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Getting there fast: globalization, intercontinental flights and location of headquarters

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Abstract

This article examines the determinants of the location of large firms' headquarters across a rich sample of European urban areas, focusing on the availability of non-stop intercontinental flights. We also account for the influence of other aspects: the proximity to large markets and specialized providers, congestion and tax costs, the availability of skilled labor, and the role of the urban area in the home country. Controlling for these factors, we find that the availability of direct non-stop flights has a large influence on headquarters' location. This confirms the importance of transport infrastructures and tacit information exchanges between cities for firm location.

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1. Introduction

Globalization has been one of the most prominent economic trends of the last decades, with large firms emerging as key players in the new system. A common feature of the organization of many such firms is a dispersal of activities all over the world. In addition, the internal organization of those firms promotes spatial separation of headquarters from production plants. Indeed, headquarters are generally concentrated in a very few large metropolitan areas, while plants are dispersed across a much greater demographic and geographic range.

There are two agglomeration forces that are commonly mentioned as explaining the geographical concentration of headquarters. First, large metropolitan areas offer a wide diversity of large-scale business and financial intermediation services that make headquarters operations more efficient. And second, large metropolitan areas allow the clustered headquarters to exchange information and develop a heightened sense of market conditions. Davis and Henderson (2004), Henderson and Ono (2005) and Strauss-Kahn and Vives (2005) provide recent empirical evidence that both forces have strong positive effects on US firms' decisions about headquarters location. Furthermore, Lovely et al. (2005) test empirically whether the need to obtain information contributes to headquarters agglomeration. They find that the spatial concentration of headquarters is higher among exporters to difficult markets than for other exporters or

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domestically oriented firms. That is, agglomeration increases as the need to obtain information about relative unknown markets also increases.

The objective of this article is to examine the location choices of headquarters of large firms in a rich sample of European urban areas. In doing so, we account for factors such as proximity to large markets and specialized providers, congestion and tax costs, salaries paid to employees and the political and economic role of the urban area in the corresponding country. Additionally, we examine the empirical effects related to the provision of air services. In this latter case, we focus particularly on the role of the supply of direct (non-stop) intercontinental flights, as a differential indicator of the quality of air services for business travelers. Our methodology relies on estimating an equation system that accounts for the possible endogeneity in the causal relationship between headquarters and intercontinental flights.

At this point, we must explain why an urban area should seek to attract the headquarters of large firms. First, a high agglomeration of such offices both reflects and is a causal factor in the economic power of a region (Holloway and Wheeler, 1991; Meijer, 1993). Second, headquarters are major consumers of high-skilled and well-paid labor (Klier and Testa, 2002). And third, a high concentration of large firms' headquarters in knowledge-intensive sectors may promote technological spillovers in the neighborhood.

Executing information exchanges between cities can be critical for the headquarters of large firms that operate on a global scale. Indeed, the role of headquarters in a corporation is to coordinate and command activities within the firm. This always involves managing information across establishments (which are often geographically dispersed), gathering information about outside market conditions, and providing service functions with highly specific knowledge content, such as advertising, accounting and legal services. Thus, analysis of the location decisions of large firms' headquarters allows us to test explicitly the extent to which place affects the ability to manage intercity information efficiently.

Within this context, the quality of passenger transportation networks is a key input for processing and transmitting information efficiently because it influences the costs and opportunities for face-to-face contacts between cities. Indeed, large (global) firms should demand international accessibility when choosing a headquarters location.

The link between the quality of airport facilities and urban economic growth has been analyzed in some studies. Button et al. (1999) find the existence of a very significant relationship between employment in high-technology industries and the availability of a large airport across US metropolitan areas. Bowen (2002) argues that an increasing proportion of commerce is carried out via air transport, especially for high-value, low-bulk goods. Finally, Brueckner (2003) shows that a good endowment of airport facilities fosters intercity agglomeration economies and influences the location decision of firms.

Here, we focus the attention on the link between the location of headquarters and the potential of airport services in the efficient management of tacit information between cities. Some works analyze the role that communication costs from the need of information exchanges between cities have on headquarters location choices. Henderson and Ono (2005) examine the trade-off that firms must afford when separating headquarters from production plants. On the one hand, being near to production facilities reduces communication costs. On the other hand, being located in large metropolitan areas even away from production facilities allows obtaining information from other headquarters and better externalizes some services. Using data of US manufacturing firms, they find that proximity to production plants is an important attribute of a location to be selected by firms' headquarters. Additionally, Strauss-Kahn and Vives (2005) analyze decisions of US headquarters to relocate to other metropolitan areas. In this study, a measure of airport availability is used to capture the costs of transmitting services to other firm units. Their results show that the probability of headquarters to be located in a city increases substantially in case that such city has available an airport that can be considered a small or large hub.

Our contribution relies on identifying the causal relationship between the location of large firms' headquarters and the supply of direct intercontinental flights across European urban areas. This may imply additional empirical evidence of the importance that managing information exchanges between cities has on headquarters location choices. Furthermore, we may provide new evidence of the contribution of transport infrastructures to urban economic growth. Concerning the location of large firms' headquarters, we want to stress that the quality of airport services offered by an urban area is closely related to the geographical scope of the destinations with direct flight, and not only to the amount of total traffic that those airports move.

The remainder of this article is organized as follows. We next discuss the role that communication and other costs play on location choices of large firms' headquarters. The Section 3 is devoted to formulating our empirical strategy. We then describe the data used in the empirical analysis. In the Section 5, we comment on the results of our estimates and their implications. The last section is devoted to concluding remarks.

2. Location of headquarters and communication costs

There are three general trends in the organization of the modern large corporation that are relevant to our purposes. First, large corporations tend to separate production from management functions spatially in spite of the expected increase in coordination costs (Duranton and Puga, 2002). Second, large corporations tend to operate geographically on a global scale, particularly in knowledge-intensive industries (Markusen, 1995). And third, large corporations tend to outsource many activities to external suppliers (Perry, 1989).

These general trends can only be profitable for a firm when transport and communication costs are relatively low. The bulk of the globalization process has been based on a substantial reduction in transport costs of goods over the 20th century, while the costs of moving people (communication costs) are as significant as ever (Glaeser, 1998; Glaeser and Kohlhase, 2003). As Glaeser (1998) argues, two factors explain the reduction in the costs of moving goods. Technologies for moving goods have been improved, and the value added per ton has increased, so that we are now shipping fewer tons of goods relative to GDP than we have in the past.

On the other hand, two factors explain why moving people is still costly. First, these costs depend mainly on the travel time's opportunity cost, which increases with income. And second, the effects of advances in information technologies on the need for face-to-face interactions are ambiguous. Indeed, electronic and face-to-face contacts, while they can be complements (Gaspar and Glaeser, 1998), are not necessarily equivalents.[1] Storper and Venables (2004) have formalized the idea that face-to-face contacts have

1 Van Geenhuizen and Doornbos (2005) provide evidence of the important role of the Amsterdam airport in the management of global knowledge networks. This case study is focused on the behavior of

unique advantages as a mean of communication, coordination and motivation. Furthermore, given that codified information is available everywhere, the information that makes a geographic difference is of the type that can be transmitted only by face-to-face contact.

The relevance of face-to-face contacts is such that the costs of organizing human resources across markets (transaction costs) and within firms (management costs) are substantial. The recognition that it is costly to obtain, process and transmit knowledge (say, information as a firm specific asset) arises as a crucial feature in the costs involved in the multiple personal relationships that a large corporation must develop (Williamson, 1979; Demsetz, 1988). Regardless of the extent to which a large corporation uses internal or external resources to develop its operations, communication costs play an important role in the overall cost structure of such firms. Thus, where these costs differ with location, they must play an important role in sitting decisions. This is particularly true when analyzing location choices of headquarters of large firms since the output of headquarters is information.

