger and more geographically distant regional airports of Edinburgh, Glasgow, and Manchester have developed both more connections to European hub airports as well as to North American cities, and in many cases have seen an improved qualitative connection as well. Birmingham Airport, although of

¹⁰ The airports included are BHX, BRS, CWL, EMA, HUY, NWI and SOU. Neither HUY nor EMA are considered southeast airports.

similar size to the above mentioned airports, has on the contrary experienced a reduction in the quality of its European hub connections and number of connections to North American airports.

Although there are some exceptions (ABZ), the majority of the smaller regional airports have seen a reduction in the quality of their connection to the European hub airports examined. Although the reduction in frequency may have been compensated by the introduction of larger aircraft, most European hubs are like Heathrow capacity constrained (though to a lesser degree) and airlines would prefer to optimise their networks with larger aircraft at their hub airport. Given that the European FSCs are continuing to provide services to their own hubs, this may actually improve connectivity to North Atlantic services. The withdrawal of competition on routes from UK regional airports to European hubs may improve the financial viability of the FSC services in operation; something that continues to be a challenge with the development of LCC carriers over this time period.

The retrenchment of hub-spoke services between UK regional airports and European hub airports makes it easier for UK residents to access hub services in Europe than in London, excepting residents of the southeast.

While the development of new aircraft may make some previously unfeasible routes economically viable, it is unlikely that intercontinental services will return to smaller regional airports like Doncaster or Exeter. The development of routes to larger regional airports in the UK does, however provide an option to the capacity constrained airports of the southeast. The catchment areas of these airports remain sufficiently large to provide viable point-to-point services to North American hub airports. Edinburgh, Glasgow and Manchester have seen the greatest increase in services to North America from 1997 to 2017, whilst North American services to Birmingham have remained stagnant, perhaps due to Birmingham's geographic proximity to London. The North American airlines have retained their LHR slots since their move from LGW, and it is more likely that they will optimise their slot utilisation rather than commit to new routes at BHX. Thus, in addition to hub options in Europe, UK regional airports are developing hub options in North America as well.

This paper has provided a broad overview of the changing dynamics of North Atlantic air services over the past 20 years. It could benefit from an examination of further analysis to other European airports, as well as a more in depth investigation of other factors, including aircraft type, flight times, and the presence of surface transport. An inclusion of both regional and LCC carriers would obviously provide a different result of the overall connectivity, and is something that could be considered in future research should proposed interlining agreements between Norwegian and Easyjet and Ryanair come into being.

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Table 1

Weekly Frequencies by Full Service Carriers between UK Regional Airports
and Heathrow and Gatwick, 1997-2017

		1997	2007	2017	Percentage Change, 1997-2017
Aberdeen (ABZ)	LHR	47	84	51	8.5%
	LGW	26	21	0	-
Belfast (BFS/BHD)	LHR	100	52	59	-41.0%
	LGW	0	0	0	-
Edinburgh (EDI)	LHR	122	117	76	-37.7%
	LGW	38	40	23	-39.5%
Glasgow (GLA)	LHR	124	115	67	-46.0%
	LGW	32	33	23	-28.1%
Inverness (INV)	LHR	21	7	7	-66.7%
	LGW	0	20	0	-
Isle of Man (IOM)	LHR	0	0	0	-
	LGW	0	26	0	-
Jersey (JER)	LHR	28	17	0	-
	LGW	0	43	33	-
Leeds Bradford (LBA)	LHR	32	29	17	-46.9%
	LGW	23	0	0	-
Manchester (MAN)	LHR	69	102	53	-23.2%
	LGW	44	44	0	-
Newcastle (NCL)	LHR	39	39	38	-2.6%
	LGW	36	0	0	-
Newquay (NQY)	LHR	0	0	0	-
	LGW	28	7	0	-
Plymouth (PLH)	LHR	0	0	0	-
	LGW	19	0	0	-
Teesside/Durham (MME)	LHR	0	25	0	-
	LGW	32	0	0	-

Table 2

Weekly Frequencies by Full Service Carriers between UK Regional Airports
and Selected European Airports¹, 1997-2017

	1997	2007	2017	Percentage Change, 1997- 2017
Aberdeen (ABZ)	21	57	70	233.3%
Belfast (BFS/BHD)	7	0	10	42.9%
Birmingham (BHX)	177	196	141	-20.3%
Bristol (BRS)	96	57	58	-39.6%
Cardiff (CWL)	46	27	20	-56.5%
Edinburgh (EDI)	71	113	134	88.7%
Glasgow (GLA)	76	46	77	1.3%
Guernsey (GCI)	5	0	0	-
Humberside (HUY)	26	21	20	-23.1%
Inverness (INV)	0	0	14	-
Isle of Man (IOM)	0	0	12	-
Jersey (JER)	9	0	6	-33.3%
Leeds Bradford (LBA)	65	35	34	-47.7%
Manchester (MAN)	248	188	148	-40.3%
Newcastle (NCL)	85	70	82	-3.5%
Newquay (NQY)	0	0	7	-
Norwich (NWI)	32	45	26	-18.8%
Nottingham (EMA)	71	14	10	-85.9%
Southampton (SOU)	52	18	7	-86.5%
Teesside/Durham (MME)	40	21	19	-52.5%

¹ The selected airports are: Amsterdam (AMS), Brussels National (BRU), Dublin (DUB), Frankfurt (FRA), Paris Charles de Gaulle (CDG), and Reykjavik (KEF).

Table 3

Weekly Frequencies by Full Service Carriers between UK Regional Airports
and North American Airports, 1997-2017

	1997	2007	2017	Percentage Change, 1997- 2017
Belfast (BFS/BHD)		14	8	-
Birmingham (BHX)	14	15	9	-35.7%
Bristol (BRS)		7		-
Doncaster (DSA)		1		-
Exeter (EXT)		1		-
Edinburgh (EDI)		16	54	-
Glasgow (GLA)	20	47	51	155.0%
Liverpool (LPL)		1		-
Manchester (MAN)	52	106	109	109.6%
Newcastle (NCL)		2	1	-