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Abstract

In this paper, I study whether there is any evidence that the market scale surrounding a central administrative office (CAO), which includes corporate headquarters, influences a firm's cost-effectiveness in procuring business services. By linking plant-level data from the *1992 Annual Survey of Manufactures* with CAO information from the *Survey of Auxiliary Establishments*, I examine manufacturing plants' practice of outsourcing services in relation to the size of the local service market surrounding the plant and that surrounding the plant's CAO. I found statistically significant evidence that the greater the size of local market surrounding a CAO, the higher the plant's probability of relying on the CAO for outsourcing advertising, bookkeeping and accounting, and legal services. These results are found even after controlling for the size of the local market surrounding a plant and plant characteristics.

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1 Introduction

Much of urban economics literature treats the firm as a single-establishment entity. Within such a framework, agglomeration economies in a city are considered to benefit only firms located in that city.[1] In reality, however, many firms are composed of multiple establishments, which are not necessarily located in the same geographic area. This paper examines the possibility of an establishment benefiting from agglomeration economies not only in its local market but also in other markets where affiliated establishments are located.

In my earlier work (Ono [20]), I use data on manufacturing plants to examine the possibility that plants in larger local markets enjoy more cost reducing benefits by outsourcing administrative services than plants in smaller local markets. Looking at a manufacturing plant's outsourcing probability as a function of the local market scale, and controlling for plant characteristics, I found that a significant proportion of the variation in outsourcing across U.S. counties can be explained by the variation in local market scale. However, I also found that even after controlling for market scale in a location, there remains enormous variation in a plant's outsourcing probability based on plant characteristics. In particular, a plant's outsourcing probability drops significantly if it is affiliated with other plants or establishments.[2] This indicates that a manufacturing plant which has a separate head office or other plants owned by the same company relies on these establishments in procuring services. Moreover, it suggests that a plant can benefit if the market price of services is lower not only

[1]For empirical evidence of agglomeration economies, see Ciccone and Hall [5], Henderson [10], Moomaw [18] and Glaeser et al.[7].

[2]Take, for example, advertising and bookkeeping and accounting. The results for these services in Ono [20] indicate that the probability that a plant directly outsources a service drops by 17% and 37%, respectively.

in its own local market but also in the markets surrounding affiliated establishments.

In this paper, I explore the mechanism behind intra-firm sharing of procuring services, focusing on the role played by a Central Administrative Office (CAO). CAOs include corporate headquarters and other offices that perform clerical, administrative, and managerial tasks, which are essential to any firm. These services can be performed either at the firm's main operating offices or at its factories. Many firms, however, locate their CAOs separate from their main production facilities, possibly to take advantage of characteristics of other cities such as the access to information, knowledge spillover from other CAOs, or access to more competitive suppliers of business services, which are suited to tasks of CAOs. While these factors are often pointed out in the literature of multi-plant firms and of headquarters (Fujita and Ota [8], Brecher et al. [4]), little empirical testing of their effects has been performed. This study will focus on the CAO's access to competitive suppliers of services.[3] While CAOs can perform administrative services in-house, they also source such services from an outside market.[4] Therefore, the more competitive the market surrounding a CAO is, the more likely that outsourcing is performed at a CAO location rather than a plant location, allowing a firm to source services inexpensively. There might be, however, some services which are tied to the location of the production facility. The effects of the market size of a CAO location in such a case will be also discussed in the paper.

Using data from *Fortune 500*, Holloway and Wheeler [11] provide evidence that a metropolitan economy's concentration in producer services provides the resources necessary to encour-

[3]Davis [6] provides evidence that corporate headquarters benefit from the existence of other headquarters within a mile.

[4]By using the Bureau of Labor Statistics' *Contract-Out Survey*, Murphy [19] found that corporate headquarters are more likely to outsource services than non-headquarters establishments.

age growth in the number of corporate headquarters. Using more complete data from the *Survey of Auxiliary Establishments* (see Section 3 for more detailed description of the data), Davis [6] also provides evidence that a firm will locate its CAOs in a city with more service suppliers, even after controlling for the population in the city. However, whether or not the location of CAOs influences the efficiency of remote plants has not yet been studied. In this paper, I test the hypothesis that a bigger local market scale surrounding a CAO allows its affiliated manufacturing plants to rely on the CAO for outsourcing services.

