Amsterdam Center for Corporate finance

Topics in Corporate Finance

Headquarters and innovation: does location matter?

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in cooperation with

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Preface

A key public issue for many governments is how to attract (and retain) economic activities. While industrial policy, aimed at picking winners and/or subsidizing existing businesses, is out of fashion (the dreadful experiences in the seventies with protecting "old industries" like shipping and mining are still vivid…), countries and regions are nevertheless actively trying to create their own "Silicon Valley". In similar spirit, governments seem interested at being attractive as location for headquarters. Economic activity, and knowledge intensive professional services in particular, seem to cluster where headquarters are. All this might be true, yet little is known about the effectiveness and ability of governments to stimulate economic activity.

Against this backdrop the Amsterdam Center for Corporate Finance (ACCF) has decided to devote this issue of its discussion series "Topics in Corporate Finance" to this important topic. This booklet tries to take a small step in that direction. Professor Vives – one of the world's leading authorities on competitiveness and industrial policy – provides (in collaboration with Professor Vanessa Strauss–Kahn) an insightful analysis of the choice of location for headquarters. This is analyzed extensively using data on location choices of firms in the United States. In a separate chapter Professor Vives also addresses where economic activity is clustered in the EU, suggestive for what the regional competitive advantages might be. The main observation in this brief chapter is that regions have specialized, yet have very different track records in attracting innovative activities.

We hope that you enjoy reading it, and that this publication may contribute to bridging the gap between theory and practice.

A.W.A. Boot
June 2007

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1. The geography of innovation in Europe

By Xavier Vives

1.1 Introduction

Innovation is widely seen as the main driving force of growth. It is no coincidence that Europe lags behind the US both in innovation capacity and growth performance. It is perceived also that innovation has an important location component. That is, location matters because of the tendency of innovation activities and the necessary human capital to cluster in specific metropolitan areas. Globalization by providing firms with a larger market enhances innovation incentives but certain regions may be favoured over others as most desired locations for R&D activities. The EU will reduce structural funds and cohesion help to several European regions, because money will flow to the new members, while promising an increase in support to innovation. The question is whether innovation funds will flow to cohesion regions or to advanced regions.

I present a snapshot of the situation of innovation indicators in European main metropolitan areas just before enlargement, reporting some results obtained in Vives and Torrens (2004), and conclude with some possible implications for EU policy.

1.2 Economic geography and innovation

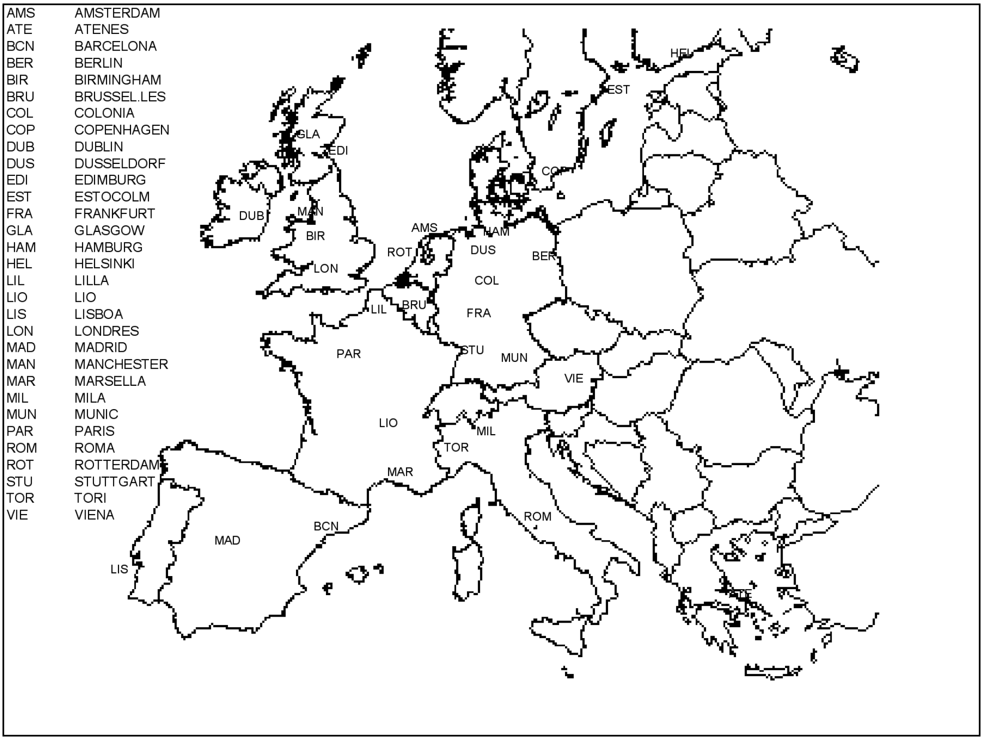
The existence of a critical mass in human and technological capital and a suitable infrastructure are necessary conditions to reach a competitive position in the global market. The evidence suggests that technological advanced activities tend to cluster. Those clusters tend to obtain where there is a high concentration of human capital; presence of leading international education and research centers (like Stanford for Silicon Valley or MIT/Harvard for the Boston area); access to a thick and advanced market of suppliers and services; availability of venture capital financing; and good quality of life.

New technologies in principle can contribute as much to centralizing as to decentralizing forces. They can give opportunities to the peripheral economies to develop a critical mass in technological capital and R&D. At the same time the improvements in communications and transport can reinforce the centers that already have a sufficient critical mass. The importance of tacit knowledge, derived from experience and that cannot be codified, is a fundamental element of the existence of clusters. Paradoxically, globalization fosters a concentration of activities with more requirements of tacit knowledge, since these need face-to-face contacts between participants and a thick labor market for highly qualified human capital. Clustering of innovation and advanced service activities need not be more decentralized with globalization (Duranton and Puga (2001)).

1.3 Snapshot of innovation indicators in European metropolitan areas.

Consider 31 main metropolitan areas of the European Union before enlargement in 2004 (see map 1).

Map 1. Metropolitan Areas

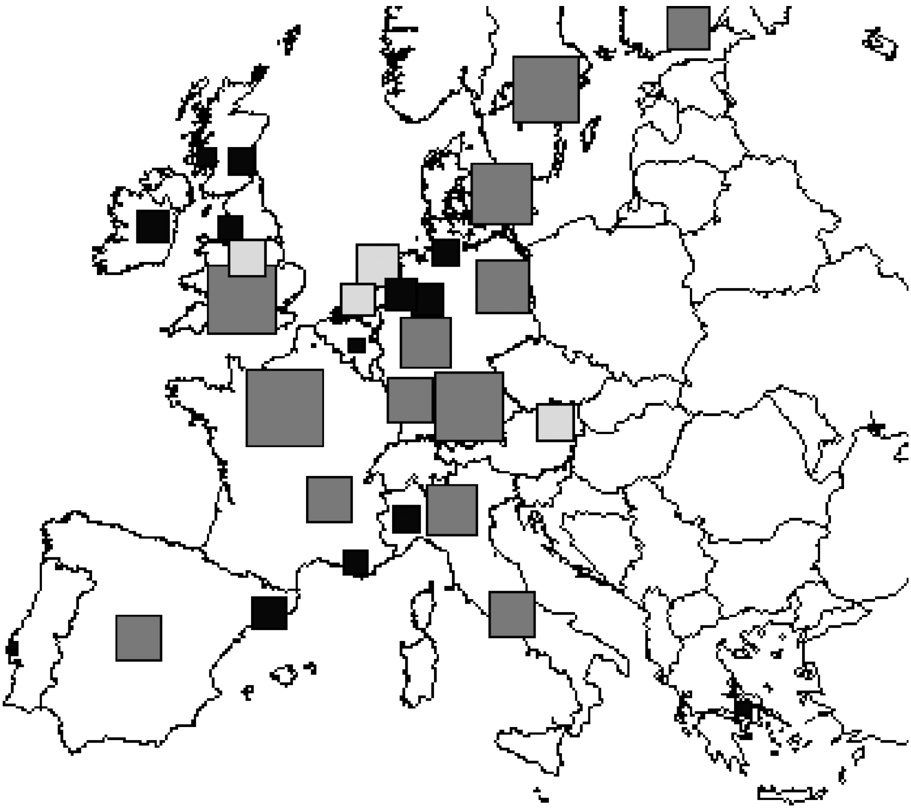


To have a snapshot on the situation of the different metropolitan areas we look at an index which aggregates the results obtained by those areas in terms of patents, international scientific publications, and employment in high technology and knowledge-intensive sectors (both in absolute terms and relative to population or employment see Vives and Torrens (2004)).

Map 2 presents the results obtained for the different regions. The areas with results 10% or more above the average are marked in dark grey colour; the areas with results 10% or less than the average in black; the rest, in light grey, are the areas with central results. The size of the squares is proportional to the results. The best results are obtained by the large cities of Paris and London, followed by Munich, and Stockholm. We observe that the location of innovation activities has a component driven by critical mass (in London and Paris), another by regions with an industrial base turned towards innovation

(Lyon, Milan and the German cities) and a Nordic derivation to Helsinki and Stockholm through Copenhagen, based on development effort.

Map 2. The Geography of Innovation



- 10 % above average
- average + /- 10 %
- 10 % below average

1.4. Conclusion

We see thus that the Nordic cities (Helsinki, Stockholm and Copenhagen) and a good part of the German (such as Munich, Berlin and Frankfurt) seem well positioned to meet the challenge of innovation coming out of globalisation and enlargement of the European Union toward the East. Other traditional industrial areas (like Barcelona, Turin, Birmingham or Düsseldorf) are more vulnerable because they have still not carried out the needed change toward innovative activities. Industrial centres such as

Stuttgart, Lyon and indeed Munich are already doing it. Madrid and Rome, as state capitals, have managed to concentrate more innovation mass. Southern areas, like Barcelona or Lisbon, should use their advantage in quality of life as strategic lever part to attract creative and innovative talent and be able to increase their undeveloped potential.

Some of the Southern areas will see their cohesion funds diminished because of enlargement and hope to obtain help to get innovative activities off the ground. However, this need not materialize if R&D funding at the European level is allocated according to efficiency criteria because the return may be likely to be higher in areas where there is already a critical mass of innovation activity. This certainly will be a challenge for European innovation policy.

References

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2. Why and where do headquarters move?[1]

By Vanessa Strauss-Kahn and Xavier Vives

2.1 Introduction

The locations of headquarters tend to be concentrated (the top 20 urban centers accumulate 75% of the headquarters weighted by sales in the continental U.S.) and the rate of movement is significant (about 5% in our sample between 1996 and 2001). This paper studies the determinants of headquarters' moves.

The location pattern of headquarters and their relocation has deep connections with the evolving internal organization of firms as well as important consequences for economic activity. The decision on where to locate the headquarters of a firm is not independent of the evolution of the modern corporation. From the unitary U-form (where functional units report to the general management) to the multidivisional M-form (where functional units report to the division head who, in turn, reports to general management), large corporations have developed a range of headquarters centers (Chandler 1990). Modern economic geography (Duranton and Puga 2005; Fujita and Thisse 2005) points at the changes in the functional specialization of cities driven by the reduction in transport and communication costs associated to globalization. In a nutshell, firms may now afford to separate management from production activities, concentrating each one where it is more efficient. Fujita and Ota (1993) provide an early theoretical model of the phenomenon. This implies that cities specialize in management or production activities. This new pattern is not unrelated to the increase in outsourcing.

There is evidence that metropolitan areas with a higher number of and more diversified headquarters have higher per-capita income (Shilton and Stanley 1999). Headquarters are perceived as attractors of business services, a highly qualified pool of labor as well as other headquarters. Indeed, when headquarters move, municipalities and regional governments worry about the possible negative externalities in terms of direct and indirect employment losses and decrease in market thickness. This was the case of when the Bank of America moved its headquarters from San Francisco because of merger and when Boeing decided to move from Seattle. Local governments try to influence headquarters' location by offering appropriate infrastructure, subsidies, and tax incentives. The location and relocation of headquarters shapes the structure of metropolitan areas and from the spatial concentration of headquarters emerges a pattern of specialization of cities in headquarters and business services activities. As we will see there are indeed quite significant movements from the industrial "rust belt" to the service-oriented "sun belt".

The analysis of headquarter location is also relevant to other business activities. Indeed, we know from Marshall that establishments tend to agglomerate because of

1 This chapter is for discussion purposes only, and distributed as CEPR Discussion Paper 5070 and IESE Business School Working Paper 650.

external economies driven by, among other factors, pooling in the labor market and knowledge spillovers. This applies with force to headquarters but also to other activities like R&D, where informal or "soft" information exchange is crucial.[2] Sales offices and other white-collar information-intensive activities provide further examples (Holmes and Stevens 2004). Holmes (2005) finds that sales offices are highly concentrated in large cities because of a home market effect and knowledge spillovers. This is to be contrasted with codified or "hard" information exchange for which geographic proximity is not crucial (Glaeser 1999; Cremer et al. 2005).[3] Our findings on the determinants of the location of headquarters may be in consequence of wider applicability.

There are many studies that analyse the determinants and evolution of the geographical concentration of industrial activity (e.g. Kim 1995, 2000; Ellison and Glaeser 1997; Rosenthal and Strange 2003a, b; Strauss-Kahn 2005). However, evidence on the determinants and evolution of the geographical concentration of business decision centers is scarce (Holloway and Wheeler 1991; and, more recently, Shilton and Stanley 1999; Davis and Henderson 2004; and Lovely et al. 2005 are exceptions).

The aim of this paper is to study the determinants of the location of headquarters according to the variables that modern economic geography indicates that should matter:

- agglomeration variables: business services and other headquarters;
- corporate taxes;
- congestion;
- cost of transmitting headquarters' services; and
- firm-specific factors such as merger activity, size, and age of the headquarters.

Congestion is proxied by high wages, and the cost of transmitting headquarters' services by, among other factors, transportation facilities. To study the issue, we use a database of more than 25,000 headquarters in the continental U.S., of which about 1,500 moved between 1996 and 2001. Headquarters are defined as a management (administration and marketing) center of a firm; the average number of headquarters per firm in our sample is 15. We find that headquarters cluster in a small number of metropolitan areas and that they are more agglomerated than economic activity. In contrast to the results for the 1980s (Holloway and Wheeler 1991), we find a tendency towards greater concentration. New York is a declining dominant center, but, excluding New York, top centers show gains (sales-weighted). The tendency is that middle-sized service-oriented "sun belt" agglomerations gain at the expense of "rust belt" industrial centers.

We estimate the probability of relocation of headquarters to a metropolitan area with a three-level nested logit structure. A firm first considers whether to relocate the headquarters, classifies the potential locations by characteristics (geographic or by size class in our case) and chooses a nest, and finally chooses a location within the nest. This procedure is not at odds with usual practice. For example, when Boeing decided to move its headquarters from

2 Jaffee et al. (1993) provide patent citation evidence of knowledge spillovers.

3 The distinction between hard and soft information is also important in the incentive literature, providing a further explanation for the separation of management and production. Namely, separation may be a commitment device to monitor less intensely the agent and this way incentivate his initiative (Aghion and Tirole 1997).

Seattle, it announced the characteristics of the potential locations of where to move.[4] The main results are as follows.

- Headquarters relocate to metropolitan areas with good airport facilities – with a dramatic impact, low corporate taxes, low average wages, high levels of business services, same industry specialization, and agglomeration of headquarters in the same sector of activity. The effect of the agglomeration variables is important and significant.

- Headquarters that are larger (in terms of sales) and younger tend to relocate more often (corporate history matters). As do firms that are larger (in terms of the number of headquarters), are foreign, or are the outcome of a merger.

- Headquarters in locations with good airport facilities, low corporate taxes, and with agglomeration of headquarters in the same sector of activity tend to stay put.

The policy interest of the exercise should be evident. The first step in finding out what local governments can do to keep and attract headquarters is understanding the determinants of their location. Greenstone and Moretti (2004) concluded that local governments have incentives to provide subsidies to attract productive plants and Garcia-Milà and McGuire (2002) argued that agglomeration externalities may justify subsidies to attract headquarters.[5] Our results are a first step to cook up a recipe for success in attracting headquarters.