Within this context, headquarters are not generally treated as independent profit centers. Neither their production nor their prices can be observed since their activities are not sold in the market. However, headquarters will be located in the places with the lowest costs for their sort of activity. Indeed, firms will locate their headquarters where they can maximize their contribution to profits (Polèse and Sheamur, 2004).

Firms will have a strong preference for setting headquarters in locations near to their other establishments and final demand. In the same sense, they will prefer to locate in places that are nodes of passenger transportation networks. The proximity to other firm units and the quality of transport services will determine the total costs of transmitting information. In our context, the quality of transport services can be expressed as a function of the international connectivity. As we explain in the following section, the appropriate measure of international connectivity for our sample of urban areas is the supply of non-stop intercontinental flights in the corresponding airports.

Given the communication costs implied by location choices, firms will be interested in avoiding as possible other costs, such as congestion costs and tax payments. Furthermore, firms will have a strong preference for setting headquarters in places with a highly diversified pool of skilled business services providers and skilled labor, because those places will minimize total labor costs of employees and external suppliers. In addition, costs of information exchanges about market conditions will be less costly when clustering with headquarters of other firms takes place.

Aside of costs, the number of headquarters located in a city may be also related to its position in the urban hierarchy in their home country. Some large firms may prefer to locate their headquarters in some of the major business centers and/or the political capital of the home country rather than in major cities of other countries.

In the following section, we develop an equation to be estimated that accounts for all these aspects that should influence on location choices of large firms' headquarters.

young high-tech firms. Interestingly, they find that the use of videoconferencing and the expenditures in travel flights are positively correlated.

3. The empirical strategy

Our empirical strategy relies on estimating an equation that accounts for the determinants of large firms' headquarters location choices in a rich sample of European urban areas. The main focus is to test the relevance of costs of transmitting tacit information in these location choices.

Indeed, large multilocation firms (frequently with a transnational orientation) will incur noteworthy costs from the coordination of their worldwide activities. These costs will mainly differ across metropolitan areas according to their international accessibility that depend on the quality of transport services supply.

Within Europe, we argue that the appropriate measure of international connectivity refers to the availability of direct intercontinental flights, both the number of destinations and the flight frequency of each connection. To this regard, differences in the quality of passenger transportation networks across major urban areas are mainly related to such availability of direct intercontinental flights.[2] Additionally, it is worth noting that low cost carriers have a relevant share of intra-European air traffic and that low cost operations are usually not addressed to business passengers. Hence the amount of intra-European traffic that moves an airport is not necessarily a good indicator of the transport services supply for business travelers.

Thus, our main causal relationship of interest refers to the number of large firms' headquarters and the availability of direct intercontinental flights across a sample of European urban areas. A crucial issue in the empirical implementation of such a causal relationship is to consider the existence of a possible endogeneity bias. Indeed, headquarters of large firms must be located in urban areas with a convenient provision of direct intercontinental flights but, at the same time, urban areas may only have a good provision of direct intercontinental flights if a critical mass of headquarters demands such air services. Thus, one must estimate simultaneously an equation system that accounts for such a possible endogeneity bias. The equation system to be estimated can be expressed in the following linear form:

$$\begin{aligned} Headquarters_r = {} & \alpha + \beta_1 Freq\_intercontinental_r + \beta_2 Wages_r + \beta_3 Fiscal\_Pressure_r \\ & + \beta_4 Industrial\_employment_r + \beta_5 Services\_employment_r \\ & + \beta_6 Population_r + \beta_7 D^{\text{Capital}} + \beta_8 GDP\_weight_r + \varepsilon_1 \qquad (1) \\ Freq\_intercontinental_r = {} & \delta + \gamma_1 Headquarters_r + \gamma_2 Population_r \\ & + \gamma_3 International\_tourists_r + \gamma_4 D^{\text{hub}} + \gamma_5 D^{\text{capital}} + \varepsilon_2, \qquad (2) \end{aligned}$$

where the subindex r makes reference to the urban area. The dependent variables are, respectively, the number of headquarters of the 1,000 largest European firms, in terms of sales, located in the corresponding urban area (*Headquarters*) and the weekly frequency of direct intercontinental flights at the airports of the urban area (*Freq_intercontinental*). Both variables enter as explanatory variables in the other equation of the system. In the next section, we explain the choice criterion for

2 In this regard, recall that most of the major urban areas in Europe are well connected through a dense network of highways and high-speed trains, taking into account that distances around the core spatial areas (e.g. blue banana) are short. In addition, large urban areas characterized by a more dispersed location (such as Lisbon, Madrid, Rome or Oslo) have available frequent airline connections (often at a low cost) to a vast number of European destinations.

constructing the sample of urban areas and for constructing the sample of intercontinental destinations.

3.1. Location of headquarters

We consider the following variables as exogenous explanatory variables of the location of headquarters. In the Appendix 1, we explain in detail the construction of each variable and data sources.

1. Compensation per employee at the region, *Wages*. The sign of the coefficient of this variable is *a priori* ambiguous. Indeed, higher wages may imply lower recruitment costs of skilled employees but they imply higher labor costs as well.
2. Tax revenues of the government over GDP at the country, *Fiscal_Pressure*. It is expected a negative sign in the coefficient of this variable, since firms should try to minimize expenditures associated to taxes. We use general fiscal pressure instead of corporate taxes to avoid any possible endogeneity bias (results are similar when using 'corporate taxes' as explanatory variable).
3. Total employees in the industry sector at the region, *Industrial_employment*. It is expected a positive sign in the coefficient of this variable, since communication costs concerning production plants should be lower when employment in the industry sector is higher. This variable also accounts for the proximity to final demand.
4. Total employees in market services at the region, *Services_employment*. We consider as market services the following services: transport and communications, financial intermediation and other market services such as business services. Recall that firms in these sectors are the main specialized providers for headquarters. Hence, we expect a positive sign in the coefficient of this variable, since communication costs concerning these firms should be lower when employment in market services is higher.
5. The population of the urban area, *Population*. If controlling for measures of market access, the variable for population should capture congestion costs. Hence, the sign of the coefficient of the variable for *Population* in the headquarters equation is expected to be negative.
6. We include a dummy variable for cities that are the political capital of the origin country, D^{capital}. The sign of the coefficient for this variable is expected to be positive because firms may take benefits from influencing political institutions and regulatory agencies, which are commonly located in the political capital.
7. We also include a variable for the percentage of the GDP of the corresponding region over the country, *GDP_weight*. The sign of the coefficient for this variable is *a priori* ambiguous, since its value is strongly related to the size of the country. Capitals of small countries will concentrate a high proportion of national firms' headquarters and a high proportion of the economic activity of its country, while major cities of large countries may well concentrate a high number of headquarters and a relatively low proportion of the economic activity of its country.

Note that our specification of the location of headquarters allows capturing the effect of transport infrastructures (frequency of direct intercontinental flights), the positive aspects of proximity lo large markets and specialized providers (regional employment in industrial and market services sectors) and the negative aspects of congestion and tax costs (population, fiscal pressure). Additionally, we take into account the political and economic role of the urban area in the corresponding country (dummy variable for the political capital, weight of the region over the country in terms of GDP). Finally, not only the variable for wages may also capture higher costs due to higher salaries but also the availability of skilled labor and so lower recruitment costs. To this point, our data do not allow taking explicitly into account the number of other headquarters located in the urban area, since our unit of observation is the urban area not the firm. However, variables for the proximity to large markets should capture this effect related to the information exchanges between headquarters of several firms.

