INTERCONTINENTAL FLIGTHS FROM EUROPEAN AIRPORTS: TOWARDS HUB CONCENTRATION OR NOT?

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Abstract: This paper empirically analyzes changes in the supply of non-stop intercontinental flights from European airports. We take advantage of OAG data for air services from a rich sample of European airports to intercontinental destinations in the period 2004-2008. Results of the empirical analysis indicate a tendency towards a more balanced distribution of intercontinental flights across European airports. We also find that the demographic size of a region, its sector specialization, the political role of its central city and the proportion of connecting traffic explain the amount of and changes in long-haul air services supplied from European airports.
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Key words: airports, air transportation, intercontinental flights.

JEL codes: L93, R58
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Acknowledgements

Our research on infrastructure and competition has received financial support from the Spanish Ministry of Education & Science (SEJ2006-04985/ECON). An earlier version of this paper was presented at the 12th ATRS World Conference in Athens (Greece). Laia Doménech has provided helpful research assistance

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1.Introduction

Urban economic growth is highly influenced by air services (Brueckner, 2003; Button et al., 1999, Green, 2007). The magnitude of the economic impact of an airport is conditioned upon the total number of passengers served annually and by the geographic scope of the direct flights offered. Large firms specializing in knowledge intensive activities consider both aspects when making location choices (Bel and Fageda, 2008). Indeed, such firms need large airports that offer direct flights to the main business centers of Europe, America and Asia. In this light, it is significant that air services in the largest European urban areas differ chiefly in the availability of direct intercontinental flights. Most of the largest European urban areas are well supplied with a dense network of highways, high-speed train and short-haul air services. In contrast, intercontinental air traffic tends to be concentrated in a few airports. Thus, the dynamics of long-haul air services to the main urban areas in Europe are of great interest.

The objective of this paper is to determine if there is a tendency towards a higher concentration of long-haul air services in the largest airports or, on the contrary, a trend towards a more balanced distribution between airports of different size. In this regard, O'Connor (2003) suggests a tendency towards a dispersal of air transport movements looking at data from 1990 to 2000 for a sample of global cities. Here we extend this analysis and contribute to the literature by using updated information collected for this study and multivariate econometric techniques.

Our conclusions will have implications for the attractiviness of urban areas to large firms specialized in knowledge intensive activities. They will also provide some expectations of the role that urban areas of different size may play in globalization trends.

We use data for direct flights to intercontinental destinations from a sample of airports associated with the largest European urban areas in the period 2004-2008. The empirical analysis allows us to assess the determinants of intercontinental traffic and to identify any tendency towards or away from higher concentration in this type of traffic.

The remainder of this paper is organized as follows. In the second section, we identify those factors that may affect traffic concentration. In the third section, we explain the criteria used to define both the sample of urban areas and intercontinental destinations, and we then examine the data relating to concentration of long-haul air services empirically. In the fourth section, we study the determinants of long-haul air services to explain the different performance of airports. Finally, the last section is devoted to concluding remarks.

2. Long-haul services from European airports: Concentration or dispersion?

Evidence from the nineties indicated a consolidation of hub-and-spoke networks by former flag carriers that was part of a period of strong spatial concentration of air traffic (Burghouwt and de Wit, 2005). However, other studies using airline data for the nineties suggest a decreasing role of very large global cities and major hubs in favour of a group of next largest cities (O'Connor, 2003).

The generalized economic growth, globalization and technological changes that have characterized the beginning of the Twenty-first century have been associated with great dynamism in airline markets. Hence it is of interest to ask whether long-haul air services have continued to concentrate in a few large hubs or, alternatively, if other airports have improved their relative position in long-haul traffic.

Note that the profitability obtained by network airlines in long-haul traffic is generally sound, with high load factors and a high proportion of business travelers on such flights. By these measures, network airlines perform much better than do in short-haul services. To some extent, this success follows from the fact that network airlines do not face competition from low-cost airlines in long-haul flights, as happens over routes that begin and end in European cities.

Low-cost airlines have been able to exploit important cost advantages in competition with network airlines. Since the liberalization of the European air market, they have substantially increased their market share of intra-European routes. However, the cost advantages of low-cost airlines appear chiefly in relation to short-haul routes (Francis et al., 2007). In fact, low-cost airlines have a very modest presence in long-haul routes, where network airlines dominate.[1]

Thus, European network airlines are increasingly focusing their business in the long-haul segment of the market. This implies a concentration of flights in their main hubs. Such airport hubs are the origin of direct flights to distant sites and the destination of flights from nearby cities that feed the long-haul traffic. Thus, the efficient exploitation of connecting traffic by network airlines may well imply an increase of the concentration of intercontinental traffic from the largest European hubs.