To test this hypothesis, I use plant-level data from the *1992 Annual Survey of Manufactures (ASM)* portion of the *Longitudinal Research Data Set (LRD)* [29], which provides information on manufacturing plants' outsourcing of administrative and clerical services.[5] Outsourcing of such services has been a serious concern of many firms [17]. The corresponding high growth of service industries is also an important economic phenomenon in recent decades. However, the Census Bureau only started collecting data on the cost of outsourced services for such services in 1992. In this paper, I use this cost information to identify whether or not a plant outsourced a given service. Included in this study are four white-collar services; advertising, bookkeeping and accounting, legal services, and software and data-processing services.[6]

In addition to the *ASM*, I use the *Survey of Auxiliary Establishments (SAE)* [30], which provides information on supporting establishments, including CAOs.[7] In 1992 in the U.S.,

[5]Plant-level data from the *1997 ASM* were not available to this study.

[6]Siegel and Griliches [9] utilized the cost data of purchased services from the *ASM* of 1977 and 1982. However, in these earlier years, the survey included only repair services and communication service, which are not the focus of this paper.

[7]Most of the existing literature on corporate headquarters use the data from *Fortune 500*, which include only public companies (Silton and Stanley [25], Shilton and Webb [24], and Holloway and Wheeler [11]).

there were about 47,000 supporting establishments (including CAOs). Firms with such supporting establishments accounted for 40% of U.S. employment (calculated based on *the 1992 Enterprise Statistics*) [28]. Of all supporting establishments, about 70% are CAOs, which are the focus of this paper. Note that the CAOs in the *SAE* can be linked to the *ASM* plants at the firm level by using the common firm identifier in both data sets; this provides a unique opportunity to investigate the intra-firm sharing of the role of procuring services.

From these data, however, it is not possible to determine whether a plant relies on its CAO for outsourcing services. That is, if a plant did not outsource any amount of a given service, the data do not indicate whether a plant relied on its CAO for the service, or performed the service in-house. Therefore, in order to examine whether the market conditions surrounding a CAO have some influence on a plant's reliance on the CAO for outsourcing services, I use a model which links a plant's probability of outsourcing to the market conditions of its CAO.

In Section 2, I present a theoretical model which, unlike the model in Ono [20], allows a plant to have access not only to its local market but also to the market surrounding its CAO. In the model, greater local demand for a service induces the entry of more suppliers, which in turn increases competition and lowers the market price of the service. Thus, if demand for a particular service is greater in the market surrounding a CAO, more suppliers will enter that market, lowering the market price of the service at the CAO's location. As a result, the plant will be more likely to depend on the CAO to outsource the service, and less likely to outsource the service in its local market.[8]

In contrast, the *SAE* is essentially a population survey which contains all auxiliary establishments (which include *CAOs*) of multi-plant firms in the U.S Economic Census.

[8]While some services are not transacted only within a local market, my aim here is not to capture the effect of a whole market size. Significant coefficients obtained for my measure of local market scale (at a

I begin my empirical analysis by constructing an index to measure local market scale as in Ono [20]. Why this index is created, how it plays an important role in identifying the effect of market size and how the index is constructed are reviewed in Section 4.1. Using the index, I examine a plant's likelihood of outsourcing a given service in relation to the local market scale of both the plant's and its CAO's locations. The empirical results presented in Section 5 show that, for advertising, bookkeeping and accounting, and legal services, the greater market scale at a CAO location does decrease the plant's probability to outsource the service from its own local market; this indicates that a greater market scale surrounding the CAO allows a plant to source the service more inexpensively.[9]

For software and data-processing services, however, the results contradict the prediction of my theoretical model. The results indicate that as the market scale at a CAO's location increases, a plant is more likely to directly outsource from "its own" local market instead of relying on the CAO. A possible reason for this is discussed in Section 5, with a comparison between software and data-processing services and the three other services.

2 Theoretical Model

Let us consider a city with plants who are final producers and whose choice of city is exogenous to the model and intermediate service suppliers whose choice of city is endogenous. I assume that plants use a service as a production input, and that the market transactions

county-level) prove that the local clustering of business activities influences a plant's decision of outsourcing.

[9]Note that the results of my empirical testings are also consistent with a Dixit-Stiglitz type variety story in which variety increases with local market size (as in Homes [12]). My results are also consistent with Hubbard [14], who investigated the contractual form in local trucking markets and found that contracts, or more vertically integrated organization structure, are more likely to be chosen than simple spot arrangements when local markets are thin.

of the service are possible only within the same city. In the model, the technology and the number of plants in the city determine the local demand for the service, which will determine the number of service suppliers who decide to enter the local market. The entry process of service suppliers is modeled using the 2-stage Cournot oligopoly game. Note that I consider only plants who have a CAO owned by the same parent firm.