The results are in line with recent economic geography models (Ekholm and Forslid 2001; Duranton and Puga 2005; Fujita and Thisse 2005). A basic story is that headquarters are located in areas with business services and other headquarters. The first factor arises because of economies of scale in the provision of business services, and the second factor arises because of externalities among headquarters due to face-to-face interactio n.[6]Headquarters benefit from diversified business services inputs and from the informal information exchange that close geographical proximity entails.

The results are also consistent with a basic story according to which the decrease in communication costs facilitates the location of headquarters in areas where they can be more productive liberating the larger headquarters, at least, from the servitude of being close to production facilities. When Boeing decided to move its main headquarters, it explicitly stated that it wanted to distance management from its traditional manufacturing base and look for a central location that could better accommodate a global and diversified aerospace company. Being close to a plant is however still important given that a headquarter wants to locate in a metropolitan region specialized in its sector of activity. There is therefore a tension between (i) being close to a plant in order to save information costs, and (ii) being away from plants in order to give more autonomy to

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4 See Garcia-Milà and McGuire (2002) for a study of the relocation of Boeing's main headquarters from Seattle to Chicago.

5 See Glaeser (2001) for a survey of location-based incentives.

6 Evidence on the concentration and localization economies of business services in Japan and the U.S. is provided by Kolko (1999), Dekle and Eaton (1999) and Adserà (2000). See also Ciccone and Hall (1996).

plant managers and profit from business services and headquarters externalities in a business center. The essential ingredients of the trade-off are exposed in the model by Fujita and Ota (1993). The fact that we find that the externality is stronger when locating to areas where headquarters of the same industry are found is consistent with the idea that the informal information exchange among executives of headquarters is important. The results are also consistent with the finding in Lovely et al. (2005) that the agglomeration of headquarters of U.S. exporters is driven by the need to acquire specialized knowledge of foreign markets.

In relation to the literature, we provide a full empirical analysis based on an equilibrium economic geography model and we condition on a full range of potentially relevant variables. Holloway and Wheeler (1991) and Shilton and Stanley (1999) are mostly descriptive. Davis and Henderson (2004) focus on headquarters' births and concentrate on the contribution of headquarters present and the diversity of business services. Their results are not inconsistent with ours. The authors rely on a production function approach to derive headquarters' profits and with their data (a micro data set on auxiliary establishments from 1977 to 1997), they cannot distinguish headquarters from other central administrative units. Our model incorporates the interaction between scales economies, transportation costs and knowledge spillovers to yield predictions on the factors that matter for the location and relocation of headquarters. More recently, Henderson and Ono (2005) analyze with Census data the trade-offs of locating headquarters away from the plant in the manufacturing sector. They conclude that firms consider also the proximity of their production facilities when locating headquarters. This is consistent with our result that the same industry specialization is a positive factor to locate a headquarter in a metropolitan area.

This paper is organized as follows. Section 2 presents the data and basic statistics on the location of headquarters and the evolution from 1996 to 2001. Section 3 contains an economic geography model of the location of headquarters, which indicates the relevant variables for the empirical exercise. Section 4 puts forward the empirical methodology of the three-level nested logit we implement. Section 5 presents the results and Section 6 concludes with some policy implications. The Appendix provides more details about the data and estimation procedure.

2.2 Data, facts, and trends

In this section we present the data and statistics of the concentration and movements of headquarters.

2.2.1 Data

We look at the decisions made by U.S. firms when relocating their headquarters and choosing the new location. The headquarters-level data come from Dun and Bradstreet (D&B) and are for the years 1996 and 2001. D&B's database includes yearly data on approximately 200,000 headquarters that are listed in a firms' directory ranked by level of sales.[7] Headquarters are defined as a management center and are strictly different from a plant. More specifically, in our database a headquarters corresponds to a center of a firm's operations, administration and marketing activity. This general definition of headquarters encompasses regional managerial centers and may include sales offices.[8]

A firm may have several headquarters (e.g. General Motors Corporation has its ultimate headquarters in Detroit, MI, and several other affiliate headquarters around the U.S., including Hughes Electronics Corporation in Los Angeles, CA, and Gmac Insurance Holdings Inc. in Southfield, MI). The D&B database distinguishes headquarters which are business establishments with branches or divisions reporting to them, and which are financially responsible for those branches or divisions (i.e., multi-site firms' headquarters) from headquarters of single-site firms. Whereas, typically, headquarters of multi-site firms are disconnected from production sites, single-site firms may locate both production and headquarter activity in the same location.[9] In our database about 80% of the headquarters are of the multi-site type. In order to ensure that we are studying the location decision of headquarters independent of the decision of locating production, we provide results for the full sample of headquarters as well as for the subsample of multi-site headquarters. The relevance and uniqueness of the D&B database stems from the fact that it provides the addresses of headquarters as well as specific company variables such as sales levels, the number of headquarters belonging to the firm, the date of birth of the headquarters, and (two-digit) standard industrial classification (SIC) codes. The database also allows the origin (U.S. or foreign) of the firm to which the headquarters belongs to be identified. Precise data definitions and sources are given in Appendix A. Because of limited access to the D&B listing we restrict our sample to the 50,000 firms with the largest sales in 1996 and 2001.

We study decisions regarding the location of headquarters across U.S. metropolitan areas. The general concept of a metropolitan area, according to the Census Bureau, is a core area containing a large population nucleus, together with adjacent communities having a high degree of economic and social integration with that core. Metropolitan areas include metropolitan statistical areas (MSAs) and consolidated metropolitan statistical areas (CMSAs), which are urban areas composed of several MSAs. D&B's data are at the zip code level and are aggregated to the metropolitan area level, based on the 1995 Census Bureau definition. Metropolitan areas that are part of a CMSA are subsumed under the larger category.

7 The accuracy of the D&B database has been successfully cross checked with other sources such as the Fortune Magazine ranking of the 500 largest U.S. corporations and the Hoover rankings of the largest U.S. firms.

8 This broad definition of headquarters is adequate for our work as regional headquarters as well as sales offices have similar inputs requirements than central headquarters in term of labor, business services or information. Their relocation across cities have similar implications on employment or economic activity than the relocation of central headquarters.

9 In 1996, the average number of employees of multi-site headquarters is 200 while the average number of employees of the firm is 3630. This corroborates the intuition that these multi-site headquarters locate away from their plants. Note that single-site firms might be a regional headquarters with no production taking place at the site. For example, Salomon North America, a sporting and recreation goods company (French owned in 1996 while German owned in 2001), has relocated its single-site location from Georgetown Mass., to Portland over the 1996-2001 period. Such single-site firm is specialized in marketing, operations and sales activities. U.S. media refereed to this change of location as a relocation of headquarters.

Our D&B database of the 50,000 firms with the largest sales in 1996 and 2001 does not allow us to identify births and deaths of headquarters. As we do not have an exhaustive listing of all headquarters within the U.S. for both years, we cannot distinguish "dead" headquarters from headquarters that have experienced a declining sales level (i.e. the headquarters' position in the ranking has decreased to below the 50,000 largest). We thus focus on the 29,000 headquarters which belong to both the 1996 database and the 2001 database. Out of these 29,000 headquarters, we only consider headquarters located in U.S. mainland metropolitan areas. We end up studying the location of 26,195 headquarters in 276 U.S. metropolitan areas.

The largest share of headquarters belongs to the Manufacturing sector (i.e. about 32%) while another 25% of the headquarters belong to the Wholesale and Retail trade sectors. Headquarters from the FIRE industries (Finance, Insurance, and Real Estate) account for about 16% of the total and headquarters from the Services industries account for about 15%.[10] A detailed description of headquarters' data is given in Appendix A (Tables A1-A4). The average size of a headquarters (the amount of sales according to the D&B definition) is U.S.$38 million. The average number of headquarters for a firm is about 15. Merged headquarters or those that have been acquired over the period account for 7%, and about 31% of headquarters are of foreign origin.

2.2.2 Clusters and movements

2.2.2.1 Headquarters cluster in a small number of metropolitan areas

A closer analysis of the data suggests that headquarters cluster in a small number of metropolitan areas. New York stands out as the dominant center, hosting 15% of the total number of headquarters representing 21% of headquarters' sales. These numbers reflect the presence of very large New York based corporations such as General Electric, Phillip Morris, AT&T, Texaco, and PespiCo. Moreover, 65% of the headquarters are located in the top 20 centers. This represents 75% of headquarters sales with leading firms such as General Motors in Detroit, Exxon in Dallas, Mobil in Washington, Hewlett-Packard in San Francisco, Sears Roebuck in Chicago, and Cargill in Minneapolis. Table A5 in the appendix presents the leading metropolitan areas by the number of headquarters and by sales levels in 1996.[11] Leading metropolitan areas for manufacturing sectors reflect the importance of traditional manufacturing centers-the higher position of Detroit, Cleveland, and Pittsburgh and the lower position of Washington, DC in the manufacturing ranking compared with the general ranking (Table A5). Foreign corporations tend to locate their headquarters in metropolitan areas close to international borders (e.g. Pacific Coast, Canada, and Mexico) as centers such as Honolulu, Buffalo, San Diego, and Anchorage enter the top 20 metropolitan areas ranking. Finally, leading centers for the

10 Table A1 in Appendix A provides a summary of the sector composition of the D&B Headquarters Database. Table A13 lists the sectors and corresponding SIC codes.

11 Similar tables have been built for subsets of the database: manufacturing headquarters, foreign headquarters, and all available headquarters (i.e. the 50,000 firms of the main database including headquarters present in only one of the two periods). These tables are not included in this paper. They are available upon request.

50,000 firms database in 2001 show a better positioning for Kansas City and San Diego, and a worse positioning of traditional industrial centers such as Cleveland, St. Louis, and Milwaukee. This feature is caused by the large share of service sector headquarters that entered the sample between 1996 and 2001.

Table 1: Percentage of total number of headquarters, total headquarters' sales and economic activity (personal income) by the top metropolitan areas, 1996–2001.

	Percentage of total number of of headquarters		Percentage of total headquarters' sales		Percentage of total economic activity (personal income)	
	1996	2001	1996	2001	1996	2001
New York	15.1	14.7	20.8	17.4	11.9	11.7
Top 5 centers	35.1	34.4	42.4	39.4	29.9	25.5
Excluding New York	20.0	19.7	21.6	22.0	18.0	13.8
Top 10 centers	49.8	49.4	59.2	56.6	42.6	41.0
Excluding New York	34.7	34.7	38.4	39.1	30.7	29.3
Top 20 centers	64.4	64.1	74.9	73.0	55.6	56.1
Excluding New York	49.3	49.4	54.1	55.5	43.7	44.4

2.2.2.2 Headquarters dominance and economic dominance

Metropolitan areas differ widely in their size and it seems sensible to assume that larger metropolitan areas host more headquarters. As a proxy for economic activity, we use personal income at the metropolitan area level.[12] Table 1 summarizes headquarters' concentration within the U.S. This table presents the percentage of headquarters belonging to the 5, 10, and 20 U.S. top centers in terms of both the number of headquarters and headquarters' sales. It also provides similar data for personal income. Table 2 performs the same exercise for headquarters of the manufacturing sector. Three broad facts emerge. First, if one excludes New York from the top category, the importance of the top centers increased across time in terms of headquarters' sales. Thus, the decline in headquarters' sales dominance seems exclusively caused by the decline of New York. This is in contrast to the period 1980-1987 where it is found that the top centers of headquarters for the Fortune 500 lose ground (Holloway and Wheeler 1991).[13]

Second, although manufacturing headquarters are less concentrated in top centers than headquarters from all sectors, manufacturing headquarters' sales are more concentrated. Thus, the smaller proportion of manufacturing headquarters in top centers is counterbalanced by their larger size. The increase in manufacturing headquarters' sales concentration between 1996 and 2001 is particularly pronounced for the top 5 and top 10 centers. Third, and most importantly, headquarters are more agglomerated than economic activity. We note, however, that such relative concentration is smaller than conventional wisdom would expect. For example, in 2001 the percentage of headquarters'

12 Such data is provided by the Bureau of Economic Analysis. Personal income is defined as the income received by all persons from all sources and is equivalent to GDP. Population was also used as a proxy for the size of metropolitan areas. Results are very similar to those obtained using personal income. These results are available upon request.

13 Holloway and Wheeler find that the concentration of headquarters in the top five and 10 centers declined between 1980 and 1987. This feature is apparent whether or not they include New York in the top centers.

sales in New York was 17.4% (and about 15% of the total number of headquarters), while about 12% of the economic activity occurs in the city.

Table 2: Percentage of total number of manufacturing headquarters and total manufacturing headquarters' sales by the top metropolitan areas, 1996–2001.

	Percentage of total number of of headquarters		Percentage of total headquarters' sales	
	1996	2001	1996	2001
New York	12.4	12.0	17.2	16.3
Top 5 centers	33.0	32.4	45.8	48.8
Excluding New York	20.6	20.4	28.6	32.5
Top 10 centers	45.6	45.0	60.8	62.8
Excluding New York	33.2	33.0	43.6	46.5
Top 20 centers	61.8	61.2	77.7	76.3
Excluding New York	49.3	49.1	60.5	60.0

2.2.2.3 Many headquarters move

Table 3 accounts for the net changes in the number of headquarters and in headquarters' sales by metropolitan areas between 1996 and 2001, whereas Table 4 presents the flow of headquarters between these two dates. Table 3 provides information for the full sample while Tables A6 and A7 in Appendix A present net changes for the manufacturing headquarters and foreign headquarters, respectively. Net changes suggest that headquarters moved away from the largest centers towards what Holloway and Wheeler (1991) call "second-tier" centers. The centers that gained the largest number of headquarters are Houston, Phoenix, Washington, and Atlanta, whereas the largest metropolitan areas, New York, San Francisco, and Los Angeles, lost the most headquarters. One may also note that sun belt centers added headquarters over this period (e.g. Houston, Phoenix, San Antonio, and Charlotte), while rust belt traditional centers have mostly lost headquarters (e.g. Philadelphia, Youngstown, and Cleveland). Some of the net changes presented in Table 3 are driven by specific sector changes. For example, Pittsburgh's net gain and Youngstown's, Cleveland's, and Rochester's net losses are principally caused by the relocation of manufacturing headquarters. Similarly, San Francisco and Phoenix sales gains as well as Washington or St. Louis sales losses reflect changes in the manufacturing sector (Table A6 in Appendix A).[14]

14 Interestingly, Washington, DC's considerable decrease in manufacturing headquarters' sales is a consequence of the relocation of Mobil Corp to Dallas. Similarly, Boeing's relocation to Chicago explains the important decline in headquarters' sales in Seattle over the period. Results for foreign firms are quite similar than for U.S. firms except for the increasing importance of Florida and border centers such as Buffalo and Anchorage. The good performance of Detroit in term of headquarters' sales reflect the installation of DaimlerChrysler into the center. The decreasing headquarters' sales level in Dallas is a consequence of the relocation of American Petrofina to Houston and Totalfina Elf Services to New York.

Table 3: Metropolitan areas gaining and losing the most headquarters between 1996 and 2001.

Metropolitan areas	Change in number of headquarters	Metropolitan areas	Change in sales (percentage points)
Gaining			
Houston–Galveston–Brazoria	37	Houston–Galveston–Brazoria	1.54
Phoenix–Mesa	24	Charlotte–Gastonia–Rock Hill	1.37
Washington–Baltimore	23	Dallas–Fort Worth	0.73
Atlanta	20	Columbus	0.51
Cincinnati–Hamilton	14	Kansas City	0.48
Greensboro–Winston–Salem–High Point	14	San Francisco–Oakland–San Jose	0.44
Pittsburgh	14	Atlanta	0.43
San Antonio	11	Raleigh–Durham–Chapel Hill	0.38
St. Louis	10	Phoenix–Mesa	0.34
Charlotte–Gastonia–Rock Hill	9	San Antonio	0.29
Indianapolis	9	Cincinnati–Hamilton	0.26
Chicago–Gary–Kenosha	9	Omaha	0.24
Dallas–Fort Worth	8	Anchorage	0.22
Losing			
New York–New Jersey–Long Island	−105	New York–New Jersey–Long Island	−3.48
San Francisco–Oakland–San Jose	−42	Los Angeles–Riverside–Orange County	−1.05
Los Angeles–Riverside–Orange County	−31	Cleveland–Akron	−0.51
Philadelphia–Wilmington–Atlantic City	−17	Philadelphia–Wilmington–Atlantic City	−0.44
Seattle–Tacoma–Bremerton	−13	Pittsburgh	−0.39
Tulsa	−8	Washington–Baltimore	−0.38
Youngstown–Warren	−8	Detroit–Ann Arbor–Flint	−0.34
Cleveland–Akron	−8	St. Louis	−0.32
Buffalo–Niagara Falls	−6	Salt Lake City–Ogden	−0.28
Little Rock–North Little Rock	−5	Boston-Worcester-Lawrence	−0.22
Scranton–Wilkes–Barre–Hazleton	−5	Minneapolis–St. Paul	−0.16
Minneapolis–St. Paul	−4	Portland–Salem	−0.14

Because net changes often hide important flow variations, Table 4 reports the flow for metropolitan areas gaining and losing the most headquarters over the period. This table reflects the significant movement of headquarters between 1996 and 2001. This is an important piece of information for our estimation of decisions regarding the location of headquarters.