Finally, international airline alliances tend to produce strong duplication of the geographical coverage of routes in those airports that move most of the long-haul traffic (Dennis, 2005). This could also spur an increase in concentration of this type of traffic by allowing former flag carriers to obtain some technical efficiencies

[1] However, some low-cost airlines offer non-stop services in long-haul routes, as is the case with Flyzoom and Air Transat in routes from Canada to Europe; Condor, in routes from Germany to America, and several airlines in routes from London to US. Recently, Ryanair has announced that in a near future will offer flights in routes from Europe to United States.

Dispersion of services, on the other hand, may be favored by broader economic factors. Economic growth and globalization are stimulating demand for point-to-point services directly connecting cities of different continents, and the threat of foreign airlines entering at neglected airports may push former flag carriers to follow a pre-emption strategy and disperse long-haul services. Either factor presents an important barrier to concentration of intercontinental traffic.

American and Asian network airlines may also directly contribute to an increase in the dispersion of intercontinental flights services from European airports. These airlines increasingly use airports located in large European urban areas, which are not necessarily hubs of any European airline, to feed traffic to their hubs in America and Asia.

Finally, congestion at some large European hubs, like London-Heathrow or Frankfurt is another barrier to traffic concentration. In fact, environmental and urban pressures limit future capacity expansions at most of the largest European airports.

In this uncertain process of spatial distribution of long-haul traffic, the relative success of the new planes from Boeing and Airbus will also play a central role. Boeing's venture in long-haul traffic is the model E787, which is particularly suitable for point-to-point traffic between airports of different sizes. In contrast, the Airbus A380 -larger than the E787 of Boeing- is particularly suited to the connecting traffic moved through the largest hubs.[2] In any case, these new models tend to reduce the costs of long-haul services, so either will likely contribute to an increase of demand of this type of traffic.

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[2] Note that the tough competition between both firms has resulted in the launch of new models of planes to compete in the long-haul traffic. Indeed, Airbus has launched the model A350 to compete with the E757 model of Boeing, while Boeing has launched the model Boeing 747-800 to compete with the A380 of Airbus.

Additionally, increasing liberalization of traffic between continents, particularly important in the transatlantic market with the recent open skies agreement, will also influence concentration of intercontinental traffic from European airports. Until recently, bilateral agreements between governments have conditioned air traffic between continents. These agreements have usually implied the monopolization of intercontinental traffic from national airports by former flag carriers. In the post-liberalization period, this scenario may no longer be the rule. However, it is not clear what effect tougher airline competition will have on the transatlantic market.

3. Availability and changes of non-stop intercontinental flights from European airports

In this section, we analyze non-stop intercontinental flights to selected destinations from the airports of a sample of large European urban areas.[3]

The criteria for determining the sample European urban areas are as follows: we include urban areas of the European Union (EU25), Switzerland and Norway with more than one million inhabitants and/or a large airport. Large airports must be one of the Top-50 European airports in terms of total traffic, but airports that move a high amount of traffic for tourism are excluded from the analysis.

Intercontinental services should not include traffic to such nearby destinations as non-EU European countries (Russia, Ukraine, Turkey, etc.) or North Africa. Thus, the analysis focuses on flights originating in airports of the sample of urban areas to a selection of intercontinental destinations. The choice criterion of intercontinental destinations is as follows: We include non-European airports having the highest amount

[3] Note that the use of airlines data is helpful to examine spatial patterns in the world city network even taken into account some potential shortcomings (Derudder and Witlox, 2005). Here the focus is on the concentration or dispersal of intercontinental fligths in airports of major urban areas given their influence on location choices of major urban areas.

of international traffic by geographical area (North America, Latin America, Middle East, Far East, Africa and Oceania) and located more than 3450 kilometers from any European airport. The distance threshold reflects the longest intra-European route with non-stop service: Lisbon-Stockholm. We exclude tourist destinations.

Insert table 1

Insert table 2

Tables 1 and 2 indicate the urban areas and the intercontinental destinations that we have used in the empirical analysis. Table 3 provides information about weekly frequencies of intercontinental departures from the airports of urban areas included in the sample. We distinguish between the summer and winter seasons, since there are some seasonal differences. Recall that the worldwide coordination of slots between airlines takes place at the half-yearly meetings of the International Air Transport Association (IATA). Data are from the last period with available information, 2007-2008 and the dynamics since the period 2004-2005. Note that data refer to a representative sample week for each period.

Insert table 3

First, the overall performance of airports over the period, both in the summer and winter, has been quite good. Indeed, most of the airports have increased the number of flights per week to intercontinental destinations. Overall, total supply has increased by about 30 per cent in both seasons. Note that the number of flights in the summer is generally higher than in the winter due to the additional traffic generated by tourism.