Plant's Probability of Outsourcing a Service: In order to procure a service, a plant can (i) perform the service in-house, (ii) purchase the service from the local market, or (iii) have its CAO purchase the service in the market in which the CAO is located.[10] Comparing the cost for each case, a plant chooses one of the above three alternatives. I assume that the plant and the CAO are located in different cities, so that they face different local market prices.

Let us assume that a plant's in-house production of a service requires only marginal costs - it occurs in a facility which has already been set up for final production. I specify marginal costs of plant i, δ_i, as

$$\delta_i = \delta(A_i) + u_i, \tag{1}$$

where A_i is the set of characteristics of plant i and u_i a zero-mean random disturbance.

Let us call the CAO of plant i, CAO_i, and denote the unit cost of a service when a plant relies on a CAO for outsourcing the service by c_i. c_i is essentially the price that the CAO pays in its local market, which I denote by $\tilde{p}$. However, taking into account that a plant

[10] The CAO could also produce the service in-house. However, not introducing this alternative does not influence the main hypothesis derived from the model.

might not have accurate information on the market price that its CAO faces, I specify c_i as

$$c_i = \tilde{p} + \epsilon_i, \tag{2}$$

where ϵ_i is a random component.

Let p stand for the local market price of the service that plant i faces in its local market. Assuming that services are purchased only from suppliers in the same city, plant i outsources the service when $p < \delta_i \ \cap \ p < c_i$. Assuming that u_i and ϵ_i are independent and have distribution functions $F(\cdot)$ and $G(\cdot)$, respectively, from (1) and (2), the probability that plant i outsources by itself, Pr_i^{os}, is written as

$$Pr_i^{os} = (1 - F[p - \delta(A_i)])(1 - G[p - \tilde{p}]). \tag{3}$$

The plant's probability to outsource to its local market increases when the market price is lower in its own local market. However, the probability decreases when the market price is lower at the CAO's location, since the plant will then be more likely to depend upon the CAO for procuring the service.

Potential Demand and Outsourcing Demand for a Service: Based on (3), I derive the demand schedule that service suppliers face. First, suppose all plants were hypothetically to outsource the service by themselves. Then, for any market price, p, there would be a resulting demand for the service which I call *potential demand*. This demand essentially determines the extent of a market for a service and plays a key role in the empirical testing. Let us assume that plants have an identical demand function for the service and specify it as $\theta a(p)$, where θ is the demand shifter,[11] and $a(p)$ is a downward sloping function of price.

[11] θ can be seen as a share parameter of an underlying Cobb-Douglas production function in a special case (see Ono [20]).

In a city with N plants, the aggregate potential demand of the service, D^p is written as

$$D^p = \theta N a(p). \tag{4}$$

Since plants could perform the service in-house or ask its CAO to outsource, in order to derive the actual demand that service suppliers face, we should consider the probability that plants outsource by themselves; I call this actual demand the *outsourcing demand*. By multiplying the potential demand D^p by the average probability of outsourcing (see (3)), the city's outsourcing demand for the service is written as

$$D(p, \theta, N) = \theta N a(p)(\frac{1}{N}) \sum_{i}^{N} (1 - F[p - \delta(A_i)])(1 - G[p - \tilde{p}]). \tag{5}$$

Here I assume that A_i and $\tilde{p}$ are exogenous to the determination of the demand schedule of a city where plant i is located.[12] Then, the inverse demand function is written as

$$p = P(\frac{Q}{N\theta}; \{A_i\}, \tilde{p}), \tag{6}$$

where Q is the total amount of the outsourced service in the city.

Intermediate Service Suppliers: Facing the city's outsourcing demand schedule, service suppliers who have entered the local production maximize their profits with respect to (w.r.t.) production. Denoting the profit of supplier j in Stage 2 by π_j, the output level of supplier j by q_j, and the marginal cost by a, we can write π_j as $\pi_j = P(\frac{Q}{N\theta})q_j - aq_j$. Note that, while the marginal cost, a, might vary across locations, its relation to the city size is not clear. While the high wage in a big city might increase a, it should be offset by higher labor productivity due to, for example, the knowledge spillover in a big city. Thus, in the

[12] As I present later, the *potential demand shifters*, which play an important role in capturing the local market size, are not correlated between a plant's and its CAO's locations.

theoretical model, I assume that the marginal cost is the same across geographical areas. In the estimation, these effects are controlled by population.