Table 4: The flow of headquarters. Flows in metropolitan areas gaining and losing the most headquarters between 1996 and 2001.

Metropolitan areas	Number of headquarters lost	Number of headquarters gained
Houston–Galveston–Brazoria	43	80
Phoenix–Mesa	9	33
Washington–Baltimore	36	59
Atlanta	46	66
Cincinnati–Hamilton	9	23
Greensboro–Winston–Salem–High Point	2	16
Pittsburgh	15	29
San Antonio	4	15
St. Louis	9	19
Charlotte–Gastonia–Rock Hill	19	28
Indianapolis	6	15
Chicago–Gary–Kenosha	81	90
Dallas–Fort Worth	63	71
Minneapolis–St. Paul	26	22
Scranton–Wilkes–Barre–Hazleton	6	1
Little Rock-North Little Rock	5	0
Buffalo–Niagara Falls	12	6
Cleveland–Akron	30	22
Youngstown-Warren	8	0
Tulsa	12	4
Seattle–Tacoma–Bremerton	25	12
Philadelphia–Wilmington–Atlantic City	70	53
Los Angeles–Riverside–Orange County	104	73
San Francisco–Oakland–San Jose	84	42
New York–New Jersey–Long Island	243	138

Among the 500 largest headquarters in 1996, 36 have moved between 1996 and 2001. Table A8 in Appendix A presents these 36 firms and their movements. Two main trends emerged. Headquarters either relocated from smaller specialized metropolitan areas towards main business centers (e.g. Pharmacia and Upjohn Inc. relocated from Kalamazoo to New York, Monsanto Company relocated from St. Louis to New York, and BP America relocated from Cleveland to Chicago) or they moved from rust belt towards sun belt agglomerations (e.g. Mobil Corporation moved from Washington to Dallas, Avnet Inc. moved from New York to Phoenix, and Usx Corp moved from Pittsburgh to Houston). As a general statement we could say that middle-sized service-oriented sun belt agglomerations gain at the expense of large rust belt industrial centers.

2.2.3 Concentration measures

We rely on two distinct measures of concentration: Lorentz curves and the Theil index. Lorentz curves plot the cumulative frequency distribution of headquarters' sales against the cumulative frequency distribution of metropolitan areas weighted by personal income. The Theil index is a measure of entropy.[15] This index is potentially very useful.

15 The Theil index is derived from the notion of entropy in information theory. It ranges from a value of 0 to $\ln n$. If p_i represents the ith metropolitan area's relative ability to attract headquarters (i.e. $p_i = x_i / \sum_{i=1}^{n} x_i$ where x_i is, say, the number of headquarters in location i), then the Theil measure ranges from a value of 0 when $p_i = 1/n$ to $\ln n$ when all of the weight is concentrated in one location. Theil indices satisfy the Pigou–Dalton condition (i.e. a shift from a large center to a smaller center lowers the index).

In the computation of both measures, we weight locations by their personal income levels. The greater the Theil coefficient, the greater the concentration.

Table 5: Concentration measures: all firms.

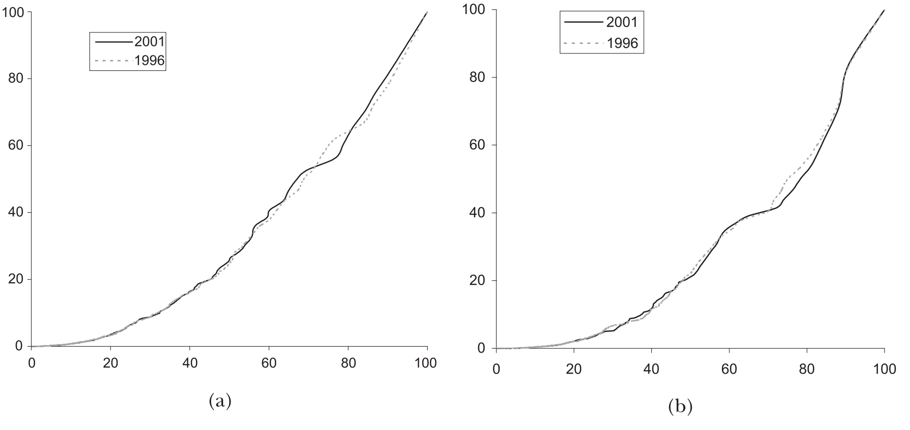
	Number of headquarters (Theil index)	Headquarters sales (Theil index)
1996	0.055	0.219
2001	0.056	0.244

Table 6: Concentration measures: manufacturing firms.

	Number of headquarters (Theil index)	Headquarters sales (Theil index)
1996	0.121	0.336
2001	0.127	0.375

The impression of increasing concentration of headquarters' sales drawn from the tables is reinforced by examination of Table 5, Table 6 and Figure 1, which provide the concentration measures and portray the Lorentz curves, respectively.

Figure 1a/b: Lorentz curves for (a) headquarters' sales and (b) manufacturing headquarters' sales. The x-axis is the cumulative frequency of metropolitan areas weighted by personal income and the y-axis is the cumulative frequency of headquarters' sales.



Figures 1(a) and 1(b) depict the Lorentz curve for headquarters' sales and manufacturing headquarters' sales, respectively. We see that the Lorentz curves are well below the 45° line, indicating that headquarters are more concentrated than economic activity, and that they cross.[16] Concentration measures are lower when metropolitan areas are

16 This indicates that Gini coefficients are not good statistics of inequality. The Gini coefficient is a numerical representation of the degree of concentration and represents the distance between the Lorentz curve and the 45° line (egalitarian distribution). There are two issues with Gini coefficients. First, they place more weight on changes in the middle part of the distribution. If a transfer occurs from a larger location to a smaller location, it has a greater effect on the Gini if these locations are near the middle rather than at the extremes of the distribution. Second, if the Lorentz curves cross, it is impossible to summarize the distribution in a single statistic without introducing value judgements. The Theil index is robust to these sensitivity issues. See Sen (1997).

weighted by personal income than while non-weighted: although far from egalitarian, the distribution of headquarters is representative of metropolitan areas economic size. In Figure 1, the upper portion of the distribution experienced a decrease in concentration (stable concentration in Figure 1(b)) whereas there is a concentration in the middle-upper part. This reinforces the idea that "second tier" centers have gained headquarters' sales over the largest centers.

The Theil coefficient is pretty high when sales-weighted, especially for manufacturing firms, indicating high inequality (for example, income inequality in France is about 0.15 in the Theil measure). Theil indices are increasing both in terms of the number of headquarters and headquarters' sales for all headquarters as well as for manufacturing headquarters. The increase in concentration is small but noticeable, especially for manufacturing headquarters' sales. Such a feature could be expected from Table 1, which relates the increasing proportion of manufacturing headquarters' sales in top centers.

2.3 A simple model for the location of headquarters

In this section we present a very stylized model of the decisions regarding the location of the headquarters of a firm which will provide the foundation for our empirical analysis.

A firm is composed of a headquarters and a plant. The firm locates its headquarters in region t and its plant in region i, $i = 1,...,R$, where R is the number of regions. Headquarters use the labor and business services available in region t in production. A plant uses the labor and intermediate goods available in region i in production. Each firm produces one variety of a differentiated product of an industry or sector in the economy, and there are many sectors in the economy. We consider a representative industry (and, therefore, do not use an index to denote the sector). We assume that there is a number (or mass) of varieties (and firms) n_{tr} with headquarters in t and plant in r. In the representative industry there are $\sum_{t=1}^{R}\sum_{r=1}^{R} n_{tr}$ varieties produced.

2.3.1 Demand

The demand for a representative variety produced in region i with headquarters in region t by a representative consumer in region j is given by[17]

$$q_{tij} = \frac{p_{tij}^{-\sigma}}{\sum_{h=1}^{R}\sum_{r=1}^{R} n_{hr} p_{hrj}^{1-\sigma}} E_j, \qquad (2.3.1)$$

where E_j is the total expenditure of a representative consumer in region j in a specific industry, σ is the elasticity of substitution among varieties, and p_{tij} is the delivered price faced by consumers in region j for a good produced in region i with headquarters in region t. Such a price is a combination of the mill price p_{ti} and trade cost $\tau_{ij} > 1$:[18]

17 This can be derived from a Cobb-Douglas specification for the representative consumer in region j with constant elasticity sub-utility for each sector à la Dixit-Stiglitz.

18 There are iceberg trade costs. For the consumer in j to obtain q_{tij}, $\tau_{ij}\, p_{ti}$ must be produced at location i.

$$p_{tij} = \tau_{ij} p_{ti} \text{ for all } i, j \text{ and } t. \tag{2.3.2}$$

2.3.2 Firms

The manufacturing sector is monopolistically competitive à la Dixit-Stiglitz. Firms set prices to maximize profit and prices are simple mark-ups over marginal costs:

$$p_{ti} = \left(\frac{\sigma}{\sigma - 1}\right) c_{ti}, \tag{2.3.3}$$

where c_{ti} is the marginal cost for a firm with plant in i and headquarters in t. The residual price elasticity of demand for a firm equals the consumer's elasticity of substitution between varieties $\sigma > 1$. Substituting (2.3.2) and (2.3.3) in (2.3.1) and rearranging yields

$$q_{tij} = \frac{\sigma - 1}{\sigma} \frac{(c_{ti}\tau_{ij})^{-\sigma}}{\sum_{h=1}^{R} \sum_{r=1}^{R} n_{hr}(c_{hr}\tau_{rj})^{1-\sigma}} E_j. \tag{2.3.4}$$

A firm with a plant in region i and headquarters in region t has gross profit on destination j equal to

$$\pi_{tij} = (p_{ti} - c_{ti}) \ \tau_{ij} \ q_{tij}. \tag{2.3.5}$$

Substituting (2.3.3) and (2.3.4) in the gross profit function yields

$$\pi_{tij} = \frac{(c_{ti}\tau_{ij})^{1-\sigma}}{\sum_{h=1}^{R} \sum_{r=1}^{R} n_{hr}(c_{hr}\tau_{rj})^{1-\sigma}} \frac{E_j}{\sigma}. \tag{2.3.6}$$

Therefore, the profit of a representative firm in location (t, i) is given by

$$\pi_{ti} = \sum_{j=1}^{R} \pi_{tij} = \frac{c_{ti}^{1-\sigma}}{\sigma} M_i \quad \text{where } M_i = \sum_{j=1}^{R} \frac{\tau_{ij}^{1-\sigma}}{\sum_{h=1}^{R} \sum_{r=1}^{R} n_{hr}(c_{hr}\tau_{rj})^{1-\sigma}} E_j. \tag{2.3.7}$$

Following Krugman (1992), and as is now standard in the literature, M_i is called the market potential of a representative variety being produced in location i (note that it does not depend on where the headquarters of the firm are located given that the number of varieties produced in r with headquarters at h is large).

A firm's production technology requires headquarters' services and intermediate goods (as in Duranton and Puga (2005)). The headquarters do not need to be located in the same region as the plant and transferring headquarters' services is costly. A Cobb-Douglas technology with cost shares η for headquarters and $1 - \eta$ for plants is assumed. We have that the (constant) marginal cost of a firm with headquarters in t and plant in i is given by

$$c_{ti} = \rho_{ti}(H_t)^{\eta} (Q_i)^{1-\eta} \tag{2.3.8}$$

where H_t is the headquarters sub-cost, ρ_{ti} represents the cost of transmitting headquarters' services from region t to region i, and Q_i is the plant sub-cost. We assume that $\rho_{ti} = \rho_t > 1$ for $t \neq i$, and $\rho_{tt} = 1$. That is, transferring headquarters' services is costly and depends only on where the headquarters are located (because of data limitations in our empirical analysis).

The net profit excludes fixed costs incurred on setting headquarters in location t and a plant in location i. Such fixed costs are assumed to be the same in all locations (The total fixed cost is, say, $F = F_H + F_P$).[19] The net profit of a representative firm is thus

$$\pi_{ti} = \frac{c_{ti}^{1-\sigma}}{\sigma} M_{ti} - F. \tag{2.3.9}$$

Assuming that corporate taxes are paid by the headquarters and that taxes are imposed on gross profit (excluding fixed cost), as in Devereux and Griffith (1998), we have

$$\pi_{ti} = (1 - T_t)\frac{c_{ti}^{1-\sigma}}{\sigma} M_{ti} - F, \tag{2.3.10}$$

where T_t is the tax rate at location t.

2.3.3 Headquarter's sub-cost function

Headquarters have a Cobb-Douglas production function between labor and business services:

$$H_t = (w_t / \gamma_t)^{\alpha} (S_t)^{1-\alpha} \tag{2.3.11}$$

where γ_t is a technology parameter that captures the positive interaction between headquarters increasing the efficiency of labor, say because of face-to-face interaction ($\partial H_t / \partial \gamma_t < 0$, i.e. the larger the agglomeration of headquarters, the smaller the cost), w_t is the wage in region t, and S_t is the price index of business services in region t

$$S_t = \left[\sum_{k=1}^{N^t} (p_t(k))^{1-\theta} \right]^{1/(1-\theta)} \tag{2.3.12}$$

where $p_t(k)$ is the price of a variety of business service k in region t, $\theta > 1$ is the elasticity of substitution among varieties of business services, and N^t is the endogenous number (or mass) of business services available in region t.

2.3.3.1 Business service sector

The service sector is also monopolistically competitive and uses labor as input. Headquarters use business services from its location. The price of representative variety of business services in region t is

$$p_t = \left(\frac{\theta}{\theta - 1} \right) w_t. \tag{2.3.13}$$

It follows that the price index for business services is given by

$$S_t = (l_t^{BS})^{1/(1-\theta)} w_t, \tag{2.3.14}$$

19 F_H and F_P stand for headquarters and plant fixed costs, respectively.

where l_t^{BS} is the employment in business services in region t. Thus,

$$H_t = (y_t)^{-\alpha} w_t (l_t^{BS})^{(1-\alpha)/(1-\theta)}. \tag{2.3.15}$$

2.3.4 Plant sub-cost

Plants also have a Cobb-Douglas production function between labor and differentiated intermediate goods yielding the following sub-cost:

$$Q_i = (w_i)^{\phi} (I_i)^{1-\phi}, \tag{2.3.16}$$

where, $\phi \in (0,1)$ w_i is the wage in region i, and I_i is the price index of intermediate goods in region i

$$I_i = \left[\sum_{k=1}^{N^i} (p_i(k))^{1-\sigma} \right]^{1/(1-\sigma)} \tag{2.3.17}$$

with $p_i(k)$ the price of a variety of intermediate good k in region i, σ the elasticity of substitution among varieties of intermediate goods, and N^i the number (mass) of intermediate goods available in region i.[20]

2.3.4.1 Intermediate goods sector

The intermediate goods sector is monopolistically competitive and uses labor as input. Plants use intermediate goods produced in their location (that is why the plant locates there in the first place). Adding trade in intermediate goods would not change the qualitative results (as we are looking at the choice of location of headquarters, and not the location of plants). As before, we can obtain that the price of representative variety of intermediate goods in region i is

$$p_i = \left(\frac{\sigma}{\sigma - 1} \right) w_i, \tag{2.3.18}$$

and the price index of intermediate goods in region i will be

$$I_i = (l_i^{IG})^{1/(1-\sigma)} w_i, \tag{2.3.19}$$

where l_i^{IG} is the employment in the intermediate goods sector in region i. Thus,

$$Q_i = w_i (l_i^{IG})^{(1-\phi)/(1-\sigma)}. \tag{2.3.20}$$

20 Note that, for simplicity of notation, we have assumed that the elasticity of substitution among varieties of final goods and intermediate goods is the same (equal to σ).