The airports with the highest number of non-stop intercontinental flights are those that act as hubs for the largest network airlines; Air France-KLM (Paris-Charles de Gaulle and Amsterdam), British Airways (London-Heathrow and London-Gatwick) and

Lufthansa (Frankfurt and Munich). At a second level, we find hubs of medium-sized airlines: Iberia (Madrid), Swiss (Zurich) or Alitalia (Milan). Demand from local urban areas generates an important supply of intercontinental flights at some other airports, as is the case with Brussels, Dublin, Dusseldorf, Manchester or Rome.

In any case, the hierarchy of intercontinental traffic across airports is closely linked to the hierarchy that prevails in terms of total traffic. Figure 1 shows the close relationship between total traffic and the supply of intercontinental flights for our sample of urban areas. However, some airports deviate from the mean relationship, with intercontinental flights either low in relation to total traffic (as in the case of Barcelona, Berlin, London-Stansted or Oslo) or high (as in the case of Dusseldorf, Helsinki, Manchester, Milan, Vienna or Zurich).

Insert Figure 1

We cannot conclude from the information in table 3 that long-haul traffic is becoming concentrated in the largest airports, since their traffic increases (in percentage) are not consistently higher than those seen in smaller airports. On the contrary, several airports now offer some intercontinental flights where they used to offer none. In this regard, we note the cases of Barcelona, Berlin, Hamburg or London-Stansted. The increases at the airports of several capitals of Eastern Europe, like Athens, Budapest, Prague or Warsaw are also notable.

Table 4 details changes in each airports share of intercontinental flights from Europe in relation to the whole sample for the period 2004-2008.

Insert table 4

The airports with the largest supply of long-haul flights, Amsterdam, Frankfurt, Paris Charles de Gaulle and especially London-Heathrow have lost market share over the period. The other airports that have lost market share initially offered a number of intercontinental flights disproportionate to their total traffic (Manchester, Milan, and Zurich in the winter).

On the other hand, among the airports showing the highest share increases are those that moved a large amount of total traffic in relation to their intercontinental flights in the initial period (Barcelona, Berlin, Hamburg, London-Stansted), airports located in cities that are important business centers (Dublin, Dusseldorf, Brussels), secondary hubs with an increasing importance for the dominant carrier (Munich, Rome) and airports of cities of Eastern Europe that have benefited from European Union enlargement (Budapest, Warsaw) or from the Asian economic growth (Athens, Helsinki).

Insert table 5

To sum up, the taxonomy of airports that have won or lost market share is diverse, but it seems that there is a tendency towards dispersion rather than concentration of intercontinental services from European airports. In fact, table 5 shows a decrease in the concentration levels of the supply of intercontinental flights according to the indicators more commonly used; the Hirschman-Herfindahl Index (HHI), and the market share of the largest and the fourth largest airports (CR1, CR4). Especially significant is the concentration rate of the four largest airports, with a decrease of between four and six points in the summer and winter season, respectively.

Importantly, figure 2 confirms the existence of a close negative relationship between the initial market share and share growth over the considered period. The market share in 2004 explains about 60 per cent of the share variation in the period 2004-2008

Insert figure 2

Finally, table 6 provides information about airlines that have stimulated the growth of intercontinental traffic at those airports showing increases in their share both in the summer and winter. It must be understood that intercontinental flights services are usually organized in the form of shared codes between a European and a non-European airline. However, it can be argued that non-European airlines have played a major role in the growth of intercontinental traffic from several airports. Indeed, the national dominant airline has clearly led traffic growth only in Dublin, Dusseldorf and Helsinki. On the contrary, many airports have benefited from direct flights by American or Asian airlines to their main airport hubs, notably Delta, Continental, Air Transat and Emirates, which have an increasing presence in the European market.

Insert Table 6

Along with the economic and demographic importante of the corresponding urban area, the amount of intercontinental traffic at European airports is very much influenced by the role they play in the organization of routes of the large European, American and Asian airlines. In this regard, the corresponding former flag carriers usually concentrate an important part of the traffic at the largest (or the two largest) national airports. However, non-European airlines may move a significant proportion of the intercontinental traffic both from these airports and, especially, from other, smaller European airports.

Thus, European airports may see significant intercontinental traffic because they play one of several roles: 1) As an airport hub of a European airline, 2) As an airport feeder of an American or Asian airline, 3) As a catalyst of the point-to-point traffic generated by the urban areas near the origin or destination of the flights.

European network airlines use a few hubs, and no increase of these types of airports is anticipated in the near future. In fact, it is possible that some of these airports will loss this function, given the expectation of airline mergers. On the other hand, point-to-point services are important for a smaller but increasing number of intercontinental routes. Finally, feeding the hubs of Asia and America may contribute to reductions in the spatial concentration of intercontinental flights services from European airports.

4. An empirical analysis of the determinants of intercontinental traffic

In this section, we attempt to identify factors that explain the amount of intercontinental traffic generated by airports in the sample in 2004 and its variation in the period 2004-2008.