3.2. Demand of intercontinental flights

Concerning the determinants of demand of intercontinental flights, Martin and Román (2004) analyze several location factors that can influence on that. In this demand, the potential traffic in and out of the urban areas plays a prominent role. Potential traffic depends mostly on population and the degree of tertiary activities in the area.[3] Additionally, the international attractiveness of the urban area in terms of tourism and the development of hubbing operations in the corresponding airports can also influence on this demand.

Hence, we consider the following variables as exogenous explanatory variables of the demand of intercontinental flights. In the Appendix 1, we explain in detail the construction of each variable and data sources.

1. The population of the urban area, *Population*. Population should condition the availability of major transport infrastructures as long as it determines the scale of its demand. Thus, the sign of the coefficient for this variable is expected to be positive.
2. The rate of arrivals of tourists that are non-resident in the country with respect to arrivals of tourists that are residents in the country, *International_tourists*. This variable captures the international attractiveness of cities in terms of tourism. Certainly, demand for non-stop intercontinental flights is mainly associated to business passengers, but some traffic for tourism can be critical to allow airlines obtaining the break-even load factor. We use this variable instead of a variable for the share of arrivals of international tourists in the urban area over the whole sample of urban areas because this latter variable is highly correlated with other explanatory variables, such as population and number of headquarters.
3. A dummy variable that takes value 1 for airports where network carriers offer high frequent services to an extensive number of European destinations, D^{hub}. This variable captures the demand for intercontinental flights that comes from the connecting traffic, that is, from the traffic that requires an intermediate stop to arrive to the final destination.
4. We include a dummy variable for cities that are the political capital of the origin country, $D^{capital}$. Airlines owned by national governments and/or that are treated as flag carriers could be pushed to concentrate their operations in the political capital.

3 Martin and Roman also suggest as a relevant factor the geographical location in relation to markets served. We have experimented with different measures of geographical location in the empirical analysis, such as distance to selected destinations or distance to major hubs, but those measures result highly insignificant.

ε_1 and ε_2 are random error terms identically and independently distributed. Our sample is based on data aggregated at the urban area level, so that any influence of firm attributes should be captured by the error term representing unobserved factors. A potential limitation of our article is that we treat firms as homogeneous. Since our unit of observation is the urban area, we cannot account appropriately for the sensitivity of results to the characteristics of the firm, such as size or type of sector. That analysis would require using the firm as unit of observation in a dynamic context. However, our main purpose is to examine the influence of the availability of airport services and other attributes of urban areas on location choices of large firms' headquarters. We argue that treating firms as homogenous should not distort these aggregate effects.

It is also worth noting that the cross-section aspect of the database prevents including dummy variables for each urban area. This is another potential limitation of the article as headquarters may locate in a specific urban area for reasons that are not captured by any of the explanatory variables, as for example amenities for workers and so on. However, we do not expect that such omission implies a bias as this effect should be randomly determined and then captured by the error term.

4. Data

In the sample of European cities, we include major urban areas from the EU25 + Switzerland and Norway. Major urban areas refer to the most populated areas (urban areas with >1 million inhabitants) and/or urban areas with a population of about 1 million inhabitants and with a large airport (airports included in the European top 50 in terms of total traffic). Furthermore, we expand our sample to include urban areas where a minimum of two headquarters of the 1,000 largest European firms are located there. To this regard, we could introduce a selection bias if we ignore headquarters located in small urban areas. However, we do not consider cities that have just one headquarters, since this may be due to idiosyncratic factors exclusively related to the firm. In this way, we want to focus the attention on cities that are relevant business centers in Europe and having more than one of the largest firm headquarters is a good indicator of this role for a city. Table 1 provides the list of the 87 European cities included in our sample. Our sample of cities concentrates about 94% of the headquarters of the 1,000 largest firms.

Data for the headquarters variable refers to the number of headquarters of the 1,000 largest European companies, in terms of the annual volume of net sales, located in the corresponding urban area. We mean by urban area the main city plus other municipalities belonging to the same NUTS 3 level (the statistical unit used by Eurostat) as the main city. Data for banks is ranked through total assets, so that we include 100 largest banks in our sample. Data have been obtained from ELC (2003).

The sample of intercontinental destinations includes the largest non-European airports in terms of international scheduled traffic to and from each geographical area (North America, Latin America, Middle East, Far East, Africa, and Oceania) that are located >3,450 kms (2,150 miles) from any European airport. The distance threshold is related to the longest intra-European route with direct flights; Lisbon–Stockholm. We exclude tourist destinations because our main purpose is to examine the influence of air traffic on firms' headquarters location. Table 2 provides a list of the 41 intercontinental

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

Aachen	Frankfurt	Munster
Aberdeen	Freiburg	Naples
Amsterdam	Geneve	Newcastle
Arnhem	Glasgow	Nottingham
Athens	Goteborg	Nurnberg
Barcelona	Gutersloh	Oslo
Basel	Hamburg	Paris
Belfast	Hannover	Porto
Bergamo	Helsinki	Prague
Berlin	Hove	Rome
Bielefeld	Karlsruhe	Rotterdam
Bilbao	Kilkenny	Seville
Birmingham	Koblenz	Saint Etienne
Bonn	Koln	Stavanger
Braunsweig	Lausanne	Stockholm
Breda	Leeds	Strasbourg
Bristol	Lille	Stuttgart
Brussels	Lisbon	Swindon
Budapest	Liverpool	The Hague
Clermont Ferrand	London	Tilburg
Copenhagen	Luxembourg	Torino
Cork	Lyon	Toulouse
Dortmund	Madrid	Valencia
Dublin	Manchester	Verona
Duisburg	Marseille	Vienna
Düsseldorf	Milan	Warsaw
Edinburgh	Milton Keynes	Wiltshire
Eindhoven	Mondeville	Wolfsburg
Essen	Munich	Zurich

destinations included in our sample. Our sample of cities concentrates almost 100% of the supply of intercontinental flights from European airports.

Data for intercontinental flights refer to weekly frequency of direct flights for the first week of October 2004 in the summer time and for the second week of February 2005 in the winter. By direct flights, we mean non-stop flights that do not involve a stop in-between to a flight with the same or different flight number.[4] We present the results of our estimates using a simple average of data for the two seasons. Results do not change substantially when using data for each season separately. Data have been obtained from the website of Official Airlines Guide (OAG).[5]

4 Concerning intercontinental flights, Lijesen et al. (2002) show that direct and non-direct flights are imperfect substitutes and that an indirect flight is not a substitute at all if it lasts twice or more as long as the direct flight. Indeed, travel time differences between direct and indirect flights may be substantial. Additionally, non-direct services carry additional costs in terms of lower quality that are not captured by the total travel time.

5 Eurostat classifies airport traffic data as domestic traffic, intra-EU25 traffic or extra-EU25 traffic. This is the common classification of traffic in European airports by geographical destination. However, extra-EU25 traffic includes traffic to close places, such as Russia, Turkey or Maghreb, and includes traffic to tourist destinations.

Table 2. Sample of destinations for intercontinental flights

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

Table 3 provides data about the number of headquarters located in each urban area and the percentage of headquarters that such urban area concentrates over the corresponding country. To make clearer the reading of the table, we just present data of urban areas where at least three headquarters of large firms are located there.

London and Paris arise as the two urban areas with the largest number of headquarters. Several German cities, Milan, Zurich, and the political capital of smaller countries have also a key role as sites of large firms' headquarters. Overall, we find substantial differences in the distribution of headquarters across countries. In UK and France, the political capital concentrates >75% of large firms' headquarters in their respective country. On the contrary, the distribution is much more balanced in Germany and Italy where the political capital is not the first-rank city in terms of headquarters. In the rest of countries, the political capital plays a very relevant role (except in Switzerland).