Supplier j maximizes π_j w.r.t. q_j. The first order condition (FOC) for this maximization is:

$$\frac{\partial \pi_j}{\partial q_j} = P(\frac{Q}{N\theta}) + P'(\frac{Q}{N\theta})\frac{q_j}{N\theta} - a = 0. \tag{7}$$

For simplicity, let us assume symmetry among the suppliers; $q_j = q = \frac{Q}{M}\ \forall j$. Substituting q for q_j in (7), p is solved as a function of M:[13]

$$p = p(M). \tag{9}$$

The typical solution for the Cournot oligopoly tells that as there are more suppliers in a market, the price approaches the marginal cost a.

The number of service suppliers M is determined in Stage 1, in which potential suppliers decide to enter production if their anticipated profits in Stage 2 exceed the sunk cost of entry α. Under the assumption of symmetry, M is determined by the zero-profit condition:

$$\pi = (p - a)\frac{Q}{M} = \alpha. \tag{10}$$

From (6), (7), and (10), the equilibrium number of suppliers M^* is solved as a function of potential demand attributes, θ and N. Using (9), the equilibrium price is also solved as a

[13]Let R stand for the second derivative of π_j w.r.t. q_j. From (7), the second order condition (SOC) is satisfied as long as $R = 2\frac{P'}{N\theta} + \frac{P''}{(N\theta)^2}q < 0$. To ensure well-behaved outcomes, I also assume the following condition which ensures that marginal revenue facing supplier j is steeper than the demand function (Long and Soubeyran [16]): $2\frac{P'}{N\theta} + \frac{P''}{(N\theta)^2}q < \frac{P'}{N\theta}$, that is simplified as

$$MP' + \frac{P''Q}{N\theta} < 0. \tag{8}$$

Note also that, in a more general case where the price elasticity of the demand changes with θ and N, p is solved as a function of M, θ, and N.

function of θ and N:

$$p = p^*(\theta, N). \tag{11}$$

Equilibrium Price at the CAO Location: Then, how is the price determined at the market surrounding plant i's CAO? Analogous to the process described above, the market price at CAO_i's location is determined by two potential demand attributes in the CAO's city. These attributes are the demand shifter and the number of plants in the market surrounding the CAO, and I denote them by $\tilde{\theta}$ and $\tilde{N}$, respectively. Let us denote the market price which CAO_i faces by $\tilde{p}$. Analogous to (11), $\tilde{p}$ is written as a function of $\tilde{\theta}$ and $\tilde{N}$:

$$\tilde{p} = p^*(\tilde{\theta}, \tilde{N}). \tag{12}$$

In principle, the number of all business establishments, including CAOs who require services, as well as the intensity of their use of the service would influence the market price of the service. How I deal with this issues in empirical testing is explained in Section 4.1. (See also footnote 16.)[14]

Comparative Statics In this section, I show how the equilibrium value for a plant's probability of outsourcing is changed by the local market size at both the plant's and its CAO's locations. Note that it is not feasible to empirically test the effect of the number of suppliers M on the probability of outsourcing. Since M is jointly determined with the probability of outsourcing, M will be correlated with the error term with respect to a presence of fixed

[14] A CAO's purchase of the service could be a very small fraction of the total service transacted in the city. For example, Davis [6] shows that, even in New York City, total legal services purchased by N.Y. auxiliaries (which includes CAOs) in 1992 accounts for only 3.6% of all service receipts by law firms in the city. For accounting services, it is only 1.6%.

effects specific to a local market.[15] Therefore, I use the exogenous variables, θ and N, which determine the level of potential demand, and examine how these local potential demand attributes at a plant's and its CAO's locations influence the plant's probability of outsourcing. Note also that, it is important to distinguish the effect of θ ($\tilde{\theta}$) from those of N ($\tilde{N}$). Because, as opposed to N ($\tilde{N}$), which is measured by county population in the empirical section, the potential demand shifter (θ) will be calculated for each of four services and will more narrowly connect the local market scale to a plant's outsourcing decision for a specific service.