Demand for intercontinental flights may be influenced by several attributes of the corrresponding region. Indeed, the amount of intercontinental traffic that an urban area can generate is closely related to population, sector specialization of economic activities and whether the central city is a political capital. Additionally, the development of connecting traffic may allow an airport to generate traffic higher than what would be generated by local demand.[4]

Hence, we estimate an equation that considers the determinants of intercontinental traffic in the sample of European airports at 2004. Note that data for most of the explanatory variables is not available for 2007-2008, so this estimation makes reference only to the initial period. The equation to estimate the determinants of intercontinental traffic in the sample of European airports in 2004 is as follows:

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[4] The geographical location of the urban area may also influence demand of air traffic. However, the relative distance to America or Asia in the sample of European urban areas here analyzed do not seem to play an important role, since the different variables used to capture this geographical effect are highly non-significant.

$$share = \alpha + \beta_1 D^{capital} + \beta_2 Pop + \beta_3 GDPc + \beta_4 Specialization + \beta_5 Hub + \varepsilon_1, \quad (1)$$

where the dependent variable, *share*, is the share of intercontinental traffic from each airport in relation to the whole sample of airports. The explanatory variables are:

1) $D^{capital}$, which is a dummy variable that takes a value of 1 for airports located in the political capital of the corresponding country,

2) *Pop*, which is the population of the corresponding region (NUTS2)

3) *GDPc*, which is the gross domestic product per capita of the corresponding region (NUTS2)

4) *Specialization*, which is the percentage of employment in the corresponding region (NUTS2) in activities that demand more air services. These are high-technology industries (optical, medical and precision instruments) and some market services (finance, business services, transport and communications). Data available do not allow including other high-technology industries like aeronautics, chemical or pharmaceutical industries.

5) *Hub*, which is a variable that takes a value of 1 in those airports with a high level of connecting traffic. To define this variable, we make use of data on total traffic per capita in all airports of the corresponding region (NUTS2). The variable takes a value of 1 for those airports whose traffic per capita is higher than the mean sample with a difference higher than the corresponding standard deviation: Amsterdam, Brussels, Copenhagen, Frankfurt, London-Heathrow, London-Gatwick, Paris-Charles de Gaulle, Oslo, Vienna and Zurich. Although it is doubtful that Brussels and Oslo are effectively airports with a high volume of connecting traffic, we find it convenient to use an objective statistical criterion to define a hub airport.

In the previous section, we have seen the existence of a close negative relationship between the variation in the share of intercontinental traffic in the period 2004-2008 and the share that each airport held in 2004. This implies a clear empirical trend towards a lower concentration in intercontinental services from European airports. However, more information can be obtained from this basic relation with the estimation of a reduced form equation that relates the variation in shares in the period 2004-2008, *Δshare*, with the factors that explain the share obtained in 2004:

$$\Delta share = \alpha' + \beta'_1 D^{capital} + \beta'_2 Pop + \beta'_3 GDPc + \beta'_4 Specialization + \beta'_5 Hub + \varepsilon_2 \qquad (2)$$

Data for intercontinental flights have been obtained from the web site of Official Airlines Guide (OAG). Data refer to a representative sample week for each period. Total traffic statistics are available in the web site of Eurostat. Data on the economic and demographic attributes of European regions have been obtained from "European Regional Prospects Report 2006", published by Cambridge Econometrics.

The estimation has been made using the Seemingly Unrelated Regression method (SURE). This allow us to estimate the two equations as a system with the same explanatory variables but different dependent variables (*share, Δshare*), using ordinary least squares. The SURE method takes into account the correlation between the residuals of both equations. Hence, the estimation is more efficient than estimating each equation separately using ordinary least squares.

Table 7 shows the correlation matrix of the variables used in the empirical analysis. It seems that correlation between the variable for specialisation in activities that demand more air services and variables for population and to be the political capital is relatively high. Hence, we also estimate the equation system excluding the variable for specialisation to check if multicolineality could distort our results.

Insert table 7

Table 8 indicates the results of the estimation of the two equations of the system. The overall explanatory power of the estimated equations is reasonably good and the value of the variation inflation factor (VIF) suggests that a problem of multicollineality does not arise. In this regard, results are not altered when excluding the variable for specialisation.

Insert table 8

From these results, we see that population and sector specialization (in activities that demand more air services) significantly influenced the amount of intercontinental traffic moved in 2004. Aside from local demand, the development of hubbing operations also substantially influenced intercontinental traffic. On the other hand, gross domestic product per capita and being a political capital did not play any central role.