One could argue that the distribution of headquarters may simply reflect the distribution of the firms' production facilities and other offices. The separation of headquarters from production facilities is a central assumption in our analysis, since such separation makes more relevant the need to communicate information across the different firm units. A limitation of our dataset is that we do not have data about location of production plants and services offices of the firms considered in our empirical analysis.

Table 4 depicts differences in the distribution of headquarters and the distribution of employment in industry and market services across the urban areas of our sample. These data may provide some evidence of the separation between headquarters and production facilities. Indeed, the 52 urban areas with the largest number of headquarters in our sample concentrate around 94% of the 1,000 largest firms' headquarters in Europe, while the corresponding region of these urban areas just concentrates almost two-thirds of industrial employment and 70% of market services employment. In fact, the first-five rank cities in terms of headquarters concentrate 41% of headquarters, 7% of industrial employment and 15% of market services employment. Thus, we can see the high geographical concentration of headquarters in comparison to production facilities.

Table 3. Data for headquarters (HQ) at the urban area

Urban area (UA)	HQ_{UA}[a]	$HQ_{UA}/HQ_{COUNTRY}$[b]
London	146	77.25
Paris	101	84.87
Munich	52	17.22
Amsterdam	45	60.81
Dublin	41	85.42
Hamburg	39	12.91
Düsseldorf	35	11.59
Frankfurt	34	11.26
Stuttgart	30	9.93
Stockholm	23	85.19
Copenhagen	20	100.00
Zurich	18	54.55
Gutersloh	17	5.63
Milan	17	36.96
Köln	15	4.97
Essen	14	4.64
Karlsruhe	14	4.64
Rome	14	30.43
Brussels	11	100.00
The Hague	11	14.86
Torino	11	23.91
Berlin	10	3.31
Madrid	10	62.50
Basel	9	27.27
Helsinki	9	100.00
Oslo	9	75.00
Lisbon	8	72.7
Rotterdam	8	10.81
Duisburg	7	2.32
Hanover	7	2.32
Vienna	7	100.00
Birmingham	6	3.17
Bonn	6	1.99
Bristol	6	3.17
Luxembourg	6	100.00
Cork	5	10.42
Dortmund	5	1.66
Edinburgh	5	2.65
Aberdeen	4	2.12
Bielefeld	4	1.32
Goteborg	4	14.81
Aachen	3	0.99
Arnhem	3	4.05
Athens	3	100.00
Barcelona	3	18.75
Breda	3	4.05
Clermont Ferrand	3	2.52
Leeds	3	1.59
Milton Keynes	3	1.59
Porto	3	27.27
Stavanger	3	25.00
Saint Etienne	3	2.52
Strasbourg	3	2.52
Rest sample	60	–

Notes: [a]Number of headquarters located in the urban area (NUTS 3). Absolute values.
[b]Percentage of headquarters located in the urban area over total headquarters located in the corresponding country.
Source: ELC (2003).

Table 4. Data for location of headquarters (HQ), industry employment (IE) and market services employment (SE)

Urban area (UA)	HQ_{UA}/HQ_{SAMPLE_UA} [a]	IE_{UA}/IE_{SAMPLE_UA} [b]	SE_{UA}/SE_{SAMPLE_UA} [c]
London	15.55	1.11	5.62
Paris	10.76	2.60	5.98
Munich	5.54	1.97	1.66
Amsterdam	4.79	0.48	1.62
Dublin	4.37	0.98	0.95
Hamburg	4.15	0.55	1.02
Düsseldorf	3.73	2.14	1.90
Frankfurt	3.62	1.46	1.83
Stuttgart	3.19	2.75	1.31
Stockholm	2.45	0.33	1.07
Copenhagen	2.13	1.90	1.72
Zurich	1.92	0.51	0.76
Gutersloh	1.81	1.12	0.61
Milan	1.81	5.76	2.94
Köln	1.60	1.60	1.51
Essen	1.49	2.14	1.90
Karlsruhe	1.49	1.50	0.93
Rome	1.49	1.13	1.84
Brussels	1.17	0.19	0.71
The Hague	1.17	0.62	1.70
Torino	1.17	2.36	1.16
Berlin	1.06	0.66	1.17
Madrid	1.06	1.43	1.97
Basel	0.96	0.55	0.43
Helsinki	0.96	0.97	0.90
Oslo	0.96	0.22	0.50
Lisbon	0.85	0.70	1.05
Rotterdam	0.85	0.62	1.70
Duisburg	0.75	2.14	1.90
Hanover	0.75	0.74	0.69
Vienna	0.75	0.36	0.93
Birmingham	0.64	0.98	1.07
Bonn	0.64	1.60	1.51
Bristol	0.64	0.67	1.02
Luxembourg	0.64	0.15	0.34
Cork	0.53	0.98	0.95
Dortmund	0.53	1.79	1.05
Edinburgh	0.53	0.47	0.81
Aberdeen	0.43	0.20	0.25
Bielefeld	0.43	1.12	0.61
Goteborg	0.43	0.72	0.58
Aachen	0.32	1.60	1.52
Arnhem	0.32	0.63	0.92
Athens	0.32	1.11	1.09
Barcelona	0.32	3.05	1.69
Breda	0.32	0.95	1.11
Clermont Ferrand	0.32	0.45	0.27
Leeds	0.32	0.71	0.85
Milton Keynes	0.32	0.56	1.43
Porto	0.32	2.17	0.45
Stavanger	0.32	0.31	0.20
Saint Etienne	0.32	2.18	1.69
Strasbourg	0.32	0.71	0.47
Rest sample	6.39	35.31	30.16

Notes: All data refer to 2003.

[a]Percentage of headquarters located in the urban area (NUTS 3) over total headquarters located in the sample of European urban areas.

[b]Percentage of industrial employment in the corresponding region of the urban area (NUTS 2) over total industrial regional employment in the sample of European urban areas. Industry refers to energy and manufacturing.

[c]Percentage of market services employment in the corresponding region of the urban area over total market services regional employment in the sample of European urban areas. Market services refer to transport and communications, financial intermediation and real state, renting and business activities.

Source: ELC (2003) and Cambridge Econometrics (2006).

Table 5. Descriptive statistics

Variable	Mean	Standard deviation	Minimum value	Maximum value
Freq. intercontinental (weekly flights)	45.12	139.63	0	1,021
Freq. intra-European (annual flights)	25,617.42	38,616.92	0	238,322
Headquarters (number of 1,000 large firms)	10.79	20.68	0	146
Population (thousands of inhabitants, NUTS 3)	1,129.51	1,080.42	107	5,671
Wages (euros)	29,188.64	7,176.33	7,252	55,955
Fiscal pressure (percentage over GDP, country)	43.41	5.21	33.9	57.2
Industry employment (thousands of employees, NUTS 2)	269.15	229.47	35	1,349
Market services employment (thousands of employees, NUTS 2)	363.54	285.63	62	1,891
International tourists (rate international over national tourists, NUTS 2)	0.89	1.53	0.04	10.15
GDP_weight (percentatge GDP NUTS 2 over country)	0.16	0.21	0.01	1
Total mean air traffic 1992–2000 (passengers)	7,397,703	1.30e07	0	8.92e07
Total air traffic 1992 (passengers)	5,686,679	1.02e07	0	6.91e07
Total air traffic 2000 (passengers)	9,557,174	1.66e07	0	1.14e08

Table 5 shows the descriptive statistics of the variables used in the empirical analysis. The Appendix 1 contains a description of the exogenous explanatory variables used in the empirical analysis and their data sources.