From the previous section, under the assumption of symmetry, we know that (6), (7), and (10) must be met in equilibrium. First, in order to evaluate the impact of θ on the equilibrium price, I totally differentiate the system ((6), (7), (10)) w.r.t. p, q, M, and θ, and use Cramer's law, which yields the following expression:

$$\frac{dp^*}{d\theta} = \frac{\alpha^2}{\theta q^{*\,3} R}, \tag{13}$$

where q^* is the equilibrium output level of a supplier and R is the second derivative of π_j w.r.t. q_j. Since R is negative as long as the SOC holds, $\frac{dp^*}{d\theta} < 0$. Because of symmetry between θ and N in the model, (13) also implies that $\frac{dp^*}{dN} < 0$. Unlike the typical positive effect of the demand upward shift on the price level, in my model, demand increase through θ and N attracts more service suppliers and enhances the competition among them, resulting in lower local market price. From (3), the lower market price at a plant location, p, increases

[15] The state of the local transportation system is one example of such fixed effects. A better local transportation system might enhance communication between demanders and suppliers and encourage outsourcing, which would attract more service suppliers. The better transportation system at a CAO's location might also encourage a firm to decide to outsource at the CAO's location as well as increase the number of suppliers there, which will lead to a superficial (negative) relationship between the market scale at the CAO's location and the plant's outsourcing probability.

the plant's probability of outsourcing.

Now, let us examine how a plant's probability of outsourcing is affected by the exogenous increase in the local demand in the market where the plant's CAO is located. Analogous to the relationship between θ (or N) and the market price at a plant's location, greater θ and/or N at a CAO location lowers the market price in that local market. From (3), this will make the plant more likely to rely on the CAO for procuring the service, and decreases the probability that the plant will outsource the service from its own local market, which I test in Section 5.[16]

3 Data

I use plant-level data from the *ASM* compiled in 1992, the first year when data on the outsourcing of white-collar services were collected. While the *Census of Manufactures* canvases every manufacturing plant with a limited set of questions, the *ASM* is a sample survey from that plant population asking a longer set of questions. Out of the plants in the *ASM* sample, I choose those whose data are not subject to imputation. I also focus on plants in the contiguous, continental U.S. states; this leaves us 45,144 plants.

I supplement these data with the *1992 Survey of Auxiliary Establishments* (*SAE*), which provides information on CAOs. The *SAE* collects data on supporting establishments, which perform services for other establishments of the same company rather than for other companies. This survey is essentially a population survey and inquiries are sent to all auxiliary establishments of multi-plant firms in the U.S Economic Census. The survey provides a va-

[16]Mathematically, we can write

$$\frac{dPr^{os}}{d\tilde{\theta}} = \frac{\partial Pr^{os}}{\partial \tilde{p}} \frac{d\tilde{p}}{d\tilde{\theta}} < 0. \tag{14}$$

riety of information, such as establishment location, employment by function, and so forth. The survey also specifically asks about the principal activity of each auxiliary establishment, which includes central administration, data-processing, R&D, warehousing, trucking, and so on. Included in this paper as CAOs are those which indicated their principal activity as central administration.

Using the common firm identifier in the *ASM* and the *SAE*, I link the *ASM* plants to the CAOs which belong to the same parent firm. Since the *SAE* covers essentially the population of auxiliary establishments, merging it with the *ASM* sample will enable us to categorize the *ASM* plants depending on whether there are affiliated CAOs. As shown in Table 1, of 45,144 *ASM* plants (spread over 2,500 counties), 14,321 plants (31.7%) are single-plant firms, which I call *non-affiliate* plants. The rest, 30,823 plants (68.3%), are *affiliate plants*, which belong to multi-establishment firms. Of those *affiliate plants*, 19,788 plants have one or more CAOs in the same firm. For these plants with CAOs, we can also identify each CAO's location based on the *SAE*. This allows us to control for the market conditions at a CAO location in the estimation.

In Table 2, I show the geographical relationship between plants and CAOs. Of 19,788 *ASM* plants that have CAOs, most have CAOs in different counties, with many CAOs more than 250 miles away. This suggests that most plants face different local market conditions, and therefore different local market prices of services, than their CAOs. In what follows, I use county as the definition of a local market.[17]

[17]Using county instead of PMSA, I could increase the number of geographical units nearly 10 times. This provides more variability in my measure of the local market scale. The significant coefficients obtained for the measure created at county-level also prove that the clustering of business activities within a county matters for a plant's choice of outsourcing. Note, however, that analyses at PMSA-level were performed for the model presented in Ono [20], in addition to the county-level analyses. The qualitative results were not

Table 1: ASM plants by organizational structure

	Number of Plants
Total	45,144
Affiliate Plants	30,823
Plants with CAOs	19,788

Source: Author's calculations based on data from *LRD* and the *SAE*

Table 2: ASM plants and CAOs location

	Number of Plants
Plants with CAOs	19,788
Plants with all CAOs in different counties	16,998
Plants with CAOs 250+ miles away	9,151

Source: Author's calculations based on data from *LRD* and the *SAE*

Outsourcing Propensities: Next I report the outsourcing propensity of the plants in our sample. Using the *1992 ASM*, I employ the observed cost of outsourcing in determining whether a plant outsources a given service.[18] As shown in Table 3, outsourcing propensities differ significantly, depending on whether or not a plant has a CAO. The percentage of plants which outsource by themselves is smaller for those which have CAOs, and greater for those which do not have CAOs. This supports the view that CAOs play a significant role in procuring services for their plants.[19]

different between two cases.