However, we find that airports located in political capitals increased their share substantially in the period 2004-2008 (although being the political capital did not influence the initial, 2004 values). This likely reflects the positive evolution in the capitals of several countries of Eastern Europe. In contrast, airports with the highest initial amount of connecting traffic show a negative variation in their share of intercontinental traffic. Thus, we find evidence of an increase in the importance of point-to-point traffic (or the traffic that feeds airports from Asia and America). Furthermore, we find a negative variation in the share of airports located in more populated regions. Hence, we can infer good performance on the part of airports of smaller cities.

5. Concluding remarks

Air services have a major impact on urban economic growth and that impact depends both on the amount and quality of those air services. Concerning location choices of large firms devoted to knowledge intensive activites, the quality of air services is strongly related to the availability of non-stop intercontinental fligths to a vast number of major destinations.

Long-haul traffic has been traditionally monopolized by former flag carriers, which tend to concentrate their operations in hubs. In this regard, the competitive advantages that low-cost airlines obtain in short-haul flights do not seem to transfer to long-haul traffic, and no substantial change is expected in the near future. However, the demand for point-to-point intercontinental flights increases with economic growth and globalization. Additionally, American and Asian network airlines have increased their presence in the European market, since traffic from the large European urban areas may increase the profitability of operations in their own hubs. Finally, congestion in the largest hubs must be taken into account. Less predictable are the effects of the new models from Airbus and Boeing and the increasing consolidation of open skies policies for air traffic between different continents, but both will likely influence intercontinental services from European airports.

The analysis of data for non-stop air services from a sample of the main European urban areas towards selected intercontinental destinations in the period 2004-2008 shows a clear tendency towards a decrease in the concentration of long-haul flights. This is indicated by concentration indexes and the strong negative correlation between the share of traffic in 2004 and the variation in the period 2004-2008.

Along with the loss of relative position experienced by the largest airport hubs, there has been high growth in intercontinental traffic from airports that had a null or very modest initial supply. In the same vein, we find that airports located in the most populated regions and having the highest volume of connecting traffic have lost share over the period, while airports located in political capitals tend to gain share.

From our analysis, it seems that not just the largest urban areas with the largest airport hubs have opportunities to play an important role in globalization trends. In this regard, it is crucial for smaller urban areas to promote longh-haul air services in their airports. The amount of and changes in intercontinental traffic moved by an airport depend upon exogenous factors related to the economic and demographic attributes of the corresponding regions. However, we should not forget the importance of elements controlled by airport managers: like the provision of capacity, marketing activities, prices or the allocation of space (slots, gates, check-in counters and so on).

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TABLES

Table 1. Sample of urban areas (EU25 + Norway and Switzerland)

Amsterdam	Hamburg	Prague
Athens	Helsinki	Rome
Barcelona	Lisbon	Seville
Berlin	London	Dusseldorf
Birmingham	Lyon	Stockholm
Brussels	Madrid	Stuttgart
Budapest	Manchester	Toulouse
Koln-Bonn	Marseille	Turin
Copenhagen	Milan	Valence
Dublin	Munich	Vienna
Frankfort	Naples	Warsaw
Genève	Oslo	Zurich
Glasgow	Porto	
Goteborg	Paris	

Table 2. Sample of intercontinental destinations

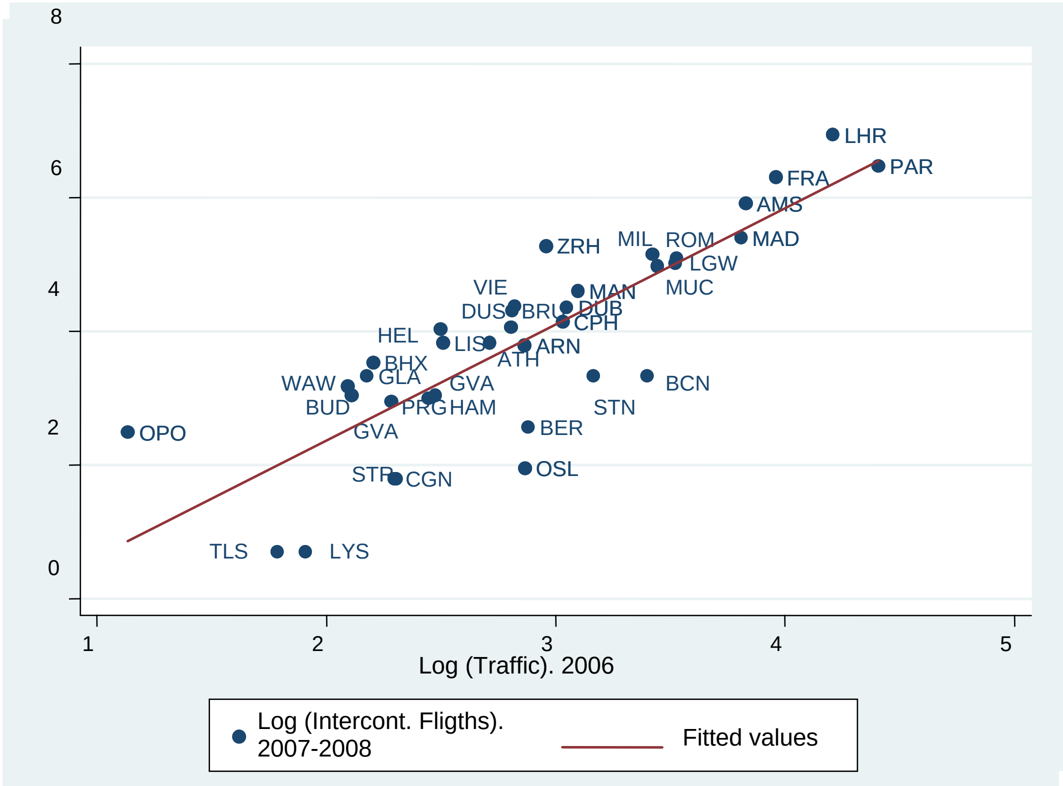
Atlanta	Houston	Philadelphia
Bangkok	Islamabad	Río de Janeiro
Beijing	Jakarta	Santiago de Chile
Bogotá	Johannesburg	Sao Paulo
Bombay	Kuala Lumpur	Seoul
Boston	Los Angeles	Shangai
Buenos Aires	Manila	Singapore
Caracas	Miami	Sidney
Chicago	Montreal	Taipei
Colombo	México DF	Tokyo
Dallas	Nairobi	Toronto
Denver	New York	Washington
Dubai	New Delhi	
Hong Kong	Osaka	