2.3.5 Decisions regarding the location of headquarters

A firm with a production plant in *i* deciding whether to locate its headquarters in region *t* or *r* will compare its (equilibrium) profit in both situations. Using (2.3.8) and (2.3.10), this yields

$$\pi_{ti} = (1-T_t)\frac{[\rho_t(H_t)^{\eta}(Q_i)^{1-\eta}]^{1-\sigma}}{\sigma}M_i - F$$

to be compared with the corresponding expression for π_{ri}.

Relevant information for the ordering of profit excludes invariant fixed costs and plant sub-costs, which we can therefore omit.[21] We have that $\pi_{ti} - \pi_{ri}$ depends on $v_t - v_r$, where

$$v_t \equiv (1-T_t)(\rho_t)^{1-\sigma}(H_t)^{\eta(1-\sigma)}.$$

Using (2.3.15) we have that

$$v_t = (1-T_t)(\rho_t)^{1-\sigma}(\gamma_t^{-\alpha} w_t (l_t^{BS})^{(1-\alpha)/(1-\theta)})^{\eta(1-\sigma)}.$$

Taking logs this yields

$$\ln v_t = \ln(1-T_t) + (1-\sigma)\ln\rho_t - \alpha\eta(1-\sigma)\ln\gamma_t + \eta(1-\sigma)\ln w_t + \eta(1-\sigma)\frac{1-\alpha}{1-\theta}\ln l_t^{BS}. \qquad (2.3.21)$$

This provides a basis for our regression analysis. We make no attempt to perform a structural test of the model, but the equation above provides the main regression variables (taxes, cost of transmitting headquarters' services, agglomeration parameter, wages, business service employment) and the signs that we should expect.

2.4 Empirical methodology

2.4.1 A model of location choice

In order to analyze the determinants of the decisions regarding the location of headquarters, we estimate a profit equation based on the conceptual framework of Section 3. We rely on the maintained assumption that firms choose the location that yields the highest profit.[22] The firm decides whether to relocate its headquarters taking into account the attractiveness of moving to other metropolitan areas. If a firm chooses not to move then this means that the firm reaches its highest profit by staying in the present location. If the firm decides to relocate its headquarters it chooses a new metropolitan area taking into account the attributes of other metropolitan areas. Thus, a location decision is made by

21 In effect, a firm that has decided to relocate its headquarters to a new location will pay the same fixed cost in any location (by assumption) Thus, the fixed cost does not influence its location choice.

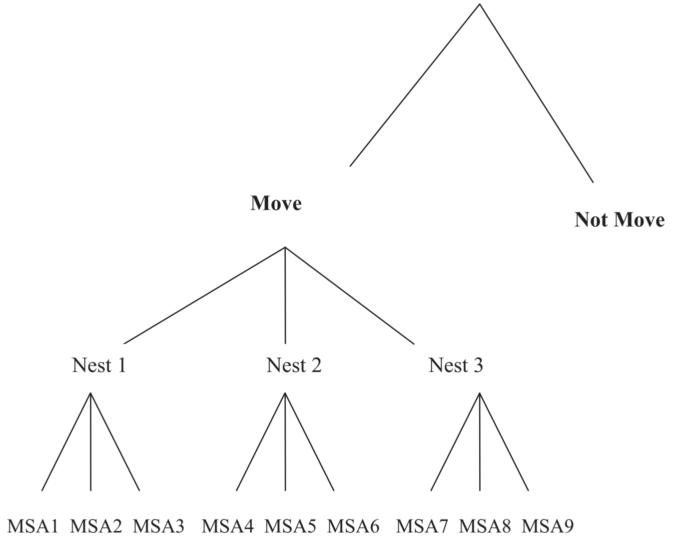
22 The model described above is appropriate to study the decisions regarding the location of headquarters of a firm that have decided to relocate its headquarters. To analyze the relocation decision (i.e. whether to move the headquarter or stay still) one should include set-up costs in the theoretical model and take such costs into account in the empirical estimation. Although we do not have data on set-up costs we will indirectly study the impact of set-up costs on firms' relocation decisions through the use of data on firms' characteristics.

comparing characteristics in potential areas. We aim to identify how these characteristics influence profit.

A natural and widely used estimation procedure consistent with such an assumption is the discrete choice model.[23] In this paper, the decisions regarding the location of headquarters are estimated as a nested logit model. A crucial hypothesis in the logit model is indeed the independence of error terms. This implies an important property, the *independence from irrelevant alternatives* (IIA), which states that the ratio of the logit probability of any two alternatives is independent of the addition or deletion of any other alternative. It seems likely that the choice of metropolitan area for the displaced headquarters is not consistent with the IIA property. The unobserved component of profitability is likely to be correlated among metropolitan areas that are close substitutes (e.g. metropolitan areas located in the same U.S. region or metropolitan areas of similar size to that finally chosen). In terms of the IIA property, this implies, for example, that if we were to eliminate Los Angeles from our sample of alternatives, then the probability that a firm will decide to locate its headquarters in New York will increase proportionally more than the probability of locating in, say, Albany.[24]

The nested logit model permits for such a structure of the error term and reconciliates the estimation with the IIA property. In the nested logit model the set of alternatives faced by the firms is divided into subsets, called nests. IIA holds within each nest whereas it does not hold for alternatives in different nests.

Figure 2: The firm decision tree: a three-level nested logit. MSA1 corresponds to the Metropolitan Statistical Area 1. Nest 1 is a nest regrouping all MSAs belonging to region 1 or having a population of size 1



23 Recent papers that have used logit and/or nested logit estimations in the regional context include Devereux and Griffith (1998), Head et al. (1995), and Head and Mayer (2004).

24 Similarly, region wise, the probability that a firm will decide to locate its headquarters in, say, Santa Barbara will increase proportionally more than the probability of locating in, say, New Orleans.

The firm's decision process is described in Figure 2. We distinguish between two types of nested structures: (i) metropolitan areas partitioned into four groups as a function of the size of their population; and (ii) metropolitan areas partitioned into eight groups as a function of the U.S. region to which they belong.[25] In the population-nested model, the decision process of the location of headquarters is equivalent to first choosing the size of the metropolitan area conditional on having decided to relocate and then selecting a location among a subset of metropolitan areas of similar size. In the region-nested model, firms that move their headquarters first choose the region in which to relocate and then select among the alternatives (i.e. the metropolitan areas) belonging to the chosen region. This decision process is convenient for the estimation and it does not lack realism. A firm when deciding to relocate headquarters may first consider whether it wants to move and then classify potential metropolitan areas by characteristics (say geographic or size classes).

In the nested logit model the value v_t derived from locating at t can be decomposed into attributes that are observable at the upper nest level (i.e. whether to move from the origin), the medium nest level r (i.e. region or population), and attributes observable within the lower nest level at the metropolitan area level. That is,

$$v_t = \phi B_m + \lambda Y_r + \beta X_t + \varepsilon_t$$

where B_m is a vector of explanatory variables that determine whether or not to relocate, Y_r is a vector of explanatory variables that determine whether to locate in region (or population nest) r, conditional on changing the headquarters' location X_t, is a vector of explanatory variables that determine the choice of metropolitan area, conditional on moving to region (or population nest) r, and ε_t is the error term, which is assumed independently, identically extreme value distributed.

In terms of our theoretical model, B_m, Y_r, and X_t include corporate tax rates, wages, the cost of transmitting headquarters information to plants, some count of agglomeration of headquarters, and the availability of business services. These variables are observed at the locations of origin for the upper nest level (i.e. the whether to move model), and at locations of destination for the medium nest level (i.e. region-nested or population-nested level) and the lower nest level (i.e. the metropolitan area level).

In a nested logit specification, we first estimate the choice of a metropolitan area within a region (respectively, population range) and then the choice of region (respectively, population range) taking into account the attractiveness of the metropolitan areas that belong to the region (respectively, population range).[26]

We are facing two types of endogeneity issues as the correlation between the explanatory variables and the error term may be contemporaneous or carried through time. Contemporaneous endogeneity may be easily solved whereas the endogeneity caused

25 The four population nests are as follows: population greater than 4 million; population between 1.5 million and 4 million; population between 500,000 and 1.5 million; and population below 500,000. The eight region nests are: New England, Mideast, Great Lakes, Plains, Southeast, Southwest, Rocky Mountain and Far West. These regions are specified according to the Bureau of Economic Analysis definition.

26 See the technical note in the Appendix for the definition of the conditional probabilities in terms of the underlying variables and details of the estimation.

by location-specific omitted variables is difficult to deal with. We discuss both types of endogeneity issues here. First, some of the explanatory variables in B_m, Y_r, and X_t may be correlated with the contemporaneous error term. Several headquarters in t may indeed choose to locate in a metropolitan area because of location- and time-specific elements that are common to all headquarters (e.g. a contemporaneous subsidy on the location of headquarters). Such elements may be unobserved by the researcher and hence not controlled for in the regression. Thus, contemporaneous headquarters' agglomeration variables may not be exogenous. Similarly, contemporaneous wage levels and business services availability may not be exogenous. The relocation of large headquarters may indeed induce a rise in wages and may imply the birth of several business services in the metropolitan area. Such location-specific changes may be expected and internalized by the headquarters. In order to deal with these endogeneity issues, we use lagged values of the explanatory variables in B_m, Y_r, and X_t. Lagged values are considered good proxies of the independent variables because of the high level of correlation between current and lagged values of the explanatory variables, and the lack of correlation between the lagged independent variables and the dependent variable. In addition to solving for contemporaneous endogeneity issues, the use of lagged variables suggests that a headquarters makes a location decision between $t-1$ and t on the basis of variables in period $t-1$. This seems a sensible assumption. Second, we may encounter endogeneity issues caused by omitted variables at the location level. A headquarters' location decision in t may indeed be influenced by some location-specific attributes or location-specific macroeconomic aggregate shocks that also influenced the location of headquarters or business services in $t-1$. We are thus facing some location-specific variables that are carried through time and are not observed by the researcher. To deal with such endogeneity, we would need to include location-specific fixed effects. Unfortunately, the restricted time length of our database prevents the introduction of such location fixed effects.[27] We experiment with several dummies variables in order to correct for this endogeneity issue. We use population range dummies in the region nested model to control for attributes specific to metropolitan areas of similar size. Similarly, we use regional dummies in the population nested model to control for attributes specific to metropolitan areas belonging to the same region. Finally, we introduce states fixed effect in both nested models. Such strategy corrects quite successfully for endogeneity across metropolitan areas within nests.

2.4.2 Specification of the model

2.4.2.1 Decision of where *to relocate (lower and medium nest level)*

In order to analyze the firm's decision of where to relocate its headquarters, we need to significantly transform the database. First, we select the subset of headquarters that have actually moved between 1996 and 2001. Second, the set of potential centers in which the headquarters could relocate is restricted to the locations that host more than 0.1% of the total number of headquarters (i.e. the 50,000) in 1996. This represents 106 metropolitan areas and 88% of all moving headquarters. This selection has two purposes: (i) it simpli-

27 The location specific variables used in the econometric model exhaust the information span.

fies the econometric analysis as nested logit models with a high number of locations are very difficult, if not impossible, to handle; and, more importantly, (ii) we eliminate locations that host very few headquarters and may add noise to our analysis. We thus work with a sample of 1,441 headquarters.[28]

Our theoretical model suggests a set of variables influencing the value of location t for a firm that we can use in our empirical model. These variables can be broken down into three types: production costs (i.e. wages, w_t, and employment in financial and business sectors, l_t^{BS}), externalities (i.e. headquarters agglomeration variables, γ_t), and environment (i.e. corporate tax, T_l, and headquarters' services transmission cost, ρ_t). Our regression analysis will be of the form:

$$\ln v_t = \beta_1 \ln(1-T_t) + \beta_2 \ln w_t + \beta_3 \ln \rho_{1t} + \beta_4 \ln \rho_{2t} + \beta_5 \ln \gamma_{1t} + \beta_6 \ln \gamma_{2t}^k + \beta_7 \ln \gamma_{3t}^k + \beta_8 \ln l_t^{BS1} + \beta_9 \ln l_t^{BS2}, \quad (2.4.1)$$

where T_l is the corporate tax level at t, w_t is the average wage at t, ρ_t denote two measures of headquarters' services transmission cost (ρ_{1t} is airport availability at t and ρ_{2t} corresponds to the distance between locations of origin and of destination t), γ_t are several measures of agglomeration (γ_{1t} is the total number of headquarters present in t, γ_{2t}^k is the number of same SIC industry headquarters present in t, and γ_{3t}^k is a measure of same SIC industry employment), $1\mathrm{n} l_t^{BS1}$ is the availability of financial services employment in t, and l_t^{BS2} is the availability of business services employment in t. Some measures of agglomeration vary over industry (k).

For wage, we use the average wage per location. Although headquarters-specific wages or skilled-labor wages would capture headquarters' labor costs more appropriately, such variables are not available in the D&B database or in regional databases. High wages supposedly decrease a firm's willingness to locate its headquarters in a metropolitan area. We thus expect a negative coefficient on wages.

Business employment data cover sectors assumed to be intensively used by headquarters. We distinguish between business and financial services. Business services encompass employment in advertising, employment agencies, computer services, legal services, engineering, and management services. Financial services consist of commercial banks, security and commodity brokers, dealers exchanges and services, and holding and other investment offices.[29] In the estimation, we use indices that reflect a metropolitan areas relative specialization in business or financial sectors. These measures are constructed as Hoover-Balassa indices and they evaluate the relative concentration of a sector (i.e. business or financial as defined above) in a metropolitan area with respect to the average concentration of this sector in the U.S.[30] Headquarters are eager to move to locations

28 This number includes headquarters that were located in metropolitan areas in 1996 and have moved to one of the 106 metropolitan areas by 2001. Extending the sample to firms that located in non-metropolitan areas in 1996 and have moved to one of the 106 metropolitan areas by 2001 increases the database to 1,582 headquarters. Empirical results obtained with the 1,582 samples are very similar to those presented here. Recall that headquarters' data are further described in Appendix A. Tables A9-A12 provide summary statistics of the main variables for *where* to locate (lower and medium nest level) while Tables A1-A4 provide these statistics for *whether* to relocate (upper nest level) models.

29 These business and financial sectors are similar to those chosen by Davis and Henderson (2004).

30 We compute the share of employment in the financial sector (respectively, business sector) in total employment of location *i* divided by the share of the financial sector (respectively, business sector) in U.S. total employment. If the index is greater than 1, then location *i* is relatively specialized in financial (respectively, business) activities.

that have relatively high levels of business and financial services. The coefficient on business and financial sector indices are hence expected to be positive.

Externality variables include counts of existing headquarters and counts of existing headquarters from the same SIC code as the headquarters being studied. Such variables capture potential positive interactions between headquarters and they are expected to positively influence a headquarters' location decision.

We also include an index that captures metropolitan areas' specialization levels in the same SIC sector as the headquarters under study. The index is of the Hoover-Balassa type. Such a measure may be a good proxy of the location of final demand as production, in the presence of transportation costs, is likely to take place close to final demand. Thus, the index may also give some indication of the location of plants. A positive coefficient is assumed as headquarters are likely to locate in metropolitan areas that specialize in their sector of activity and therefore may host some of their plants.

Corporate tax rates are at the state level data from the World Tax Database. State corporate tax is levied in addition to federal corporate tax when a corporation derives income from sources within a state, owns or leases property there, employs personnel there, or has capital or property in the state. If a business operates in multiple states, income is apportioned according to complex formulae. For our purpose, corporate tax levels at the headquarters' location is the relevant variable as corporate taxes levied on plants do not vary with the location of the headquarters. As some metropolitan areas cover multiple states, we built weighted average corporate tax rates, where weights correspond to the share of the MSA (or the CMSA) belonging to specific states. Taxes are assumed to have a negative impact on headquarters' location. As Taxes enter Equation (2.4.1) with a negative sign (i.e. $1 - T_t$), the coefficient on this explanatory variable is expected to be positive.