[18]Plants are asked to report the costs of each service purchased from other *companies* that are paid *directly* by this establishments. Note that when we observe that some amounts are outsourced, it is possible that a plant also performs a fraction of the service in-house and/or asked the CAO to perform. Assuming that the fraction is exogenously determined, this will not qualitatively affect the main results of the estimation.

[19]Note also that the outsourcing decision of plants varies within a firm. For example, of the firms with five ASM plants in the sample, the fraction of those within which all plants outsource was .18.

Table 3: Percentage of Plants which Outsource

	Total	Plants with CAOs	Plants without CAOs
Number of plants	45,144	19,788	25,356
Advertising	.51	.37	.61
Bookkeeping and Accounting	.45	.16	.67
Legal Services	.52	.38	.63
Software and Data-Processing	.46	.45	.47

Source: Author's calculations based on data from *LRD* and the *SAE*

4 Empirical Implementation

In this section, I derive the empirical model to test my hypotheses. Since we observe only whether or not a plant directly outsources by itself, we rely on equation (3) for empirical testing. Using (11) and (12), assuming the linearity between variables and using standardization over the random components specified in (1) and (2), we can rewrite the probability that plant i outsources from its local market (see (3)) as follows:

$$\begin{aligned} Pr_i^{os} &= P_{1i}P_{2i}, \qquad (15) \\ \text{where } P_{1i} &= \Phi[(1, \theta, N, A_i)\boldsymbol{\beta}], \\ P_{2i} &= \Phi[(1, \theta, N, \tilde{\theta}, \tilde{N})\boldsymbol{\tau}], \end{aligned}$$

and $\boldsymbol{\beta}$ and $\boldsymbol{\tau}$ are vectors of coefficients. Note that $\boldsymbol{\theta}$, $\boldsymbol{N}$, $\tilde{\boldsymbol{\theta}}$, and $\tilde{\boldsymbol{N}}$ are county level variables. In the above equation, $\boldsymbol{P_{1i}}$ represents the probability that plant $\boldsymbol{i}$ chooses to directly outsource instead of performing the service in-house, and $\boldsymbol{P_{2i}}$ represents the probability that plant $\boldsymbol{i}$ chooses to directly outsource instead of depending on its CAO. As discussed in Section 2, we expect the coefficients for $\boldsymbol{\theta}$ to be positive and those for $\tilde{\boldsymbol{\theta}}$ to be negative. Allowing the variances of $\boldsymbol{u}$ and $\boldsymbol{\epsilon}$ in (1) and (2) to be different, the coefficients of $\boldsymbol{\theta}$ and $\boldsymbol{N}$ in $\boldsymbol{P_1}$ are different from those in $\boldsymbol{P_2}$, but only in scale.

As for plant characteristics, I control for plant size, age, industry and affiliation type. I measure plant size by *Beginning-of-Year Asset*, which is determined before the decision is made and is therefore considered exogenous, at least in the short run. Plant age is calculated based on the first year a plant started the current business. Both plant size and age are in logarithmic form. Industry is controlled by 2-digit SIC industry dummies. Another dummy is used to control for affiliation type.

For $\boldsymbol{N}$ and $\tilde{\boldsymbol{N}}$, I use population of counties where plant $\boldsymbol{i}$ and $\boldsymbol{CAO_i}$ are located, respectively. Note that in the theoretical model where I assumed all plants are identical, $\boldsymbol{N}$ ($\tilde{\boldsymbol{N}}$) stands for the number of plants. However, considering that plant size is different in reality, the use of population should capture total demand more realistically.

Note that plants in the data set often have multiple CAOs. Of all the CAOs in a firm, however, the CAO which influences a plant's outsourcing decision about a given service would be the one which is located in a city with a market price lower than that of other CAOs. To select such a CAO, based on (11) and coefficients estimated for $\boldsymbol{\theta}$ and $\boldsymbol{N}$ in Ono [20], I choose the CAO which has the lowest inferred market price among all CAOs in the same firm.