Table 3. Data of non-stop intercontinental flights from airports of the sample of European urban areas

Airport (code)	Winter season 2007-08 (November 2007-April 2008)		Summer season 2007 (May 2007-October 2007)	
	Weekly frequency (2007-08)	Difference in frequency (2007-08/2004-5)	Weekly frequency (2007)	Difference in frequency (2007-2004)
London (LHR)	988	103	1080	163
London (LGW)	157	48	169	37
London (STD)	29	29	26	26
Paris (CDG)	611	114	684	166
Frankfort (FRA)	522	32	579	66
Amsterdam (AMS)	351	75	386	76
Madrid (MAD)	215	51	227	54
Zurich (ZRH)	206	53	186	3
Milan (MXP)	144	11	146	0
Munich (MUC)	172	58	174	38
Rome (FCO)	123	41	177	62
Manchester (MAN)	87	-4	113	11
Vienna (VIE)	72	6	85	4
Copenhagen (CPH)	58	8	68	18
Brussels (BRU)	82	38	65	17
Dublin (DUB)	81	56	74	22
Dusseldorf (DUS)	55	35	61	23
Lisbon (LIS)	36	3	55	18
Stockholm (ARN)	35	11	52	28
Helsinki (HEL)	51	25	61	37
Birmingham (BHX)	34	14	33	3
Hamburg (HAM)	20	20	22	22
Athens (ATH)	38	24	53	35
Barcelona (BCN)	22	22	34	27
Budapest (BUD)	18	11	23	16
Prague (PRG)	13	5	26	18
Glasgow (GLA)	23	9	33	11
Warsaw (WAW)	17	11	31	24
Genève (GVA)	19	5	18	4
Berlin (SFX)	11	11	14	14
Stuttgart (STR)	5	-2	7	0
Porto (OPO)	10	9	14	6
Oslo (OSL)	6	3	7	0
Lyon (LYS)	0	0	4	4
Toulouse (TLS)	0	0	3	3
Koln-Bonn (CGN)	5	5	7	7
TOTAL	4 316	940	4 797	1 063

Note 1: In the rest of airports of the sample of urban areas (Goteborg, Marseille, Naples, Seville, Torino, Valence) there is no supply of intercontinental flights in any period.
Source: Own elaboration from data obtained from *Official Airlines Guide* (OAG).

Figure 1. Range scatter regression of intercontinental flights against total traffic



Code airports:
AMS: Amsterdam, ARN: Stockholm, ATH: Athens, BCN: Barcelona, BER: Berlin (3), BHX: Birmingham, BUD: Budapest, BRU; Brussels, CGN: Koln/Bonn, CPH: Copenhagen, DUB: Dublin, DUS: Dusseldorf, FRA: Frankfort, GLA: Glasgow, GVA: Genève, HEL: Helsinki, LGW: London-Gatwick, LHR: London-Heathrow, LYS: Lyon, MAD: Madrid, MAN: Manchester, MUC: Munich, MIL: Milan (2), LIS: Lisbon, OSL: Oslo, OPO: Porto, PAR: Paris (2), PRG: Prague, ROM: Rome (2), STN: London-Stansted, STU: Stuttgart, VIE: Vienna, WAW: Warsaw, ZRH: Zurich , TLS: Toulouse

Source: Own elaboration from data obtained from *Official Airlines Guide* (OAG).