Table 6 indicates the correlation between the variables used in the empirical analysis; the endogenous variables, the explanatory variables and the excluded instruments. Correlation between intercontinental flights and headquarters is high providing evidence that a simultaneous determination of both variables may be taken place. Hence, the possible endogeneity bias in the estimation of our equation system must be taken into account. To this regard, the range scatter regression of headquarters against intercontinental flights (Figure 1) shows the expected positive relationship between both variables. However, it can be seen that several urban areas do not follow the mean estimated relationship, so that they have a higher or lower number of headquarters in relation to the availability of intercontinental flights in their airports.

It is also worth noting the high correlation between the supply of intercontinental flights and the supply of intra-European flights. To this regard, note that many passengers flying from European cities to the largest European airports may have other airports from other continents as final destination. Indeed, large hub airports use traffic coming from several European cities to fill their flights to intercontinental destinations. This explains to great extent the high correlation between intercontinental and intra-European traffic. In addition to this, the variable for intra-European traffic is more

Table 6. Correlation matrix

	Freq Intercont.	Freq intra European	Head-quarters	Population	Wages	Fiscal pressure	Industry empl.	Services empl.	Tourists	GDP weigth	Mean traffic 1992–2000	Traffic 1992	Traffic 2000
Freq _intercontinental	1.00	0.90	0.86	0.24	0.33	0.05	0.08	0.68	0.10	0.08	0.88	0.87	0.87
Freq _intraEuropean	0.90	1.00	0.84	0.35	0.37	0.17	0.15	0.61	0.28	0.24	0.83	0.81	0.83
Headquarters	0.86	0.84	1.00	0.19	0.44	0.05	0.13	0.77	0.03	0.14	0.89	0.89	0.88
Population	0.24	0.35	0.19	1.00	−0.15	0.14	0.28	0.10	0.11	0.10	0.19	0.19	0.18
Wages	0.33	0.37	0.44	−0.15	1.00	0.10	−0.11	0.35	−0.07	0.03	0.49	0.48	0.49
Fiscal_ pressure	0.05	0.17	0.04	0.14	0.10	1.00	0.03	0.04	−0.03	0.18	0.07	0.08	0.06
Industry_empl.	0.08	0.14	0.13	0.28	−0.11	0.03	1.00	0.10	−0.13	0.08	0.02	0.03	0.01
Services _empl.	0.68	0.61	0.78	0.10	0.35	0.04	0.10	1.00	0.07	0.16	0.81	0.82	0.80
Tourists	0.10	0.28	0.03	0.11	−0.07	−0.03	−0.13	0.07	1.00	0.28	0.12	0.09	0.13
GDP_weight	0.08	0.24	0.14	0.11	0.03	0.18	0.08	0.16	0.28	1.00	0.07	0.07	0.07
Mean traffic 1992–2000	0.88	0.83	0.88	0.18	0.49	0.07	0.01	0.81	0.12	0.07	1.00	0.99	0.99
Traffic 1992	0.87	0.81	0.89	0.19	0.48	0.08	0.03	0.82	0.08	0.07	0.99	1.00	0.99
Traffic 2000	0.87	0.84	0.88	0.18	0.49	0.06	0.009	0.80	0.13	0.07	0.99	0.99	1.00

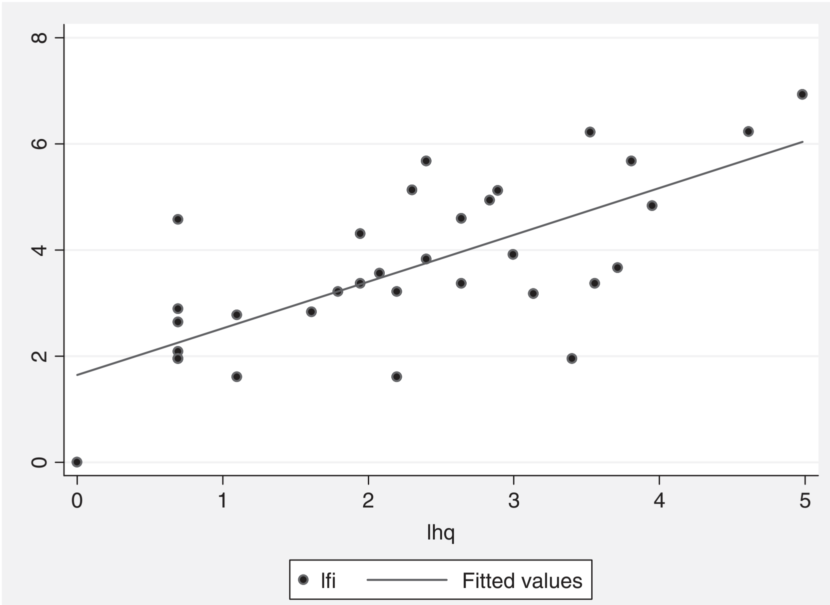

Figure 1. Range Scatter of headquarters (lhq) against intercontinental flights (lfi).
Note: To make easier the reading of the table, we exclude urban areas that do not have headquarters and/or airports with intercontinental flights (Data are in logarithms).

correlated with the rest of explanatory variables of the headquarters equation (with the exception of the variable for market services employment). Intra-European traffic is more correlated with the economic, demographic and political relevance of the corresponding urban area. Hence, we prefer to use the availability of intercontinental flights as the more accurate differential measure of the quality of transport services that an urban area is able to offer to firms. However, we will also present results using the variable for Intra-European flights as indicator of the quality of transport services.

5. Estimation and results

We estimate our equation system using the ordinary least square (OLS) and the two-Step efficient generalized method of moments (2-step GMM) estimators. The latter estimator accounts for the possible bias that may imply the inclusion of endogenous explanatory variables in the equation to estimate.[6] Note that the equations of our system will be identified in case that we find that at least one different explanatory variable in each equation is statistically significant.

In all the estimations, error terms are clustered by the country of origin of the urban area. Since error terms capture unobservable firm attributes, spatial correlation can arise across urban areas of the same origin country. Indeed, airlines still concentrate

6 The efficiency gains of this estimator in relation to the traditional two-stage least square estimator (IV/2SLS) are related to the use of the optimal weighting matrix, the use of several excluded instruments and the relaxation of the error term assumptions.

Table 7. Intercontinental flights equation estimates

Dependent variable (Freq_intercontinental)		
	OLS	2-Step GMM
Headquarters	5.44 (1.19)***	5.65 (0.79)***
Population	0.007 (0.005)	0.004 (0.005)
International_tourists	9.61 (4.79)*	12.67 (3.57)***
D^{hub}	50.25 (25.46)*	54.99 (12.47)***
D^{capital}	−31.77 (33.27)	−55.71 (21.00)***
Intercept	−34.27 (8.44)	−29.27 (8.81)***
Number of observations	87	87
R^2	0.77	0.78
F-test (joint significance)	30.25***	880.25***
Test Hansen J-statistic (overidentification of excluded instruments)	–	5.62
Test Anderson canonical correlations (underidentification and weak indentification)	–	75.55***
Shea's partial R^2 (excluded instruments)	–	0.58
F-test (significance of excluded instruments)	–	8.00***

Notes: Standard errors in parenthesis: Robust to heterocedasticity and clustered by country of origin. Significance at 1% (***), 5% (**), 10% (*). Instruments for headquarters are wages, fiscal_pressure, industry_employment, services_employ ment, and GDP_weigth.

most of its operations in airports of their home country so that any unobservable affecting such airlines will influence on those airports. Additionally, several large firms have still a strong national identity so that any unobservable effect affecting such large firms will influence on the urban areas of the corresponding origin country. In short, error terms could be capturing unobservable country effects.