Note also that, instead of limiting the sample only to plants with CAOs, I used all 45,144 plants include plants without CAOs; this will increase the efficiency of parameters commonly estimated for all categories. For such plants, $\boldsymbol{P_2}$, the probability that a plant chooses local outsourcing instead of relying on CAOs, is set to $\mathbf{1}$. I also assume $\boldsymbol{P_2}$ to be 1 for plants whose selected CAOs are in the same county as the plants.[20]

[20] Of 19,788 plants that have CAOs, the number of those that have a selected CAO in the same counties are about 1,400.

Based on (15), the likelihood function is written as

$$\ln L = \sum_{i \in B} [\ln P_{1i} P_{2i} * Y_i + \ln(1 - P_{1i} P_{2i}) * (1 - Y_i)] + \sum_{i \in C} [\ln P_{1i} * Y_i + \ln(1 - P_{1i}) * (1 - Y_i)], \tag{16}$$

where B stands for the group of plants which have CAOs in different counties, and C stands for all other plants. Y_i is an indicator variable which equals to 1 if plant i directly outsources the service, and 0 otherwise.

4.1 Index for θ

Here, I summarize how I measure θ for each county. In Ono [20], I showed that the demand shifter θ is a cost share parameter of the underlying Cobb-Douglas production function. The cost share parameter represents the intensity of the use of the service, which is likely to be different across industries. Thus, in order to calculate the demand shifter of a particular county, I take the average of the intensity of the use of a service over local industries with share of industry as a weight.

More specifically, let γ_l stand for the cost share of a given service of industry l at a *national level*, and σ_{kl} the share of industry l in the total output of final producers in county k. Following Ono [20], with the assumption of Cobb-Douglas production function, θ in county k, which I denote by θ_k, is constructed as

$$\theta_k = \sum_l \gamma_l \sigma_{kl}. \tag{17}$$

Since the use of a service differs across industries, different industrial composition across counties produces different intensities of the use of a service.[21] Note that $\tilde{\theta}$ is θ of the county where the CAO is located.

[21] Ono [20] provides a table which shows industrial composition differs across U.S. counties.

To calculate $\boldsymbol{\theta}$, it would be ideal to take all industries' potential requirements of a service into consideration. However, since cost data for services, which allow me to calculate share parameters, are available only from the data on manufacturing industries to this study, $\boldsymbol{\theta}$ is calculated based only on information of manufacturing sector. The exclusion of other industries does not change the qualitative result of the empirical estimation, as long as a service's cost share outside of the manufacturing sector is not systematically different from that of the manufacturers.[22]

Based on the cost data from the *1992 ASM*, I first calculate $\boldsymbol{\gamma_l}$ for each of 140 3-digit manufacturing industries. To obtain $\boldsymbol{\sigma}$, I calculate each manufacturing industry's share of county manufacturing production using the *Census of Manufactures* in the LRD data set. Then, to obtain $\boldsymbol{\theta}$ for each county, following (17), I take the weighted average of $\boldsymbol{\gamma}$ by using $\boldsymbol{\sigma}$ as a weight. Table 4 shows the summary statistics for potential demand shifters calculated for U.S. counties. The standard deviations of the potential demand shifters are quire large - as much as 30 to 49% of their means.

The plants in the sample are spread over 2,500 counties; this provides variation in $\boldsymbol{\theta}$ for the estimation. Moreover, CAOs of the ASM plants are distributed across more than 500 counties instead of being located in a few major cities, which would also provide variation in $\tilde{\boldsymbol{\theta}}$ and $\tilde{\boldsymbol{N}}$ for the estimation. Note that the correlation between $\boldsymbol{\theta}$ and $\tilde{\boldsymbol{\theta}}$ is quite small;

[22]More specifically, $\boldsymbol{\theta}$ can be written as $\boldsymbol{\theta} = \boldsymbol{\theta}(\boldsymbol{\theta^M}, \boldsymbol{\theta^S}, \boldsymbol{\theta^O})$, where $\boldsymbol{\theta^M}$ is the demand shifter of the manufacturing sector, $\boldsymbol{\theta^S}$ is the demand shifter of the service sector, $\boldsymbol{\theta^O}$ is the demand shifter of other sectors. Therfore,

$$\frac{d\boldsymbol{Pr^{os}}}{d\boldsymbol{\theta^M}} = \frac{\partial \boldsymbol{Pr^{os}}}{\partial \boldsymbol{\theta}} \frac{d\boldsymbol{\theta}}{d\boldsymbol{\theta^M}}.$$