Table 4. Variation in the shares of intercontinental traffic. Period 2004-2007.

Airport (code)	Winter season	Summer season
Dublin (DUB)	1.14	0.15
Dusseldorf (DUS)	0.68	0.25
London-Stansted (STN)	0.67	0.54
Munich (MUC)	0.61	-0.01
Brussels (BRU)	0.60	0.07
Barcelona (BCN)	0.51	0.52
Athens (ATH)	0.47	0.62
Hamburg (HAM)	0.46	0.46
Rome (FCO, CIA)	0.42	0.61
Helsinki (HEL)	0.41	0.63
London-Gatwick (LGW)	0.41	-0.01
Berlin (TXL, SFX)	0.25	0.29
Zurich (ZRH)	0.24	-1.02
Warsaw (WAW)	0.22	0.46
Budapest (BUD)	0.21	0.29
Porto (OPO)	0.20	0.08
Birmingham (BHX)	0.20	-0.12
Madrid (MAD)	0.12	0.10
Glasgow (GLA)	0.12	0.10
Koln/Bonn (CGN)	0.12	0.15
Stockholm (ARN)	0.10	0.44
Prague (PRG)	0.06	0.33
Oslo (OSL)	0.05	-0.04
Genève (GVA)	0.03	0.0003
Lyon (LYS)	0.00	0.08
Toulouse (TLS)	0.00	0.06
Amsterdam (AMS)	-0.04	-0.26
Stuttgart (STR)	-0.09	-0.04
Copenhagen (CPH)	-0.14	0.08
Lisbon (LIS)	-0.14	0.16
Vienna (VIE)	-0.29	-0.40
Paris (CDG, ORY)	-0.56	0.39
Milan (MSP, LIN)	-0.60	-0.87
Manchester (MAN)	-0.68	-0.38
Frankfort (FRA)	-2.42	-1.67
London-Heathrow (LHR)	-3.32	-2.04

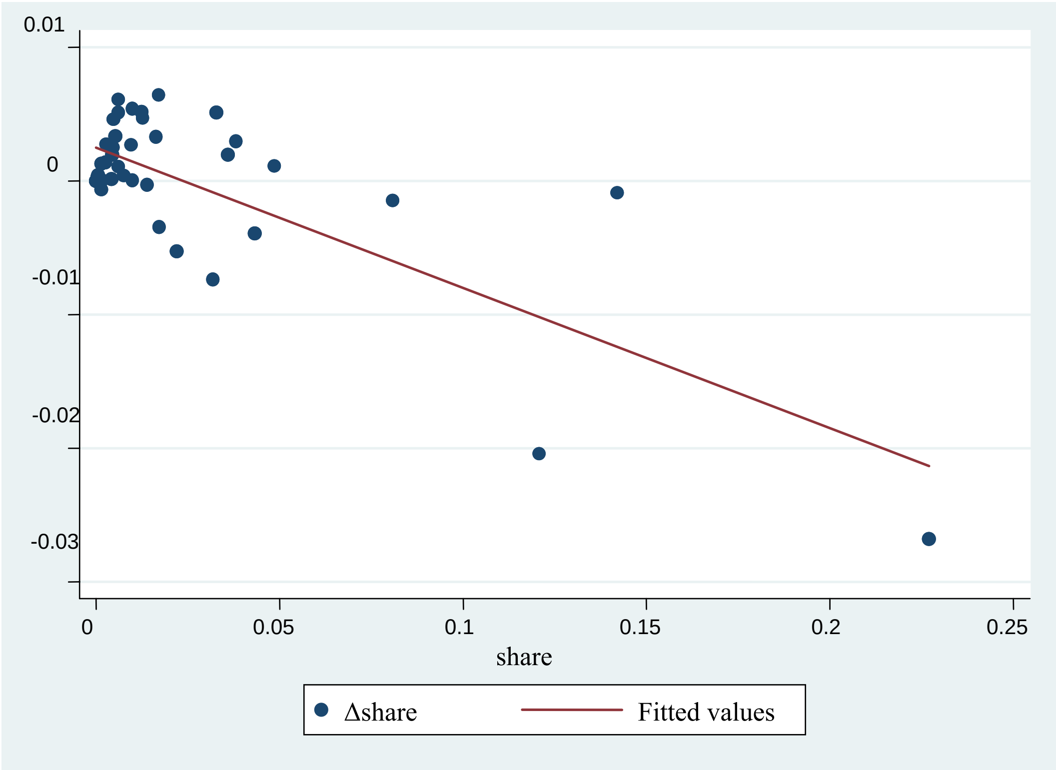
Note 1: In the rest of airports of the sample of urban areas (Goteborg, Marseille, Naples, Seville, Torino, Valence) there is no supply of intercontinental flights in any period.
Source: Own elaboration from data obtained from *Official Airlines Guide* (OAG).