Results for standard tests of validity of instruments are reported when the 2-step GMM estimator is used. We report results of the Hansen J-test for over-identifying restrictions in which the null hypothesis is that the instruments are uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation. This test cannot be implemented when we use just one excluded instrument as the equation in this case is exactly identified. We also report the Anderson canonical correlations test in which the null hypothesis of the test is that the equation is under-identified (that is, instruments are weak). Finally, we report the Shea's partial R^2 measure of instrument relevance that measures the correlation between the excluded instruments and the endogenous regressor, and the F-test statistic of the excluded instruments in the corresponding first-stage regression.

Table 7 show the results of the intercontinental flights equation estimated using the OLS and the two-step efficient generalized method of moments (2-step GMM) estimators. The overall explanatory power of the equation is high. Results for the tests of validity of instruments in the estimation using the 2-step GMM indicate that the excluded instruments are not correlated with the error term and that they are highly correlated with the endogenous explanatory variable, which is the number of headquarters in each urban area. Note that the excluded instruments of this variable are the explanatory variables of Equation (1) previously specified that are not included as explanatory variables in the intercontinental flights equation. To this regard, we find substantial differences in the results using the OLS or the 2-step GMM estimator. The statistical significance and the value of coefficients of explanatory variables are higher when using the 2-step GMM estimator. Hence, the endogeneity bias related to the use of the number of headquarters as explanatory variable seems to be statistically troublesome.

Regarding the determinants of the demand of intercontinental flights, the variable for headquarters seems to be a relevant explanatory factor. This variable may be also considered as a proxy of the size of tertiary activities in each urban area. In fact, several of the excluded instruments used for dealing with the possible endogeneity of the variable for headquarters show it. Note that our main interest in estimating this equation is to assess the potential statistical effects related to the simultaneous determination of number of headquarters and availability of intercontinental flights.

As expected, demand for intercontinental flights coming from tourists or connecting traffic play also a statistically significant role, particularly when using the 2-step GMM estimator. On the contrary, the coefficient of the variable for population is not statistically significant. Thus, the size of the city does not seem matter so much in terms of the availability of intercontinental flights in their airports, at least for the considered sample. Finally, the dummy variable for cities that are the political capital of the origin country is statistically significant (when using the 2-step GMM estimator) but with a negative sign. This latter result may be explained by the fact that cities like Frankfurt, Munich, Düsseldorf, Milan, Manchester or Zurich are very relevant airports in terms of intercontinental traffic.

Table 8 show the results of the headquarters equation estimated, using the OLS and the two-step efficient generalized method of moments (2-step GMM) estimators. Table 9 shows the elasticities that can be inferred from the linear estimations for the headquarters equation.

We make use of two alternative strategies with regard to the excluded instruments for the endogenous explanatory variable, which is the availability of intercontinental flights. In this way, we use data of past traffic (total number of passengers) in the period that goes from 1992 to 2000. We do not have available data for previous years, while using data for 2001–2003 could cast doubts on the exogeneity of the excluded instruments. To this regard, we first use the average annual traffic in the period 1992–2000 as instrument. Then, we also use as an alternative instrumentation strategy data for the first and last year of the period, 1992 and 2000. The second alternative allows implementing the Hansen *J*-statistic for over-identifying restrictions. Results for the tests of validity of instruments in the estimation using the 2-step GMM estimator show that excluded instruments are highly correlated with the endogenous explanatory variable. This is true for the two alternative instrumentation strategies that we use. Additionally, the Hansen *J*-statistic for the second instrumentation strategy shows that the excluded instruments are not correlated with the error term.[7]

The overall explanatory power of the equation is high. Concerning the determinants of the location of headquarters, the variable for the supply of intercontinental flights

7 We could use as instruments the explanatory variables of the Equation (2) for the provision of intercontinental flights that are not included in the Equation (1) for the headquarters location. Recall that these variables account for international tourists and airports where network carriers offer high frequent services to an extensive number of European destinations; *International_tourists* and D^{hub}. However, we are more confident with the strength and exogeneity attributes of the variables for past traffic as instruments.

Table 8. Headquarters equation estimates

	Dependent variable (headquarters)		
	OLS	2-Step GMM (1)	2-Step GMM (2)
Freq _intercontinental	0.09 (0.02)***	0.10 (0.01)***	0.10 (0.01)***
Population	−0.0004 (0.007)	−0.0008 (0.0006)	−0.001 (0.0004)**
Wages	0.0003 (0.0001)***	0.0003 (0.00009)***	0.0003 (0.00009)***
Fiscal_ pressure	−0.13 (0.21)	−0.11 (0.19)	−0.09 (0.19)
Industrial_employment	0.009 (0.004)**	0.009 (0.003)***	0.009 (0.003)***
Services_employment	0.02 (0.007)***	0.01 (0.006)***	0.02 (0.006)***
$D^{capital}$	5.69 (2.76)**	4.89 (2.46)**	4.16 (2.28)*
GDP_weigth	−3.17 (7.11)	−1.82 (6.14)	0.09 (5.64)
Intercept	−9.25 (9.49)	−7.45 (8.72)	−8.08 (8.68)
Number of observations	87	87	87
R^2	0.83	0.86	0.86
F-test (Joint significance)	78.16***	1,019.64***	1,112.11***
Test Hansen *J*-statistic (overidentification of excluded instruments)	–	–	0.62
Test Anderson canonical correlations (underidentification and weak indentification)	–	76.97***	75.39***
Shea's partial R^2 (excluded instruments)	–	0.59	0.57
F-test (significance of excluded instruments)	–	105.37***	78.26***

Notes: Standard errors in parenthesis: Robust to heterocedasticity and clustered by country of origin. Significance at 1% (***), 5% (**), 10% (*). Instrument for Freq _intercontinental in specification (1) is mean traffic 1992–2000, while instruments for Freq _intercontinental in specification (2) are traffic 1992 and traffic 2000. Test Hansen *J*-statistic is not reported in specification (2) since this test requires more than one excluded instrument to be implemented.

Table 9. Elasticity (evaluated at sample means) of the headquarters equation estimates

	OLS	2-Step GMM (1)	2-Step GMM (2)
Freq_intercontinental	0.36 (0.10)***	0.43 (0.08)***	0.41 (0.07)***
Population	−0.05 (0.07)	−0.08 (0.06)	−0.11 (0.04)**
Wages	1.02 (0.26)***	0.90 (0.21)***	0.91 (0.20)***
Fiscal_pressure	−0.53 (0.85)	−0.44 (0.79)	−0.37 (0.75)
Industrial_employment	0.23 (0.07)***	0.23 (0.07)***	0.23 (0.07)***
Services_employment	0.74 (0.19)***	0.57 (0.18)***	0.56 (0.18)***
$D^{capital}$	0.11 (0.06)*	0.09 (0.05)*	0.08 (0.04)*
GDP_weigth	−0.04 (0.10)	−0.03 (0.09)	0.001 (0.08)

Notes: Standard errors in parenthesis: Robust to heterocedasticity and clustered by country of origin. Significance at 1% (***), 5% (**), 10% (*). Instrument for Freq_intercontinental in specification (1) is mean traffic 1992–2000, while instruments for Freq_intercontinental in specification (2) are traffic 1992 and traffic 2000.

has a positive and significant effect. In terms of elasticities, a 10% increase in the provision of intercontinental flights involves around a 4% increase in the number of headquarters located in the corresponding urban area. To this regard, the value of the corresponding elasticity is slightly higher in the 2-step GMM estimation than in the

OLS estimation. Thus, we find evidence that the availability of long-haul air services is a major determinant of large firms' headquarters location.