The cost of transmitting headquarters' services across regions is proxied by the availability of airports in the headquarters' metropolitan area. Greater availability is expected to increase the attractiveness of a location. We also include a measure of the distance between the 1996 headquarters' location and the 2001 headquarters' potential location. Assuming that the 1996 location hosts the headquarters' plant (i.e. assuming that in 1996 the headquarters were located close to the plant and may decide to move away from it by 2001), such a measure proxies the potential distance between the headquarters and its plant. Thus, the larger the distance, the greater the cost of transmitting headquarters' services and the less likely it is that the headquarters will locate in the metropolitan area. In consequence, we expect a negative coefficient on distance.

We experimented with several middle nest level variables Y_r.[31] None of these variables were relevant, suggesting that the inclusive value captures most of the information.

2.4.2.2 Decision whether *to relocate (upper nest level)*

In order to study a firm's decision on relocation of its headquarters, we use the full database of firms that were located in a metropolitan area in 1996 and have made the decision of whether to relocate to one of the 106 metropolitan areas, as defined above,

31 Such as population, average tax rate and some dummies as North/South or coast/no coast.

by 2001. Thus, we study the moving decision of about 25,900 headquarters.[32] The explanatory variables used in the estimation are similar to those defined above, except for firm-specific variables, which are added. Although these variables are not included in the theoretical model, they provide important information on the attributes of firms that choose to relocate. As described below such firm-specific variables are related to the influence of set-up costs on the decision of whether to relocate. Firm size is controlled by firm's sales level and by the size of the group to which the firm belongs. The age of the headquarters as well as a dummy stating whether firms have merged (or have been acquired) over the period, and the nationality of the firm (i.e. U.S. or foreign) are also included. All firms' data come from the D&B database. The estimation also includes an industry-specific "inclusive value", which has been computed at the middle nest level and reflects the attractiveness of moving for each industry. Finally, the size of the population of metropolitan areas, and regional and industrial dummies also enter the estimation.

At this level of the firm's decision tree firms compare whether they obtain a higher profit by staying in their present location or by moving. Such a decision should take into account moving and set-up costs. Such costs are not as relevant for headquarters as they are for plants, as headquarters do not require heavy capital investment, but they may however influence the decisions of whether to relocate. We may hypothesize that larger, younger, and foreign firms, as well as merged (or acquired) firms, will be less sensitive to moving and set-up costs and, in consequence, they are more likely to relocate some of their headquarters from the present location.

Coefficients on wages, w_t, corporate tax, T_t, headquarters' services transmission cost, ρ_t, headquarters agglomeration variables, γ_t, and employment in financial and business sectors, l_t^{BS}, are expected to have opposite signs to those in the decision of *where* to locate, as variables are now measured at the location of origin. We are estimating the parameters of variables that influence headquarters' relocation from their current location. For example, higher wages in a location positively influence a headquarter's decision to relocate whereas higher availability of airport is expected to decrease the willingness to move from such a location. Thus, we expect a positive sign on wages and a negative sign on the availability of airport.

2.5 Results

We first provide the results of the "where to locate" estimation. We consider both the region-nested logit estimation, where nests depend on U.S. regions, and the population-nested logit estimation, where nests depend on the population range of metropolitan areas. We first estimate the choice of a metropolitan area within a region (respectively, population range) and then the choice of region (respectively, population range) taking into account the attractiveness of the metropolitan areas that belong to the region (respectively, population range). We estimate the "where to locate" model simultaneously

32 From the database of 26,195 headquarters, we must omit the firms that have decided to relocate to some other location than the 106 metropolitan areas defined hereinabove. This eliminates 66 headquarters. Several other headquarters (249 to 374, depending on the specification) are not included in the estimation because some independent variables concerning these headquarters were missing.

for all nests by constraining the parameters to be the same across nests. Second, we focus on the results of the "whether to relocate" estimation. We thus provide the logit estimation of the parameters of firm- and location-specific variables that influence a firm's decision to move its headquarters from its 1996 location.

Table 7: The *where* to locate model: first and second stage of the nested logit.

Model	(1)	(2)	(3)	(4)	(5)	(6)
ln wage	0.61	-2.58^{***}	-2.51^{***}	1.44^{***}	-1.37^{**}	-1.37^{**}
	(0.39)	(0.55)	(0.55)	(0.43)	(0.64)	(0.64)
ln (1 − corporate tax rate)	3.87^{***}	2.22^{**}	2.21^{**}	-0.61	-0.33	-0.40
	(0.91)	(1.02)	(1.02)	(1.15)	(1.26)	(1.26)
airport_D1	0.25	0.04	0.01	0.32^{**}	0.33^{**}	0.23
	(0.19)	(0.21)	(0.21)	(0.16)	(0.17)	(0.18)
airport_D2	0.58^{***}	0.27	0.22	0.75^{***}	0.65^{***}	0.48^{**}
	(0.22)	(0.24)	(0.24)	(0.19)	(0.22)	(0.22)
ln population	0.80^{***}	-0.04	-0.00	0.82^{***}	0.17	0.22
	(0.07)	(0.14)	(0.15)	(0.06)	(0.15)	(0.15)
ln (distance)		-0.23^{***}	-0.23^{***}		-0.07	-0.07
		(0.03)	(0.03)		(0.05)	(0.05)
ln (total headquarters)		0.45^{***}	0.45^{***}		0.28^{*}	0.27^{*}
		(0.14)	(0.14)		(0.16)	(0.16)
ln (headquarters same SIC)		0.50^{***}	0.59^{***}		0.44^{***}	0.63^{***}
		(0.05)	(0.08)		(0.06)	(0.08)
ln (HQ same SIC) squared			-0.02			-0.03^{***}
			(0.01)			(0.01)
ln (share of employment same SIC)		0.72^{***}	0.72^{***}		0.74^{***}	0.74^{***}
		(0.11)	(0.11)		(0.11)	(0.12)
ln (share of employment in finance)		0.52^{**}	0.52^{**}		0.56^{**}	0.61^{**}
		(0.27)	(0.27)		(0.28)	(0.28)
ln (share of employment in business)		1.40^{***}	1.42^{***}		0.81^{***}	0.74^{**}
		(0.31)	(0.31)		(0.34)	(0.34)
N	30,566	30,519	30,519	24,989	24,982	24,982
Likelihood ratio index	0.024	0.088	0.088	0.246	0.279	0.280
Inclusive value (δ)	0.56^{***}	0.52^{***}	0.51^{***}	0.53^{***}	0.53^{***}	0.54^{***}
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
N	5,341	5,341	5,341	10,053	10,053	10,053
Likelihood ratio index	0.149	0.150	0.150	0.101	0.109	0.109

Note: Specifications (1), (2), and (3) are population nested, (4), (5) and (6) are region nested. Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. N corresponds to the number of headquarters that relocate (i.e. 1,441) times the number of potential locations for each headquarters. Note that, depending on the nest chosen, headquarters differ in the number of MSAs they are considering.

2.5.1 Decision of *where* to relocate: lower and medium levels of the nested logit model

Lower nest estimations yield the probability that a headquarters locates in a metropolitan area within a region or population range in function of the variables defined in Equation (2.4.1). The choice of metropolitan area within a nest is conditioned on all attributes that are nest specific and thus do not vary across constituent metropolitan areas.

The results of the estimation are presented in Table 7. In specifications (1), (2), and (3), metropolitan areas are partitioned by population ranges (i.e. population-nested model), whereas in specifications (4), (5), and (6) they are partitioned by regions (i.e. region-nested model). In the population-nested model, firms have an average of 26.5 choices of location whereas in the region-nested model they have an average of 13.5 choices of location. Table A15 in the appendix presents the results for the subsample of headquarters of multi-site firms. These results are very similar to the ones presented here.

Wages are significant in most specifications. Although the effect of wages is positive in specifications (1) and (4), such a positive effect is not robust to the introduction of variables capturing headquarters' agglomeration effects and the availability of financial and business services. Thus, it is likely that in specifications (1) and (4), higher wages reflect higher availability of qualified labor. The magnitude of the wage effect can be assessed by computing elasticities. In nested logit models, the elasticities are equivalent to computing $\hat{\beta}_i(1-P_r)$, where P_r is the probability of choosing an alternative in nest r and P_r is approximated by the average location choices. The coefficient on column (2) hence suggests that a 10% increase in the wage decreases the probability of choosing the metropolitan area by 25%. A similar wage increase would decrease the probability by 13% according to the region-nested specification (5). Population is positive and significant in specifications (1) and (4), whereas it is not significant and sometimes negative in the other specifications. In the former case, a larger population may again reflect a high availability of services and qualified labor, whereas in the latter case it may represent congestion costs.

Interestingly, corporate tax rate levels have a significant impact on the choice of location of headquarters in the population-nested model, but are insignificant in the region-nested model. It is important to note, however, that corporate tax rates vary more appreciably across regions than across metropolitan areas within regions. Relying on specification (2), a one-point rise in the corporate tax rate yields a decrease of about 2.25% in the probability that headquarters will choose a location. This corporate tax effect is smaller than others found in the literature (e.g. Head and Mayer (2004) obtained an elasticity of about 5 with data on Japanese-owned affiliates establishing in 57 regions belonging to nine European countries between 1984 and 1995). Most studies, however, only consider manufacturing firms, which tends to inflate the tax effect. Using the manufacturing headquarters sample, we find that a one-point rise in the corporate tax rate yields a decrease of about 4.4% in the probability that headquarters will chose a location. Results for manufacturing headquarters are given in Table A16 in Appendix A.

Similarly, the distance between a headquarters' original location and destination is only significant in the population-nested model. Such a variable captures the potential distance between the headquarters' plant (assuming it is located in the headquarters' original metropolitan area) and the headquarters in its new location. It thus reflects the cost of transmitting headquarters' services. Whereas such costs may vary greatly between metropolitan areas within a population nest, they are likely to be small between metropolitan areas within a region nest. Consider a headquarters originally located in Santa Cruz, CA. If such a headquarters chooses to relocate according to the population-nested structure and aims at locating in a CMSA, its cost of transmitting headquarters' services would be very different if it moves to Los Angeles, Chicago, or New York. In contrast, if the headquarters follows the region-nested structure of decision, its cost of transmitting headquarters' services would be quite similar in Los Angeles or San Francisco. Relying on specification (2), a 10% increase in distance decreases the probability of choosing the metropolitan area by 2.2%.

In contrast, airport availability has a much more significant influence on the choice of metropolitan area in the region-nested model. This feature is not surprising, as metropolitan areas within population nests tend to host similar numbers of airports. Relying on specification (5), the probability of locating in a metropolitan area increases significantly with the availability of airports. In order to interpret the impact of the availability of airport on the probability of locating in a metropolitan area, we rely on the odds ratio.[33] We find that the probability of locating in a metropolitan area increases by 40% if the city offers a small hub and increases by 90% if the city offers a large hub, compared with a location with no hub. The impact is dramatic and confirms the intuition that headquarters rely intensively on airport connections in their relation with plants and customers.

The agglomeration variables also have a large influence on the choice of metropolitan area made by headquarters. The coefficients on the total number of headquarters and on the count of headquarters of the same SIC industry are always positive and significant.[34] Coefficients in column (5) suggest that a 10% increase in the total number of headquarters of a SIC different than the headquarters increases the probability of choosing a location by 2.6%, while a 10% increase in the number of headquarters from the same SIC industry increases the probability of choosing a location by 6.7%. Note that a 10% increase in the number of headquarters from the same SIC industry increases the probability of choosing a location because it increases both the same SIC headquarters agglomeration and total headquarters agglomeration. We must, thus, add the two effects, which leads to this 6.7% increase.[35] Specifications (3) and (6) in Table 7 introduce a non-linear effect by including a quadratic term for the same-industry headquarters variable. Relying on specification (6), a 10% increase in the number of same-industry headquarters in a metropolitan area that hosts one such headquarters increases the probability of choosing the location by 8.3%. If the metropolitan area counts 100 same-industry headquarters, the increase in probability is 5.8%, and if it counts 600 same-industry headquarters, the increase in probability is 4.8%. Thus, although the presence of headquarters in a metropolitan area has significant influence on a headquarters' location decision, the marginal effect is decreasing in the size of the agglomeration.

Moreover, the probability of headquarters choosing a metropolitan area is increased if the metropolitan area is specialized in the headquarters' sector of activity. This is captured by the highly significantly positive coefficient on the measure of same SIC industry specialization. A 10% increase in this specialization measure increases the probability of locating in a metropolitan area by 7%.[36] This result suggests that headquarters choose to locate where final demand, and consequently production of goods from their industry, is high. Among several options, headquarters may thus decide to locate close to some of their plants.

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33 This ratio tells us how much more likely it is that a MSA that presents the attribute under study will attract headquarters compared with a MSA that does not present the attribute.

34 Industrial codes are of the two-digit SIC level.

35 These elasticities are in the same range than the elasticities found in Head and Mayer (2004), who measured the effect of the count of Japanese establishments on Japanese firms' decision to locate in the U.S.

36 These elasticities are computed using coefficients of specification (5).

Importantly, both measures of relative availability of financial and business services are significant and have positive effects on the decision of headquarters' locations across all specifications. This feature is stronger for business services, which present large coefficients with high significance.[37] A 10% increase in the measure of financial services specialization increases the probability of choosing a location by about 5%, while a 10% increase in the measure of business services specialization increases the probability of choosing a location by 7-13.5%, depending on the specifications. Whereas the availability of business services has a significant influence on the location decision of manufacturing headquarters (Table A16 in Appendix A), the availability of financial services is irrelevant as a determinant of manufacturing headquarters location. This result is consistent with Davis and Henderson (2004).

In view of the value and significance of the inclusive value, the nested structure seems an appropriate methodology to study headquarters' location choice. Our inclusive value lies between 0.51 and 0.56 and is highly significant in all specifications. A coefficient approaching zero would suggest that conditional on the observed factors metropolitan areas within nests are almost similar from the point of view of the firm, whereas a coefficient approaching one would reject the nested structure and suggest that all alternatives be considered separately.

In order to correct for endogeneity issue caused by omitted variables at the location level, we introduce several dummy variables. Table A17 in the appendix provides the results.[38] Specification (1) is population-nested and includes regional dummies whereas specification (2) is population-nested with states fixed effects. Specification (3) is region-nested and includes population-range dummies whereas specification (4) is region-nested with states fixed effects. Introducing population-range dummies in the region-nested model makes the airport variables insignificant because availability of airports is highly correlated with cities size. Similarly, introducing regional dummies in the population-nested model makes the tax variable insignificant because tax rate is similar within region.[39] The main results in specification (1) and (3) are otherwise similar to the ones of Table 7. Adding states fixed effects provides interesting results. First, the inclusive value is significant and close to zero. The error is hence almost perfectly correlated across alternatives that compose the nests. Another way to put it is that there is no dissimilarities between metropolitan areas which compose a nest: they are almost perfect substitutes to the firms. Thus, controlling for a number of variables, we have exhausted the location specific effects. Such improvement in term of controlling for location specific endogeneity has however a cost as we must drop the tax variable which is also at the state level. Importantly, the main results are unchanged.

37 We also used the level of employment in financial (respectively, business) services and the number of establishments in financial (respectively, business) services as a proxy for financial (respectively, business) availability. Results obtained are similar, but are less significant.

38 Table A18 in the appendix presents the results for the subsample of multi-site firms.

39 Such effects are expected from the analysis of specification (2) and (5) in Table 7.

2.5.2 Decision of *whether* to relocate: upper level of the nested logit model

Table 8 provides the results of the upper level of the nested logit estimation of specification (5) of Table 7. That is, in Table 8 we use the results of specification (5) to compute the inclusive value. Results of the upper level model obtained with other specifications of Table 7 are similar to that presented below.[40] Coefficients on the inclusive value and on the constant are the only results that vary.