Table 5. Evolution of the concentration in the supply of intercontinental flights

Period	CR1 (%)	CR4 (%)	HHI	Total frequencies
Winter 2004-05	26.21	63.63	0.1288	3 376
Winter 2007-08	22.89	57.28	0.1056	4 316
Summer 2004	24.56	60.47	0.1171	3 734
Summer 2007	22.51	56.89	0.1032	4 797

Source: Own elaboration from data obtained from *Official Airlines Guide* (OAG).

Figure 2. Range scatter regression of the variation in the share in the period 2004-2007 against the share in 2004. Mean values of the summer and winter season



Source: Own elaboration from data obtained from *Official Airlines Guide* (OAG).

Table 6. Airlines that add frequencies in intercontinental flights in 2004-2007 (winter and/or summer season).

Airports with positive variations of share in summer and winter	Airline
Dublin (DUB)	**Air Lingus** (5), Continental (2), Delta (2), US Airways
Dusseldorf (DUS)	Delta, Emirates Airlines, **Lufthansa** (3)
London-Stansted (STN)	American Airlines, Eos Airlines
Brussels (BRU)	Continental, Jet Airways India (2), **SN Brussels**, US Airways
Barcelona (BCN)	Air Transat, Aerolíneas Argentinas, Avianca/Iberia, Continental, Delta (2), US Airways
Athens (ATH)	Continental, Delta, Emirates airlines, Singapore Airlines, **Olympic Airways**, Thai Airways, US Airways
Hamburg (HAM)	Air Transat, Continental, Emirates (2)
Rome (FCO, CIA)	Air Canada**,** Air Transat**, Alitalia (3)**, Alitalia/China airlines, Alitalia/Delta, Alitalia/Japan air, American Airlines (3), Continental, Delta, United (2)
Helsinki (HEL)	**Finnair** (5)
Berlin (TXL, SFX)	Continental, Delta
Warsaw (WAW)	LOT/Air Canada, LOT/United (2)
Budapest (BUD)	Delta, **Malev** (2), Malev/Hainan airlines
Porto (OPO)	**TAP**, TAP/United
Madrid (MAD)	Aerolineas Argentinas, Air China, Air Transat, Avianca, Continental, Continental/air Europa, **Iberia** (2), Iberia/American Airlines (4), Iberia/Mexicana, South Korean airlines, 1Thai/Spanair
Glasgow (GLA)	Air Transat, Continental (2), Emirates, Fly Zoom, FlygoSpan
Koln/Bonn (CGN)	Continental
Stockholm (ARN)	Continental, Malaysia airlines, **SAS,** US Airways
Prague (PRG)	**Czech airlines** , Czech Airlines/Delta (2), Czech airlines/South Korean airlines
Genève (GVA)	Continental, Qatar Airways

Note 1: In brackets, the number of destinations where some frequencies are added.
Note 2: In bold, European airlines that do not operate with shared codes.
Source: Own elaboration from data obtained from *Official Airlines Guide* (OAG).

Table 7. Correlation matrix of variables used in the empirical analysis

	share	Δshare	$D^{capital}$	Pop	GDPc	Specialization	Hub
share	1						
Δshare	-0.81	1					
$D^{capital}$	0.20	0.12	1				
Pop	0.37	-0.16	-0.03	1			
GDPc	-0.16	0.19	-0.22	-0.22	1		
Specialization	0.46	-0.25	0.46	-0.09	0.11	1	
Hub	0.60	-0.51	0.32	-0.11	-0.06	0.49	1

Table 8. Estimation results (SURE). N = 42

	Share (1)	Share (2)	Δshare (1)	Share (2)
$D^{capital}$	-0.005 (0.011)	0.004 (0.011)	0.004 (0.001)***	0.003 (0.001)**
Pop	9.03e-06 (2.03e-06)***	8.82e-06 (2.15e-06)***	-5.65e-07 (2.98e-07)*	-5.44e-07 (3.09e-07)*
GDPc	-0.077 (0.10)	-0.08 (0.10)	0.000013 (0.00002)	0.00001 (0.00001)
Specialization	0.19 (0.08)**	-	-0.018 (0.015)	-
Hub	0.06 (0.013)***	0.07 (0.01)***	-0.008 (0.002)***	-0.01 (0.001)***
Intercept	-0.07 (0.002)***	-0.03 (0.01)***	0.005 (0.0034)	0.0004 (0.002)
R^2 **F (Joint Sig.)** **VIF**	0.60 64.73*** 1.41	0.56 52.82*** 1.26	0.43 31.51*** 2.14	0.39 29.50*** 1.39

Note 1: Standard errors in parenthesis: Robust to heterocedasticity and clustered by country of origin
Note 2: Significance at 1% (***), 5% (**),10% (*).