As far as we know, only the study of Strauss-Kahn and Vives (2005) analyze the link between the location of headquarters and the availability of airport services in the US. In this study, the availability of airport services is measured using dummy variables that account for having a large hub, a small hub or a small airport. A large hub moves >1% of total traffic over the country, a small hub moves between 0.5% and 1% of total traffic over the country and a small airport moves <0.5% of total traffic over the country. Results of their empirical analysis show that urban areas that have a large or a small hub are much more attractive for locating headquarters. Concerning the location of large firms' headquarters in Europe, we find that not only matters the amount of total traffic moved by an airport but also the amount of long-haul traffic moved by such airport. Although both measures of availability of airport services are correlated, we can still find substantial differences across European urban areas. For example, the airports of Milan, Munich or Zurich have a much higher amount of intercontinental traffic than that related to their total traffic.

The coefficients of the variables of regional employment in the corresponding sector are positive and statistically significant. Hence, we find that the proximity to large markets and specialized providers influences positively on the location of headquarters. In terms of elasticities, the effect of the employment in market services is higher than the effect of the employment in industrial services. These variables account for the lower communication costs to production plants and offices of the firm (and proximity to final demand). However, the variable for market services captures also the proximity to external providers, since firms devoted to market services are the main external providers of headquarters.

The effect of the variable for population is negative, so that this variable is effectively capturing congestion costs. However, its coefficient is only statistically significant in the 2-step GMM estimation that uses as instrumentation strategy past traffic data for 1992 and 2000. In fact, this is the only substantial difference between the results of the two alternative instrumentation strategies used for the variable of intercontinental flights. Thus, no strong inferences can be made concerning the statistical significance of the variable for population. In any case, all the estimations show that its coefficient has a negative sign. To this point, note that the positive aspects of proximity to large markets are captured by other variables.

With regard to the variable for wages, the sign of its coefficient is positive and statistically significant. Recall that this variable not only may indicate a higher availability of skilled labor but also higher labor costs. We find that the lower recruitment costs of skilled labor seem to compensate for the higher salaries that must be paid. Likely, this could be explained by the fact that a high proportion of headquarters employees are high-skilled employees. Saving costs in terms of salaries may not be a choice for large firms' headquarters.

The coefficient of the variable for fiscal pressure is negative, as expected, but it is not statistically significant. This does not mean that saving tax costs are not a priority for large firms' headquarters. It may well be that what matters for headquarters is other measures of tax, such as local tax rates and location incentives.

In relation to the role of the urban area in the corresponding country, we find that the coefficient of the dummy variable for the political capital is positive and statistically significant. Hence, large firms' headquarters seem to appreciate proximity to public

Table 10. Headquarters equation estimates (additional specifications)

Dependent variable (headquarters)		
	2-Step GMM (4)	2-Step GMM (5)
Freq_intercontinental	–	0.07 (0.01)***
Freq_intraEuropean	0.0004 (0.00008)***	–
Price_offices	–	0.01 (0.01)
Population	−0.001 (0.0008)*	0.0007 (0.001)
Wages	0.00008 (0.0001)	0.0002 (0.0002)
Fiscal_pressure	−0.31 (0.24)	−0.23 (0.45)
Industrial_employment	−0.0004 (0.004)	0.001 (0.01)
Services_employment	0.02 (0.005)***	0.02 (0.008)***
$D^{capital}$	−5.08 (5.76)	3.24 (11.81)
GDP_weigth	−3.03 (6.57)	13.22 (11.88)
Intercept	6.01 (10.12)	−12.37 (22.15)
Number of observations	80	30
R^2	0.80	0.91
F-test (joint significance)	121.52***	146.40***
Test Anderson canonical correlations (underidentification and weak indentification)	53.14***	37.07***
Shea's partial R^2 (excluded instruments)	0.48	0.70
F-test (significance of excluded instruments)	42.23***	80.59***

Notes: Standard errors in parenthesis: Robust to heterocedasticity and clustered by country of origin. Significance at 1% (***), 5% (**), 10% (*). Instrument for Freq_intraeuropean in specification (4) and Freq_intercontinental in specification (5) is mean traffic 1992–2000. Test Hansen *J*-statistic is not reported, since this test requires more than one excluded instrument to be implemented. In specification (4) data for Swiss and Norwegian urban areas are not considered since intra-European traffic is not applicable. Concerning specification (5), data for price offices is just available for 30 urban areas. In specification (5), the elasticity of headquarters to direct intercontinental flights is: 0.36 (0.09)***.

administrations and regulatory agencies. On the contrary, the variable for the weight of the urban area over the country in terms of GDP do not have a relevant effect. Differences in the country size of the urban areas of our sample, and so differences in the economic weight of each urban area in those countries explain that no clear inferences can be made concerning this latter variable.

Finally, we present in Table 10 the results of additional specifications of the headquarters equation estimated, using the two-step efficient generalized method of moments (2-step GMM) estimator.[8] In the first additional specification, we use as explanatory variable total annual departures to European destinations (*Freq_intraEuropean*) instead of the variable for intercontinental flights. We examine here to what extent intra-European traffic may be also an appropriate measure of the quality of air services. In the second specification, we add as explanatory variable office rents and occupancy costs in the main municipality of the urban area (*Price_offices*). In this estimation, we consider the possible effects of these costs in large firms' headquarters location choices. Large firms may want to save office rents in deciding

8 To make clearer the reading of the table, we only report results of the 2-step GMM estimation that uses as instrumentation strategy the average annual traffic in the period that goes from 1992 to 2000. Results do not change substantially when using as instrumentation strategy traffic from 1992 to 2000.

where to locate their headquarters. Note that we must be cautious in the interpretation of results of the estimation for this latter specification since data are just available for 30 large cities.

Results for the specification that use intra-European traffic as explanatory variable indicate that such traffic plays also a significant role in the location choices of large firms' headquarters. However, the empirical effects obtained for the rest of explanatory variables are generally reduced for the inclusion of this variable. Recall that the Table 6 presented in the previous section shows that the correlation between the variable for intra-European traffic and the rest of explanatory variables of the headquarter location equation is substantially higher than in the case of the variable for intercontinental traffic. Hence, the former variable may be capturing other effects not necessarily related to the quality of the air services that the urban area provides. Additionally, intra-European traffic is also highly correlated with intercontinental traffic, since an important proportion of passengers coming from several European cities feed the intercontinental flights offered by large airports. Within the European context, we claim that intercontinental traffic is the most appropriate measure of the quality of air services as explanatory factor of large firms' headquarters location choices.

Results of the specification that include as explanatory variable office rents and occupancy costs for 30 large European cities show the robustness of the causal relationship estimated between the supply of direct intercontinental flights and the location of large firms' headquarters. Indeed, the coefficient of the variable for intercontinental flights is positive and statistically significant and the elasticities inferred are of the same magnitude than in previous estimations. However, the statistical significance of the rest of variables is low. This may be explained by the scarcity of observations and the low data variability that implies a sample of few large cities. In fact, higher office rents and occupancy costs do not seem to play a relevant role for headquarters location choices, at least for a small sample of large cities.

To sum up, our empirical analysis demonstrates the relevance of the quality of air services in deciding where to locate headquarters. A major attribute of this quality is the geographical scope of the airport services offered in each urban area. Importantly, this finding takes into account several control factors, such as the proximity to large markets and specialized providers, congestion and tax costs, the role of the urban area in the corresponding country and the salaries paid in that urban area.

Hence, we find that information exchanges between cities play a major role on large firms' headquarters location choices. These exchanges involve tacit information, since air travel reflects the value of the face-to-face contact in contrast to the coded information that flows by electronic means. Furthermore, our results show the relevance of the quality of air services to the appeal of an urban area for large firms, and hence offer additional empirical evidence of the contribution of airports to urban economic growth.