Table 8: The *whether* to locate model: third stage of the nested logit.

Model	(1)	(2)	(3)	(4)
ln sales	0.13^{***}	0.13^{***}	0.13^{***}	0.13^{***}
	(0.02)	(0.02)	(0.02)	(0.02)
ln (number of headquarters in the firm)	0.09^{***}	0.09^{***}	0.09^{***}	0.09^{***}
	(0.02)	(0.02)	(0.02)	(0.02)
ln (age)	-0.31^{***}	-0.30^{***}	-0.30^{***}	-0.30^{***}
	(0.04)	(0.04)	(0.04)	(0.04)
ln (merger)	1.40^{***}	1.37^{***}	1.39^{***}	1.39^{***}
	(0.12)	(0.12)	(0.12)	(0.12)
ln (foreign)	0.64^{***}	0.59^{***}	0.65^{***}	0.66^{***}
	(0.10)	(0.11)	(0.11)	(0.11)
ln wage	0.23	0.75^{*}	0.82	1.80^{**}
	(0.38)	(0.42)	(0.60)	(0.78)
ln (1 − corporate tax rate)	−0.91	-2.45^{*}	-2.62^{*}	
	(0.98)	(1.39)	(1.41)	
airport_D1	−0.15	-0.32^{*}	-0.40^{**}	−0.27
	(0.12)	(0.17)	(0.19)	(0.20)
airport_D2	−0.21	-0.44^{**}	-0.52^{**}	-0.48^{*}
	(0.16)	(0.22)	(0.24)	(0.28)
ln population	0.02	−0.10	0.01	−0.05
	(0.06)	(0.08)	(0.16)	(0.21)
ln (total headquarters)			0.12	0.11
			(0.14)	(0.18)
ln (headquarters same SIC)			-0.28^{***}	-0.29^{***}
			(0.05)	(0.05)
ln (share of employment same SIC)			−0.13	−0.10
			(0.10)	(0.11)
ln (share of employment in finance)			0.22	−0.02
			(0.31)	(0.40)
ln (share of employment in business)			0.20	−0.21
			(0.33)	(0.40)
Inclusive Value	0.08^{***}	0.06^{***}	0.15^{***}	0.16^{***}
	(0.02)	(0.02)	(0.03)	(0.03)
Constant	-6.82^{**}	-9.99^{***}	-12.83^{***}	-21.76^{**}
	(3.35)	(3.94)	(6.33)	(8.53)
Industry and region dummies	No	Yes	Yes	Yes
States fixed effects	No	No	No	Yes
N	25,880	25,880	25,755	25,672
Likelihood ratio index	0.033	0.040	0.046	0.055

Note: Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. *N* is the total number of headquarters for which all explanatory variables were available.

Table 8 presents four different specifications. Specification (1) includes firm-specific variables, environment variables (i.e. corporate tax and airport availability), and standard location-specific variables (i.e. wages and population). Specification (2) adds region, industry, and population range fixed effects. These fixed effects capture part of the unob-

40 Results obtained with the population-nested model are very similar to those obtain with the region-nested model. Using specifications of table A15, table A17 or table A18 would also provide similar results.

servable correlation in the characteristics of metropolitan areas within regions, industries, or in a similar population range. Specification (3) presents the full set of variables by adding cost variables that are specific to headquarters (i.e. employment in financial and business services) and agglomeration variables. Finally, specification (4) adds states fixed effects. The signs and magnitude of the coefficients are consistent across specifications. For the interpretation we rely on specification (3), which is the most complete (including tax) and significant.

Firm-specific variables are highly significant. The larger the headquarters in term of sales, the more likely it is to relocate. This result may suggest that small headquarters may locate close to their plants, which are hard to move, whereas large headquarters, with global activities, are likely to be attracted by active business centers. Similarly, headquarters belonging to very large firms with several managerial centers (i.e. headquarters), are more likely to change metropolitan areas. If there are set-up costs to change the location of a headquarters then larger firms may be able to afford it more easily (e.g. less costly per unit of sales, say). This may also reflect the global strategy of large firms which spread their activities over several locations and aim at being present in most profitable locations. In contrast, small firms with reduced numbers of headquarters have local strategies and are more reluctant to make changes.

The coefficient on the age of the headquarters suggests that young headquarters are more likely to relocate. A 10% increase in age decreases headquarters' probability of moving by about 3%. This result suggests that corporate history matters as established headquarters, in activity since the late 1800s or early 1900s, are more reluctant to change location than headquarters in activity since the second part of the 20th century. As expected, the coefficient on the merger dummy variable is positive. Headquarters belonging to firms that have merged or have been acquired between 1996 and 2001 have a higher probability of relocating. Similarly, foreign firms are more likely to relocate than their U.S. counterparts.

Although mostly not significant, the coefficient on wages suggests that high wages in a metropolitan area positively influence a firm's decision to move its headquarters. The effect of corporate taxation on the decision to relocate headquarters is also meaningful. A one-point rise in the corporate tax rate yields an increase of about 2.8% in the probability of headquarter's relocation. As in the where to locate model, airport availability is highly relevant in a headquarters' decision of whether to relocate. The larger the airport hub, the less likely the headquarters is to move away from such a metropolitan area. The probability of relocating decreases by 33% if the current location offers a small hub and decreases by 40% if the current location offers a large hub, compared with a location with no hub.

Headquarters are less likely to relocate if they are currently in a metropolitan area with a large number of headquarters belonging to the same industry. The coefficient in column (3) suggests that a 10% increase in the number of headquarters from the same SIC industry decreases the probability of moving by about 4%. Surprisingly, the index of specialization in the headquarters' sector of activity is insignificant. We would have expected such a measure to negatively influence a headquarters' decision to relocate as it may be a proxy for the location of the plant. The higher the measure of specialization, the more likely it is that production will take place in the metropolitan area. In contrast, for the manufacturing headquarters' sample the coefficient on the measure of specialization in the headquarters' sector of activity is high and significant (see Table A19 in Appendix A). Manufacturing headquarters are reluctant to move from a metropolitan area that specializes in their sector of activity. This may reflect the fact that production is less geographically dispersed in the manufacturing sector than, say, in the service or retail sectors. The headquarters' location vis-à-vis its plants is more important in the manufacturing sector as production is more likely to take place in a single location.

Results obtained for the measures of financial and business services specialization are disappointing. We would have expected both coefficients to be negative and significant, as the relative importance of financial and business service employment in a metropolitan area is supposed to have a positive influence on a firm's profit through headquarters cost efficiency gains. Although the firm decision of whether to relocate its headquarters does not seem to depend on the availability of financial and business services, we know from the previous section that such variables affect the firm's decision of where to move its headquarters.

Table A19 in Appendix A presents similar specifications for the subsample of headquarters that belong to the manufacturing sector. The results for manufacturing headquarters differ from the full sample on three main points: (i) the coefficient on corporate tax rates is of greater magnitude; (ii) the coefficient on large airport hubs is insignificant; and (iii) the coefficient on headquarters of the same SIC industry is insignificant, whereas the coefficient on the measure of specialization in the headquarters' sector of activity is statistically and economically significant. The latter results may reflect the fact that manufacturing headquarters have a greater need to locate close their plants. Consequently, they are influenced less by the location of other headquarters and the availability of airport hubs.

For the full sample, the coefficient on the inclusive value is highly significant although quite low (Table 8). Thus, the attractiveness of moving depends somewhat on the two-digit SIC industry in which the firm specializes. This feature is not relevant for the manufacturing headquarters sample for which the inclusive value is always insignificant. Within manufacturing, firms in different two-digit sectors thus value moving in a similar fashion.

2.6 Conclusions

In summary, headquarters relocate to metropolitan areas with good airport facilities, low corporate taxes, low average wages, high levels of business services, same industry specialization, and agglomeration of headquarters in the same sector of activity. Larger (saleswise) headquarters tend to relocate more as well as foreign firms, global (in terms of their numbers of headquarters) firms, and firms that are the outcome of a merger. Corporate history matters, as older headquarters are less likely to move. Finally, headquarters in a location with good airport facilities, low corporate taxes, and with agglomeration of headquarters in the same sector of activity are more likely to stay still.

What are the policy implications of our analysis?
Our results imply that a metropolitan area that wants to keep and attract headquarters must improve airport facilities, lower taxes, and promote the location of business services and other headquarters. The dramatic impact of a better airport cannot be underscored. In order to attract business services and headquarters direct subsidies and incentives can be provided.

When Boeing decided to move its main headquarters from Seattle it induced competition among Chicago, Dallas, and Denver as potential locations. Chicago offered by far the most generous package with incentives for more than U.S.$50 million.[41] According to our analysis, the negative aspects of Chicago are: highest wage, high tax (Dallas and Seattle are very low while Denver taxes are slightly higher than Chicago), largest population (congestion costs), less specialized in transport equipment (i.e. Boeing SIC2 activity) than Denver or Dallas.[42] The positive aspects of Chicago are: highest levels of total headquarters and transport equipment headquarters (i.e. headquarters of same SIC2), and higher specialization on finance and business services (except for Denver, which is more specialized in business services). In conclusion, Chicago may have subsidized in order to counterbalance the negative aspects of the city and the headquarters' agglomeration effects may have loomed large in the decision.

Regional and local governments subsidize the location of headquarters because of its external effects (in attraction of business services and other headquarters as well as general demand). How large should subsidies be? Using our theoretical model we can calibrate relevant deep parameters and obtain an estimate of the own scale elasticity of headquarters production. Relying on our specification (4) we obtain an elasticity estimate of 0.204 (0.321) for the number of headquarters from a different (the same) SIC, implying that a 10% increase in the number of headquarters from a different (the same) SIC in a location increases headquarters' production by 2.04% (5.25%).[43] As in Davis and Henderson (2004), optimal subsidies for each headquarters would amount to the elasticity estimate times the value of headquarters' output. Similarly, we could compute optimal subsidies for business services on the basis of their share in production and elasticity of substitution.[44] This would result in a subsidy for the service sector up to 64% of total headquarters' output.[45] We therefore see that the external effects and optimal subsidies are quite important. However, before advocating its use one must take into account the strategic aspect of subsidies. Indeed, if all locations offer subsidies they neutralize each other.

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41 See Garcia-Milà and McGuire (2002).

42 However, Phil Condit, the chairman and CEO of Boeing in 2001, stated explicitly that he wanted to move the headquarters from Seattle so as not to be close to the existing operations: "As we've grown, we have determined that our headquarters needs to be in a location central to all our operating units, customers and the financial community-but separate from our existing operations". This turned a potential negative aspect of Chicago into a positive one.

43 Davis and Henderson's (2004) own scale elasticity of headquarters' production is 1.7%. See Appendix A for a summary of the externalities exercise.

44 Optimal subsidies can be derived by solving the developer's program of maximizing land rents minus subsidies to inputs that yield external benefits. The developer internalizes social benefits via urban land rents (see, e.g., Duranton and Puga (2001) and Davis and Henderson (2004)).

45 This is because we obtain a strong value for diversity of business services (with a low elasticity of substitution of $\theta = 1{,}48$) and a share of labor in headquarters' production of $\alpha = 0{,}63$). The subsidy as a percentage of total headquarters' output is then given by $(1 - \alpha)/(\theta - 1)$.

Technical note on the nested logit model

The probability of moving to location t (in middle nest r) for a firm in industry i, P_{it}, can be written as the product of the conditional probabilities of each choice:

$$P_{it} = P_{im} * P_{ir|m} * P_{it|rm}$$

where P_{im} denotes the probability of choosing to relocate the headquarters, $P_{ir|m}$ is the probability of choosing an alternative in nest r conditional on having chosen to relocate, and $P_{it|rm}$ is the probability of choosing location t conditional on having decided to move in nest r:

$$P_{it|rm} = \exp(\beta X_{it}) \Big/ \sum_{k=1}^{N_r} \exp(\beta X_{ik})$$

where $N_r \in r$ is the number of alternatives in nest .

$P_{ir|m}$ depends on both nest-level characteristics Y_r and on characteristics of the alternatives that compose the nest through the so-called inclusive value $I_{ir} = \ln(\sum_{k=1}^{N_r} \exp(\beta X_k))$:

$$P_{ir|m} = \exp(\delta_1 I_{ir} + \lambda Y_r) \Big/ \sum_{k=1}^{N_r} \exp(\delta_1 I_{ik} + \lambda Y_k)$$

where R is the number of nests.

P_{im} depends on a firms characteristics, on characteristics of the location of origin (through B_m) and on the industry-specific expected value of moving through the inclusive value $I_i = \ln(\sum_{k=1}^{R} \exp(\delta_1 I_{ik} + \lambda Y_k))$:

$$P_{im} = \exp(\delta_2 I_i + \phi B_m) / (1 + \exp(\delta_2 I_i + \phi B_m)).$$

The nested logit model is estimated simultaneously for all nests (i.e. the parameters are constrained to be the same across nests). Thus, we first obtain the estimates of the coefficients from the conditional probability at the lowest level of the decision tree, $P_{it|rm}$. We identify the determinants of the choice of location, conditional on moving to region (respectively, population range) r. This depends on the explanatory variables X_t. Then we obtain the estimates of the coefficients from the conditional probability at the middle level of the decision tree $P_{ir|m}$. This depends on nest-level characteristics and on the inclusive value I_{ir}.[46] The coefficient on the inclusive value, δ_1, is important as it measures the relevance of the nested structure. It reflects the degree of dependence among the unobserved parts of profit for metropolitan areas in a given nest, with lower δ_1 indicating less independence (more correlation). If $\delta_1 = 1$, then there is no correlation in the unobserved component of profitability, metropolitan areas are not substitutes, and the nested logit is equivalent to a standard conditional logit estimation. Finally, we estimate the choice of whether or not to relocate the headquarters. P_{im} depends on firms' charac-

46 Recall that the inclusive value reflects characteristics of the alternatives that compose the nest.

teristics and characteristics of the location of origin and on the inclusive value I_i.[47]

As for standard logit, parameters of nested-logit are estimated using maximum log-likelihood techniques.[48]

47 Recall that the inclusive value is derived from the medium nest level and reflects industry-specific expected value of moving. The full relocation model should include set-up costs as relevant variable of the decision process. Assuming that set-up costs are the same in all potential areas, the impact or such costs on the decision of relocating depends mainly on firms' characteristics (e.g. bigger firms sales-wise are less sensitive to high set-up costs). Although, we do not have access to cost data, we aim to capture some of the set-up costs effects through firms' level data.

48 For more details on logit and nested logit methods see Train (2002).

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Appendix A

A.1 Headquarters' data

Our headquarters database is built from D&B's Who Owns Whom publication. D&B's business database is one of the world's largest with over 84 million companies worldwide. Who Owns Whom is a worldwide company directory file that links a company to its corporate family, showing the size of its corporate structure, its family hierarchy, as well as key information on the company. The D&B Who Owns Whom database is developed from company interviews as well as government sources, large-volume mailings, and third-party sources. Company data include sales levels, SIC code, age of the headquarters as well as country of ownership of the corporation (see Tables A1-A4).

Table A1: Sector composition of D&B's headquarters database.

Industrial sector (SIC1)	Frequency 1996 (%)	Frequency 2001 (%)
Agriculture, forestry, and fishing	0.08	0.09
Mining	1.72	1.73
Construction	3.71	3.70
Manufacturing	31.55	31.35
Transportation, communication, and utilities	7.47	7.53
Wholesale trade	18.14	18.10
Retail trade	6.93	6.98
Finance, insurance, and real estate	15.69	15.79
Service industries	14.71	14.74
Total number of headquarters	26,195	26,195

A.2 Metropolitan areas and regions: concept and components

Metropolitan areas include MSAs and CMSAs. MSAs must include at least one city with 50,000 or more inhabitants, or a Census-Bureau-defined urbanized area (of at least 50,000 inhabitants) and a total metropolitan population of at least 100,000. An area that qualifies as an MSA and has a population of one million or more may be recognized as a CMSA if separate component areas that demonstrate strong internal, social, and economic ties can be identified within the entire area and local opinion supports the component areas.

Locations' definitions change over time as new MSAs and CMSAs are added. Before the creation of a CMSA we keep track of all separate MSAs that later form the CMSA in order to obtain a consistent time series. Similarly, before the creation of a MSA we keep track of all separate counties that later form the MSA.

Table A2: Origin composition of D&B's headquarters database.

Origin of corporation	Frequency 1996 (%)	Frequency 2001 (%)
U.S.	68.68	68.58
Foreign	31.32	32.12
Total number of headquarters	26,195	26,195

Table A3: Status composition of D&B's headquarters database.

Status	Frequency (%)
No change in status	92.86
Merged/acquired	7.14
Total number of headquarters	26,195

Table A4: Summary statistics: logit model, *whether* to relocate.

Variable	Mean	Standard deviation
ln sales	10.56	1.94
ln (family size)	2.58	1.61
ln (age)	2.85	0.76
age	23.95	24.10
Year started	1977	24.10
ln (1 + merge)	0.05	0.18
merge	0.07	0.26
ln (1 + foreign)	0.22	0.32
ln wage	10.36	0.14
ln (1 − corporate tax rate)	−0.07	0.03
tax rate	0.07	0.03
ln (1 + airport)	1.28	0.38
airport	2.82	1.06
ln population	15.19	1.21
ln (total headquarters)	6.91	1.38
ln (1 + headquarters same SIC)	3.57	1.52
ln (share of employment same SIC)	0.77	0.33
ln (share of employment in finance)	0.71	0.12
ln (share of employment in business)	0.70	0.14

A.3 Independent variables

Wages are from the Bureau of Economic Analysis, Regional Economic Information System database.

Table A5: Leading metropolitan areas by number of headquarters and headquarters' sales in 1996.

Metropolitan areas	Number of headquarters	Metropolitan areas	Sales (×U.S.$1000)
New York–New Jersey–Long Island	3,954	New York–New Jersey–Long Island	1,490,597
Los Angeles–Riverside–Orange County	1,804	Chicago–Gary–Kenosha	499,081
Chicago–Gary–Kenosha	1,532	Detroit–Ann Arbor–Flint	384,339
San Francisco–Oakland–San Jose	951	Los Angeles–Riverside–Orange County	338,464
Boston–Worcester–Lawrence	945	San Francisco–Oakland–San Jose	324,822
Philadelphia–Wilmington–Atlantic City	885	Dallas–Fort Worth	302,642
Houston–Galveston–Brazoria, TX	806	Philadelphia–Wilmington–Atlantic City	249,651
Washington–Baltimore	767	Minneapolis–St. Paul	228,154
Dallas–Fort Worth	721	Washington–Baltimore	217,835
Atlanta	684	Houston–Galveston–Brazoria	203,888
Detroit–Ann Arbor–Flint	625	Atlanta	189,515
Minneapolis–St. Paul	513	Boston–Worcester–Lawrence	165,901
Cleveland–Akron	400	Cleveland–Akron	125,778
Miami–Fort Lauderdale	371	St. Louis	122,920
Seattle–Tacoma–Bremerton	369	Pittsburgh	100,589
St. Louis	367	Cincinnati–Hamilton	99,015
Pittsburgh	331	Seattle–Tacoma–Bremerton	94,984
Denver–Boulder–Greeley	306	Hartford	85,784
Milwaukee–Racine	283	Columbus	71,417
Charlotte–Gastonia–Rock Hill	270	Charlotte–Gastonia–Rock Hill	67,075

Business and financial services employment data are from the County Business Pattern, U.S. Census Bureau, for 1996 and 2001. The following SIC codes were selected: advertising (7311, 7312, 7313, 7319), employment agencies (7361), computer services (7371, 7372, 7373, 7374, 7375, 7376, 7377, 7378, 7379), legal services (81), engineering and management services (8711, 8712, 8713, 8720, 8731, 8732, 8733, 8734, 8741, 8742, 8743, 8744, 8748), commercial banks (6020), security and commodity brokers, dealers, exchanges and services (6210, 6220, 6230, 6280), and holding and other investment offices (6710, 6720, 6732, 6733, 6792, 6794, 6798, 6799). Data were aggregated to the MSA/CMSA levels.

Externality variables: headquarters agglomeration variables are built from the D&B database whereas industries agglomeration indices are built from the County Business Pattern. SIC2 level data are used to built agglomeration effects of same SIC levels.

Corporate tax rates are from the World Tax Database (WTDB) for 1996 and 2001. The WTDB is a project of the Office of Tax Policy Research. This database has current and historical data on the tax systems of the world. It is provided by the University of Michigan Business School.

Airports data are from the Bureau of Transportation Statistics (BTS): Airport Activity Statistics of Certificated Air Carrier (1999). We constructed dummies that indicate the availability of airports in a location. Airport_D2 takes a value of 1 if the location corresponds to a large airport hub. This airport enplaned more than 1% of total enplaned passengers per year (i.e. more than 6,106,287 passengers). Note that according to the BTS, there are 29 large hubs. Airport_D1 takes a value of 1 if airports in a location enplaned from 0.05% to 1% of total enplaned passengers per year (i.e. from 305,314 to 6,106,287 passengers). There are 75 of these small airport hubs. Airport_D0 takes a value of 1 if airports in a location enplaned less than 0.05% of total enplaned passengers-177 locations presented such a feature.

Table A6: Metropolitan areas gaining and losing the most manufacturing headquarters between 1996 and 2001.

Metropolitan areas	Change in number of headquarters	Metropolitan areas	Change in sales (percentage points)
Gaining			
Greensboro–Winston–Salem–High Point	10	San Francisco–Oakland–San Jose	1.76
Pittsburgh	10	Detroit–Ann Arbor–Flint	1.22
San Diego	7	Chicago–Gary–Kenosha	0.82
Detroit–Ann Arbor–Flint	7	Houston–Galveston–Brazoria	0.51
Phoenix–Mesa	6	Austin–San Marcos	0.49
Indianapolis	5	Cincinnati–Hamilton	0.47
San Antonio	5	Dallas–Fort Worth	0.41
Dallas–Fort Worth	5	Atlanta	0.35
Raleigh–Durham–Chapel Hill	4	Phoenix–Mesa	0.33
Nashville	4	San Antonio	0.31
Jacksonville	4	Columbia	0.18
Losing			
New York–New Jersey–Long Island	−32	Washington–Baltimore	−1.64
Cleveland–Akron	−10	Seattle–Tacoma–Bremerton	−1.26
San Francisco–Oakland–San Jose	−8	St. Louis	−1.00
Youngstown–Warren	−8	New York–New Jersey–Long Island	−0.98
Minneapolis–St. Paul	−8	Cleveland–Akron	−0.96
Philadelphia–Wilmington–Atlantic City	−7	Los Angeles–Riverside–Orange County	−0.41
Los Angeles–Riverside–Orange County	−7	Richmond–Petersburg	−0.31
Denver–Boulder–Greeley	−3	Raleigh–Durham–Chapel Hill	−0.31
Tulsa	−3	Kalamazoo–Battle Creek	−0.23
Rochester	−3	Reading	−0.13
Atlanta	−3	Nashville	−0.13
Allentown–Bethlehem–Easton	−3	Hartford	−0.11

A.4. Summary of the externalities simulation

The headquarters' production function equivalent to the sub-cost function (2.3.11) is $Y_t^H = \gamma_t^\alpha L_t^\alpha (Q_t^{BS})$, where Y_t^H is the headquarters' output, L_t is labor and Q_t^{BS} is business services; γ_t is a technology parameter that captures the positive interaction between headquarters. We consider two types of interaction (total number of headquarters and headquarters from same SIC). Thus, we have $\gamma_t^\alpha = (\gamma_{1t}^{\phi_1} \gamma_{2t}^{\phi_2})^\alpha$. Taking logs on the production function yields

$$\ln Y_t^H = \alpha\phi_1 \ln \gamma_{1t} + \alpha\phi_2 \ln \gamma_{2t} + \alpha \ln L_t + (1-\alpha) \ln Q_t^{BS}.$$

Using Equation (2.3.21), and the coefficients found in the empirical analysis, we can identify $\alpha\phi_1$ and $\alpha\phi_2$.[49] Specifically, after rescaling Equation (2.3.21) by β, we obtain that the coefficients on tax, wage, total headquarters and headquarters same SIC are β, $\eta\beta(1-\sigma)$, $-\alpha\phi_1\eta\beta(1-\sigma)$ and $-\alpha\phi_2\eta\beta(1-\sigma)$, respectively. Relying on specification (4), we find that $\alpha\phi_1$ = 0,204 and $\alpha\phi_2$ = 0,321. Thus, a 10% increase in the number of headquarters from a different SIC increases a headquarters' production by 2.04% and a 10% increase in the number of same SIC headquarters increases a headquarters' production by 5.25%.

49 Note that we cannot identify all of the model's parameters.

Table A7: Metropolitan areas gaining and losing the most foreign headquarters between 1996 and 2001.

Metropolitan areas	Change in number of headquarters	Metropolitan areas	Change in sales (percentage points)
Gaining			
Houston–Galveston–Brazoria	12	Detroit–Ann Arbor–Flint	4.73
Charlotte–Gastonia–Rock Hill	10	Chicago–Gary–Kenosha	3.23
San Diego	9	Washington–Baltimore	3.03
Cincinnati–Hamilton	8	Anchorage	2.44
Chicago–Gary–Kenosha	7	Philadelphia–Wilmington–Atlantic City	1.66
Raleigh–Durham–Chapel Hill	7	Cincinnati–Hamilton	1.29
Miami–Fort Lauderdale	6	Houston–Galveston–Brazoria	0.85
Atlanta	6	Buffalo–Niagara Falls	0.59
Richmond–Petersburg	5	Columbia	0.53
Tampa–St. Petersburg–Clearwater	4	Tulsa	0.47
San Antonio	4	Richmond–Petersburg	0.33
Phoenix–Mesa	4	Cedar Rapids	0.28
Losing			
New York–New Jersey–Long Island	−62	New York–New Jersey–Long Island	−10.73
San Francisco–Oakland–San Jose	−23	Cleveland–Akron	−3.23
Los Angeles–Riverside–Orange County	−13	Los Angeles–Riverside–Orange County	−3.03
Philadelphia–Wilmington–Atlantic City	−6	Dallas–Fort Worth	−0.91
Pittsburgh	−5	Raleigh–Durham–Chapel Hill	−0.77
Washington–Baltimore	−4	San Francisco–Oakland–San Jose	−0.33
Seattle–Tacoma–Bremerton	−4	Nashville	−0.30
Rochester	−3	St. Louis	−0.29
Reno	−3	Portland–Salem	−0.27
Cedar Rapids	−2	Louisville	−0.25
Scranton–Wilkes–Barre–Hazleton	−2	Pittsburgh	−0.16

Table A8: Headquarters relocation among the 500 largest 1996 headquarters.

Company name	Industrial sector	Metropolitan area 1996	Metropolitan area 2001
Ahold U.S.A. Holdings, Inc.	Grocery Stores	Atlanta	Washington
Ashland Inc.	Petroleum Refining	Huntington	Cincinnati
Avnet Inc.	Electronic Part and Equipment	New York	Phoenix
Banc One Corporation	National Commercial Banks	Columbus	Chicago
Bank of America National Trust and Savings	National Commercial Banks	San Francisco	Charlotte
Boeing Company, The, Inc.	Aircraft	Seattle	Chicago
BP America Inc.	Petroleum Refining	Cleveland	Chicago
Browning-Ferris Industries Inc.	Refuse Systems	Houston	Phoenix
First Data Corporation	Computer Processing/Data	New York	Denver
Fleming Companies, Inc.	Groceries	Oklahoma	Dallas
FMC Corporation	Alkalies and Chlorine	Chicago	Philadelphia
Fort James Corporation	Paper Mills	Richmond	Atlanta
Fortune Brands Inc.	Distilled and Blended Liquors	New York	Chicago
GTE Corporation	Phone Communications	New York	Dallas
Highmark Inc.	Hospital and Medical Insurance	Harrisburg	Pittsburgh
Honeywell Inc.	Automatic Regulating Controls	Minneapolis	New York
Lincoln National Corporation	Life insurance	Fort Wayne	Philadelphia
MCI Communications Corporation	Phone Communications	Washington	Jackson, MS
Mobil Corporation	Petroleum Refining	Washington	Dallas
Monsanto Company Inc.	Organic Fibers Non-cellulosic	St. Louis	New York
Norwest Corporation	National Commercial Banks	Minneapolis	San Francisco
Pharmacia and Upjohn Inc.	Pharmaceutical Preparation	Kalamazoo	New York
PNC Bancorp Inc.	National Commercial Banks	Pittsburgh	Philadelphia
Revco Discount Drug Centers Inc.	Dispensing Chemists	Cleveland	Providence
RJR Nabisco Inc.	Cigarettes	New York	Greensboro
Rockwell International Corporation	Display/Control Instruments	Los Angeles	Milwaukee
Standard Oil Company, The, Inc.	Petroleum Refining	Cleveland	Chicago
Tenneco Inc.	Cardboard	New York	Chicago
Tosco Corporation	Petroleum Refining	New York	Phoenix
Transamerica Corporation	Life Insurance	San Francisco	Chicago
Union Pacific Corporation	Railroads Line Haulage	Allentown	Omaha
Unisource Worldwide, Inc.	Printing and Writing Paper	Philadelphia	Atlanta
Usx Corporation	Crude Petroleum/Natural Gas	Pittsburgh	Houston
Vf Corporation	Trousers Male	Reading	Greensboro
Waste Management of North America Inc.	Refuse Systems	Chicago	Houston
Westinghouse Electric Corporation	TV Broadcasting Stations	Pittsburgh	New York

In order to get insights into the elasticity of substitution between business services, we run a restricted version of the model relying on specification (4) (i.e. regional nest). This restricted version includes tax, wage, airport, total headquarters, and business services as main variables.[50] We find that $\alpha = 0{,}76$ and $\theta = 1{,}37$. The value for α makes sense as the share of labor in headquarters' production. It also makes sense as the effect of an additional headquarters on headquarters' production. θ is quite low but not very different from that found by Davis and Henderson (2004) which is close to 2.

50 Using headquarters same SIC instead of total headquarters did not allow for identification because of the insignificancy of the tax and wage coefficients.

Table A9: Sector composition of the nested logit headquarters database.

Industrial sector (SIC1)	Frequency 1996 (%)	Frequency 2001 (%)
Agriculture, forestry, and fishing	0.07	0.00
Mining	3.33	3.12
Construction	2.57	2.71
Manufacturing	33.59	33.80
Transportation, communication, and utilities	8.81	9.16
Wholesale trade	20.82	20.61
Retail trade	5.27	5.34
Finance, insurance, and real estate	9.72	9.65
Service industries	15.81	15.61
Total number of headquarters	1,441	1,441

Table A10: Origin composition of the nested logit headquarters database.

Origin of corporation	Frequency 1996 (%)	Frequency 2001 (%)
U.S.	62.60	58.57
Foreign	37.40	41.43
Total number of headquarters	1,441	1,441

Table A11: Status composition of the nested logit headquarters database.

Status	Frequency (%)
No change in status	85.87
Merged/acquired	14.43
Total number of headquarters	1,441

Table A12: Summary statistics: nested logit model, where to relocate.

	Areas chosen by headquarters		All 106 metropolitan areas	
Variable	Mean	Standard deviation	Mean	Standard deviation
ln sales	10.87	2.01		
In (family size)	2.92	1.59		
ln (age)	2.70	0.74		
age	20.29	20.37		
year started	1981	20.37		
ln wage	10.33	0.13	10.22	0.11
ln $(1 - \text{corporate tax rate})$	−0.07	0.03	−0.07	0.03
corporate tax rate	0.07	0.03	0.07	0.03
ln $(1 + \text{airport})$	1.28	0.34	0.81	0.52
airport	2.76	0.97	1.55	1.16
ln population	15.05	1.06	13.77	0.98
ln (total headquarters)	6.73	1.25	5.24	1.10
ln $(1 + \text{headquarters same SIC})$	3.34	1.54	1.76	1.01
ln (share of employment same SIC)	0.78	0.37	0.66	0.07
ln (share of employment in Finance)	0.70	0.12	0.62	0.14
ln (share of employment in Business)	0.71	0.14	0.57	0.16

Table A13: Sectors and SIC codes.