6. Concluding remarks

In this article, we have examined empirically the determinants of the location of large firms' headquarters for a rich sample of European urban areas. Our main interest has been to measure the existence of a causal relationship between the supply of direct intercontinental flights and headquarters location choices, given the value of several control factors.

We find that variables for proximity to large markets and specialized providers influence positively on the location choices of large firms' headquarters. Indeed, the regional employment in industrial and market services play a relevant role in these choices. Given that, firms may want to avoid congestion and tax costs. Additionally, urban areas that paid high salaries and whose main city is the political capital of the corresponding country are more attractive for locating headquarters. No clear inferences can be made concerning the economic role of the urban area in countries of very different size.

Taking into account the existence of a possible endogeneity bias, we find that the supply of direct intercontinental flights is effectively a major determinant in the location choices of large firms' headquarters. Indeed, a 10% increase in the supply of intercontinental flights involves around a 4% increase in the number of headquarters of large firms located in the corresponding urban area.

Overall, we find evidence that location choices of large firms' headquarters are highly influenced by the communication costs that imply the exchanges of information between different cities.

Given the substantial benefits that urban areas can obtain from attracting large firms' headquarters, our results provide new evidence of the contribution of transport infrastructures to urban growth. Additionally, our results provide empirical evidence of the importance of exchanges of tacit information between cities. Finally, since these exchanges are between cities on different continents, new insights into the globalization process can be inferred.

Regional policies aimed at attracting headquarters of large firms (and other knowledge-intensive activities) must promote the development of international airports. In particular, investments to expand and/or improve their capacity and possibly the implementation of commercial strategies to attract major airlines are critical factors for the success of these policies.

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References

Bowen, J. (2002) Network change, deregulation, and access in the global airline industry. *Economic Geography*, 78: 425–439.

Brueckner, J. K. (2003) Airline traffic and urban economic development. *Urban Studies*, 40: 1455–1469.

Button, K., Lall, S., Stough, R., Trice, M. (1999) High-technology employment and hub airports. *Journal of Air Transport Management*, 5: 53–59.

Cambridge Econometrics (2006) European Regional Database. Cambridge: Cambridge Econometrics.
Davis, J. and Henderson, J. (2004) The agglomeration of headquarters. *CES Working Paper 04-02*.
Demsetz, H. (1988) The theory of the firm revisited. *Journal of Law, Economics and Organization*, 4: 141–161.
Dennis, N. (2005) Industry consolidation and future airline network structures in Europe. *Journal of Air Transport Management*, 11: 175–183.
Duranton, G. and Puga, D. (2002) From sectoral to urban specialization. *NBER Working Paper 9112*.
ELC (2003) *Europe's 15,000 largest companies*. London: ELC publishing.
Gaspar, J. and Glaeser, E. L. (1998) Information technology and the future of cities. *Journal of Urban Economics*, 43: 136–156.
van Geenhuizen, M. and Doornbos, H. (2005) *The role of international airports in knowledge networks of young high-tech companies*. A rough-set approach. 8th Nectar Conference, Las Palmas G.C. (Spain).
Glaeser, E. L. (1998) Are cities dying? *Journal of Economic Perspectives*, 12: 139–160.
Glaeser, E. L. and Kohlhase, J. E. (2003) Cities, regions and the decline of transport costs. *Harvard Institute of Economic Research Discussion Paper 2014*.
Henderson, J. V. and Ono, Y. (2005) Where do manufacturing firms locate their headquarters? *Federal Reserve Bank of Chicago WP 2004-09*.
Holloway, S. R. and Wheeler, J. O. (1991) Corporate headquarters relocation and changes in metropolitan corporate dominance, 1980-1987. *Economic Geography*, 67: 55–72.
Klier, T. and Testa, W. (2002) Location trends of large company headquarters during the 1990s. *Federal Reserve Bank of Chicago Economic Perspectives*, 26: 12–26.
Lijesen, M., Rietveld, P., Nijkamp, P. (2002) How do carriers price connecting flights? Evidence from intercontinental flights from Europe. *Transportation Research-E*, 38: 239–252.
Lovely, M. E, Rosenthal, S. S., Sharma, S. (2005) Information, agglomeration and the headquarters of U.S exporters. *Regional Science and Urban Economics*, 35: 167–191.
Markusen, J. R. (1995) The boundaries of multinational enterprises, and the theory of international trade. *Journal of Economic Perspectives*, 9: 169–189.
Martin, J. C. and Román, C. (2004) Analyzing competition for hub location in intercontinental aviation markets. *Transportation Research-E*, 40: 135–150.
Meijer, M. (1993) Growth and decline of European cities: changing positions of cities in Europe. *Urban Studies*, 30: 981–990.
Perry, M. K. (1989) Vertical integration: determinants and effects. In R. Schmalensee and R. D. Willig (eds) *Handbook of Industrial Organization*, Vol. 1. Amsterdam: North Holland, 183–225.
Polèse, M. and Sheamur, R. (2004) Culture, language, and the location of high-order service functions: the case of Montreal and Toronto. *Economic Geography*, 80: 329–350.
Storper, M. and Venables, A. J. (2004) Buzz: face-to-face contact and the urban economy. *Journal of Economic Geography*, 4: 351–370.
Strauss-Kahn, V. and Vives, X. (2005) Why and where do headquarters move? *CEPR Discussion Papers 5070*.
Williamson, O. (1979) Transaction-cost economics: the governance of contractual relations. *Journal of Law and Economics*, 22: 233–261.

Appendix 1

Description of the exogenous explanatory variables

Population

Total inhabitants at the NUTS 3 level (Statistical unit used by Eurostat). Source: Cambridge Econometrics (2006). Time Period: 2003.

Wages

Total compensation per employee at the NUTS 2 level (Statistical unit used by Eurostat). Data are measured in annual euros. Source: Cambridge Econometrics (2006). Time Period: 2003.

Fiscal_pressure

General government total tax and non-tax receipts over GDP at the country level. Source: OECD web site (National Accounts of OECD countries). Time period: 2003.

Industrial_employment

Total employees in energy and manufacturing at the NUTS 2 level. Source: Cambridge Econometrics (2006). Time Period: 2003.

Services_employment

Total employees in market services at the NUTS 2 level. Market services refer to transport and communications, financial intermediation and real state, renting and business activities. Source: Cambridge Econometrics (2006). Time Period: 2003.

GDP_weight

Percentage of GDP at the NUTS 2 level over GDP at the country level. Source: Cambridge Econometrics (2006). Time Period: 2003.

International_tourists

Rate of arrivals of international tourists with respect to national tourists at the NUTS 2 level. Source: Eurostat. Time period: 2003.

D^{hub}

Dummy variable that takes value 1 for airports that are considered viable hubs for any international airline alliance. According to Dennis (2005), viable hubs are airports where airlines belonging to an international alliance offer non-stop flights to >20 European destinations with a frequency high enough to develop a complete wave of connections. Source: Dennis (2005). Time period: 2002.

Traffic 1992–2000

Total annual passengers moved in airports of the corresponding urban. Data refer to the mean annual values for period 1992–2000. Source: Airport Traffic Statistics from International Civil Aviation Organization (ICAO).

Traffic 1992 and 2000

Total annual passengers moved in airports of the corresponding urban. Data refer to the annual value for the considered year. Source: Airport Traffic Statistics from International Civil Aviation Organization (ICAO).

Freq_intraEuropean

Total annual flight departures from airports of the corresponding urban area to intra-European destinations. Source: Eurostat. Time Period: 2004.

Price_Offices

Office rents and occupancy costs in the municipality. Data are measured in annual euros per square meter. Source: CBRE (CB Richard Ellis), *Global Market Rents*, August 2004. Time period: Second half 2004.