One-digit SIC	One-digit sector	Two-digit SIC	Two-digit sector
1	Agriculture, forestry, and fishing	07	Agricultural services
		08	Forestry
		09	Fishing, hunting, and trapping
2	Mining	10	Metal mining
		12	Coal mining
		13	Oil and gas extraction
		14	Nonmetallic minerals, except fuels
3	Construction	15	General building contractors
		16	Heavy construction contractors
		17	Special trade contractors
4	Manufacturing	20	Food and kindred products
		21	Tobacco manufactures
		22	Textile mill products
		23	Apparel and other textile products
		24	Lumber and wood products
		25	Furniture and fixtures
		26	Paper and allied products
		27	Printing and publishing
		28	Chemicals and allied products
		29	Petroleum and coal products
		30	Rubber and miscellaneous plastics products
		31	Leather and leather products
		32	Stone, clay, glass, and concrete products
		33	Primary metal industries
		34	Fabricated metal products
		35	Industrial machinery and equipment
		36	Electrical and electronic equipment
		37	Transportation equipment
		38	Instruments and related products
		39	Miscellaneous manufacturing industries
5	Transportation, communications, and utilities	40	Railroads
		41	Local and interurban passenger transit
		42	Motor freight transportation and warehousing
		43	U.S. Postal Service
		44	Water transportation
		45	Transportation by air
		46	Pipelines, except natural gas
		47	Transportation services
		48	Communications
		49	Electric, gas, and sanitary services
6	Wholesale trade	50	Wholesale trade: durable goods
		51	Wholesale trade: non-durable goods
7	Retail trade	52	Building materials, hardware, garden supply
		53	General merchandize stores
		54	Food stores
		55	Automotive dealers and gasoline service stations
		56	Apparel and accessory stores
		57	Furniture, home furnishings and equipment stores
		58	Eating and drinking places
		59	Miscellaneous retail

Table A13: Continued.

One-digit SIC	One-digit sector	Two-digit SIC	Two-digit sector
8	Finance, insurance, and real estate	60	Depository institutions
		61	Non-depository credit institutions
		62	Security, commodity brokers, and services
		63	Insurance carriers
		64	Insurance agents, brokers, and service
		65	Real estate
		67	Holding and other investment offices
9	Service industries	70	Hotels, rooming houses, camps, and lodging
		72	Personal services
		73	Business services
		75	Automotive repair, services, and parking
		76	Miscellaneous repair services
		78	Motion pictures
		79	Amusement and recreational services
		80	Health services
		81	Legal services
		82	Educational services
		83	Social services
		84	Museums, art galleries, gardens
		86	Membership organizations
		87	Engineering and management services
		88	Private households
		89	Miscellaneous services

Table A14: List of CMSAs.

CMSA name and states
Boston–Worcester–Lawrence, MA–NH–ME–CT
Chicago–Gary–Kenosha, IL–IN–WI
Cincinnati–Hamilton, OH–KY–IN
Cleveland–Akron, OH
Dallas–Fort Worth, TX
Denver–Boulder–Greeley, CO
Detroit–Ann Arbor–Flint, MI
Houston–Galveston–Brazoria, TX
Los Angeles–Riverside–Orange County, CA
Miami–Fort Lauderdale, FL
Milwaukee–Racine, WI
New York–New Jersey–Long Island, NY–NJ–CT–PA
Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD
Portland–Salem, OR–WA
Sacramento–Yolo, CA
San Francisco–Oakland–San Jose, CA
Seattle–Tacoma–Bremerton, WA
Washington–Baltimore, DC–MD–VA–WV

Table A15: The *where* to locate model: first and second stage of the nested logit without single-site firms.

Model	(1)	(2)	(3)	(4)
ln wage	0.87**	−2.59***	1.87***	−1.13*
	(0.42)	(0.60)	(0.47)	(0.70)
ln (1 − corporate tax rate)	4.02***	2.30**	−0.85	−0.65
	(0.98)	(1.11)	(1.25)	(1.37)
airport_D1	0.19	−0.08	0.27*	0.26*
	(0.20)	(0.22)	(0.17)	(0.18)
airport_D2	0.52**	0.13	0.69***	0.55**
	(0.23)	(0.25)	(0.20)	(0.23)
ln population	0.74***	−0.13	0.77***	0.14
	(0.08)	(0.16)	(0.07)	(0.16)
ln (distance)		−0.24***		−0.08
		(0.03)		(0.05)
ln (total headquarters)		0.50***		0.28*
		(0.15))		(0.17)
ln (headquarters same SIC)		0.49***		0.42***
		(0.06)		(0.06)
ln (share of employment same SIC)		0.72***		0.76***
		(0.11)		(0.12)
ln (share of employment in finance)		0.68**		0.68**
		(0.29)		(0.30)
ln (share of employment in business)		1.77***		1.02***
		(0.34)		(0.36)
N	26,361	26,314	21,296	21,289
Likelihood ratio index	0.023	0.089	0.237	0.271
Inclusive value (δ)	0.59***	0.54***	0.53***	0.53***
	(0.03)	(0.03)	(0.03)	(0.03)
N	5,164	5,164	9,884	9,884
Likelihood ratio index	0.136	0.136	0.098	0.106

Note: Specifications (1) and (2) are population nested, (4) and (5) are region nested. Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. N corresponds to the number of headquarters that relocate (i.e. 1,222) times the number of potential locations for each headquarters. Note that, depending on the nest chosen, headquarters differ in the number of MSAs they are considering.

Table A16: The *where* to locate model: first and second stage of the nested logit for manufacturing headquarters.

Model	(1)	(2)	(3)	(4)	(5)	(6)
ln wage	0.32	-2.24^{**}	-2.25^{**}	0.79	-0.54	-0.37
	(0.66)	(0.93)	(0.93)	(0.76)	(1.08)	(1.09)
ln (1 − corporate tax rate)	3.83^{**}	4.35^{***}	4.36^{***}	0.73	2.09	1.96
	(1.59)	(1.72)	(1.72)	(2.07)	(2.27)	(2.27)
airport_D1	0.16	0.35	0.35	0.18	0.43^{*}	0.38
	(0.29)	(0.33)	(0.33)	(0.24)	(0.26)	(0.27)
airport_D2	0.19	0.52	0.52	0.41	0.63^{*}	0.54
	(0.34)	(0.39)	(0.39)	(0.30)	(0.35)	(0.36)
ln population	0.88^{***}	0.61^{**}	0.60^{**}	0.86^{***}	0.54^{**}	0.59^{**}
	(0.13)	(0.25)	(0.26)	(0.11)	(0.26)	(0.27)
ln (distance)		-0.32^{***}	-0.32^{***}		-0.11	-0.11
		(0.04)	(0.04)		(0.09)	(0.09)
ln (total headquarters)		0.10	0.10		-0.04	-0.05
		(0.24)	(0.24)		(0.26)	(0.27)
ln (headquarters same SIC)		0.42^{***}	0.41^{***}		0.41^{***}	0.53^{***}
		(0.09)	(0.15)		(0.10)	(0.15)
ln (headquarters same SIC) squared			0.002			-0.03
			(0.03)			(0.02)
ln (share of employment same SIC)		0.80^{***}	0.80^{***}		0.78^{***}	0.77^{***}
		(0.15)	(0.15)		(0.16)	(0.16)
ln (share of employment in finance)		-0.09	-0.10		-0.08	-0.02
		(0.48)	(0.48)		(0.49)	(0.50)
ln (share of employment in business)		1.63^{***}	1.63^{***}		0.67	0.63
		(0.55)	(0.55)		(0.58)	(0.58)
N	10,597	10,597	10,597	8,729	8,729	8,729
Likelihood ratio index	0.022	0.093	0.093	0.209	0.249	0.249
Inclusive value (δ)	0.55^{***}	0.43^{***}	0.42^{***}	0.57^{***}	0.53^{***}	0.54^{***}
	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
N	1,845	1,845	1,845	3,319	3,319	3,319
Likelihood ratio index	0.122	0.120	0.120	0.109	0.112	0.112

Note: Specifications (1), (2), and (3) are population nested, (4), (5), and (6) are region nested. Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. N corresponds to the number of manufacturing headquarters that relocate (i.e. 480) times the number of potential locations for each headquarters. Note that, depending on the nest chosen, headquarters differ in the number of MSAs they are considering.

Table A17: The *where* to locate model: first and second stage of the nested logit with population-range dummies, regional dummies, and States fixed effects.

Model	(1)	(2)	(3)	(4)
ln wage	-1.38^{**}	0.30	-1.08^{*}	-1.20
	(0.66)	(1.04)	(0.66)	(0.92)
ln (1 − corporate tax rate)	-0.01		0.26	
	(1.32)		(1.31)	
airport_D1	0.09	-0.26	0.08	0.46^{**}
	(0.21)	(0.28)	(0.21)	(0.21)
airport_D2	0.35	-0.28	0.33	0.53^{**}
	(0.25)	(0.34)	(0.25)	(0.27)
ln population	0.07	0.95^{***}	0.12	0.48^{**}
	(0.16)	(0.26)	(0.17)	(0.24)
ln (distance)	-0.23^{***}	-0.23^{***}	-0.07	-0.03
	(0.03)	(0.03)	(0.05)	(0.05)
ln (total headquarters)	0.27^{*}	0.25	0.30^{*}	0.04
	(0.16)	(0.23)	(0.16)	(0.24)
ln (headquarters same SIC)	0.50^{***}	0.54^{***}	0.45^{***}	0.48^{***}
	(0.05)	(0.06)	(0.06)	(0.06)
ln (share of employment same SIC)	0.71^{***}	0.76^{**}	0.75^{***}	0.74^{**}
	(0.11))	(0.11)	(0.12)	(0.12)
ln (share of employment in finance)	0.61^{**}	1.78^{***}	0.65^{**}	1.06^{***}
	(0.29)	(0.39)	(0.30)	(0.37)
ln (share of employment in business)	0.90^{***}	0.41^{*}	0.69^{**}	0.59^{*}
	(0.35)	(0.47)	(0.36)	(0.45)
Region Dummy	*Yes*	*No*	*No*	*No*
Population Range Dummy	*No*	*No*	*Yes*	*No*
State fixed effect	*No*	*Yes*	*No*	*Yes*
N	30,519	30,519	24,982	24,982
Likelihood ratio index	0.090	0.18	0.280	0.34
Inclusive value (δ)	0.52^{***}	0.03^{***}	0.54^{***}	0.01^{***}
	(0.03)	(0.002)	(0.03)	(0.001)
N	5,341	5,341	10,053	10,053
Likelihood ratio index	0.150	0.080	0.109	0.003

Note: Specifications (1) and (2) are population nested, (4) and (5) are region nested. Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. N corresponds to the number of headquarters that relocate (i.e. 1,441) times the number of potential locations for each headquarters. Note that, depending on the nest chosen, headquarters differ in the number of MSAs they are considering.

Table A18: The *where* to locate model: first and second stage of the nested logit with population dummies, regional dummies and States fixed effects and without single-site firms.

Model	(1)	(2)	(3)	(4)
ln wage	-1.15^{*}	0.49	-0.88	-0.79
	(0.71)	(1.10)	(0.71)	(0.97)
ln (1 − corporate tax rate)	-0.44		-0.21	
	(1.45)		(1.44)	
airport_D1	-0.01	-0.34	0.00	0.38^{*}
	(0.22)	(0.29)	(0.23)	(0.22)
airport_D2	0.24	-0.40	0.24	0.40^{*}
	(0.27)	(0.36)	(0.27)	(0.29)
ln population	0.03	0.92^{***}	0.07	0.48^{*}
	(0.18)	(0.28)	(0.18)	(0.26)
ln (distance)	-0.24^{***}	-0.23^{***}	-0.08	-0.04
	(0.03)	(0.03)	(0.05)	(0.06)
ln (total headquarters)	0.26	0.33	0.31^{*}	-0.09
	(0.17)	(0.24)	(0.17)	(0.25)
ln (headquarters same SIC)	0.50^{***}	0.53^{***}	0.43^{***}	0.46^{***}
	(0.06)	(0.06)	(0.06)	(0.06)
ln (share of employment same SIC)	0.72^{***}	0.77^{***}	0.76^{***}	0.76^{***}
	(0.11)	(0.11)	(0.12)	(0.12)
ln (share of employment in finance)	0.73^{**}	1.99^{**}	0.74^{**}	1.25^{***}
	(0.31)	(0.41)	(0.32)	(0.40)
ln (share of employment in business)	1.16^{***}	0.72^{*}	0.92^{**}	0.82^{*}
	(0.38)	(0.45)	(0.38)	(0.47)
Region Dummy	*Yes*	*No*	*No*	*No*
Population Range Dummy	*No*	*No*	*Yes*	*No*
State fixed effect	*No*	*Yes*	*No*	*Yes*
N	26,314	26,314	21,289	21,289
Likelihood ratio index	0.092	0.182	0.272	0.340
Inclusive value (δ)	0.55^{***}	0.03^{***}	0.53^{***}	0.01^{***}
	(0.03)	(0.01)	(0.03)	(0.03)
N	5,164	5,164	9,884	9,884
Likelihood ratio index	0.135	0.074	0.106	0.004

Note: Specifications (1) and (2) are population nested, (4) and (5) are region nested. Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. N corresponds to the number of headquarters that relocate (i.e. 1,441) times the number of potential locations for each headquarters. Note that, depending on the nest chosen, headquarters differ in the number of MSAs they are considering.

Table A19: The *whether* to locate model: third stage of the nested logit, manufacturing headquarters.

Model	(1)	(2)	(3)
ln sales	0.23^{***}	0.22^{***}	0.23^{***}
	(0.03)	(0.03)	(0.03)
ln (number of HQ in the firm)	0.06	0.06	0.05
	(0.04)	(0.04)	(0.04)
ln (age)	-0.23^{***}	-0.22^{***}	-0.22^{***}
	(0.06)	(0.06)	(0.06)
ln (merger)	1.41^{***}	1.42^{***}	1.43^{***}
	(0.20)	(0.20)	(0.20)
ln (foreign)	0.57^{***}	0.53^{***}	0.57^{***}
	(0.18)	(0.18)	(0.18)
ln wage	0.51	1.25	1.49
	(0.68)	(0.78)	(1.05)
ln (1 − corporate tax rate)	−2.40	-4.64^{*}	-5.24^{**}
	(1.72)	(2.54)	(2.60)
airport_D1	−0.19	-0.71^{**}	-0.77^{***}
	(0.20)	(0.31)	(0.31)
airport_D2	−0.09	−0.46	−0.52
	(0.27)	(0.39)	(0.40)
ln population	−0.01	−0.12	−0.36
	(0.10)	(0.14)	(0.28)
ln (total headquarters)			0.25
			(0.25)
ln (headquarters same SIC)			−0.12
			(0.10)
ln (share of employment same SIC)			-0.51^{***}
			(0.17)
ln (share of employment in finance)			−0.34
			(0.54)
ln (share of employment in business)			−0.35
			(0.57)
Inclusive value	−0.03	−0.02	0.02
	(0.04)	(0.04)	(0.06)
Constant	-9.96^{*}	-15.51^{**}	−15.37
	(6.07)	(7.18)	(11.07)
Industry and region dummies	No	Yes	Yes
N	8,104	8,104	8,092
Likelihood ratio index	0.041	0.047	0.054

Note: Standard errors are in parenthesis. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. N is the total number of headquarters for which all explanatory variables were available.

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Vanessa Strauss-Kahn is Assistant Professor of Economics at INSEAD since September 2001, Vanessa Strauss-Kahn received a Ph.D. in Economics from New York University. Previously, she worked at New York University, as a teaching assistant in Microeconomics and Macroeconomics Principles. She also worked for The World Bank, on a project focusing on social spending analysis for Asia as well as for the United Nations Development Program, where she assisted the Chief Economist of the RBA-Policy unit and conducted research on the Euro and the CFA Franc. Professor Strauss-Kahn's current research focuses on firms' location decision across countries. More specifically, she aims to provide a contribution to the understanding of outsourcing decision and its impact on inequality between skilled and unskilled workers. More recently, she focuses on headquarters' locations within and across countries. Her fields of interest are International Trade, Economic Geography and Labor Economics.

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