Since $\frac{d\boldsymbol{\theta}}{d\boldsymbol{\theta^M}} > \mathbf{0}$ as long as $\boldsymbol{\theta^S}$ and $\boldsymbol{\theta^O}$ are not systematically (negatively) correlated with $\boldsymbol{\theta^M}$. By examining the sign of $\frac{d\boldsymbol{Pr^{os}}}{d\boldsymbol{\theta^M}}$, we could also infer the sign of $\frac{\partial \boldsymbol{Pr^{os}}}{\partial \boldsymbol{\theta}}$ (how the probability of outsourcing changes with the demand shifters) based on all sectors.

Table 4: Variation in Potential Demand Shifters across Counties

All Counties (over 3,000 counties)		
	Mean	S.D.
Advertising	.0098	.0048
Bookkeeping & Accounting	.0044	.0016
Legal Services	.0040	.0012
Software & Data-Processing	.0024	.0010

Source: Author's calculations based on data from *LRD*

it is 0.0722 for advertising, 0.0306 for bookkeeping and accounting, 0.1081 for legal services, and 0.0546 for software and data-processing services. This precludes the possibility of multicollinearity in estimating the parameters in (15). Note also that in Ono [20], I also examined how $\boldsymbol{\theta}$ correlates with the number of suppliers. I regressed the number of suppliers on $\boldsymbol{\theta}$ and $\boldsymbol{N}$ for each of the four services.[23] $\boldsymbol{\theta}$ obtained positive and significant coefficients, which justifies my use of $\boldsymbol{\theta}$ in capturing the effect of local market scale.

5 Empirical Results

Table 5 presents the results of the estimation. As discussed in Section 4, note that the coefficients of $\boldsymbol{\theta}$ and $\boldsymbol{N}$ in $\boldsymbol{P_1}$ must be proportional to those in $\boldsymbol{P_2}$. I performed the estimations both with and without the restriction. For all four services, however, the likelihood ratio tests suggest the structure is the same for both constrained and unconstrained cases.[24] Here I present only the results from the unrestricted maximum likelihood analyses.[25] Notice that, as shown in Table 5, the result obtained for software and data-processing services is

[23]The data of the number of suppliers are provided in the *County Business Patterns.*

[24]The null hypothesis that coefficients of $\boldsymbol{\theta}$ and $\boldsymbol{N}$ in $\boldsymbol{P_1}$ are different from these in $\boldsymbol{P_2}$ only in scale passes the LM test at 10 % level.

[25]Note that I also performed the analysis by controlling for the distance between a plant and its CAO. However, the qualitative results for the variables of interest remained the same.

somewhat different from that of the other services in terms of the coefficients obtained for demand shifters. Below, I discuss each case separately.

Table 5: Effect of Local Market Surrounding CAO

Dependent Variable=1 if a plant outsources a service

		Advertising	Bookkeeping and Accounting	Legal Services	Software and Data-Processing
P_1	$\boldsymbol{\theta}$	4.835**	17.534*	39.205***	24.330**
		(2.49)	(1.70)	(4.47)	(2.30)
	$\boldsymbol{N}$	.015***	.0434***	.0419***	.063***
		(3.06)	(7.85)	(8.11)	(11.45)
	Plant Size	.107***	.065***	.237***	.252***
		(32.40)	(12.53)	(46.79)	(53.88)
	Plant Age	.240***	.244***	.237***	.131***
		(22.63)	(21.20)	(21.47)	(13.26)
	Dummy: Affiliate Plant	-.204***	-.792***	-.383***	-.163***
		(-11.48)	(-41.93)	(-20.47)	(-9.58)
Influence of the Location of a Selected CAO					
P_2	$\boldsymbol{\theta}$	6.313	41.925**	55.414***	75.112**
		(1.61)	(2.21)	(3.79)	(2.19)
	$\boldsymbol{N}$	.114***	.067***	.036***	.013
		(11.26)	(6.75)	(3.87)	(.74)
	$\tilde{\boldsymbol{\theta}}$	-9.800***	-52.699***	-93.837***	54.824***
		(-4.55)	(-3.62)	(-6.86)	(3.20)
	$\tilde{\boldsymbol{N}}$	-.011	-.020	-.015	.0863***
		(-.83)	(-1.61)	(-1.18)	(4.26)
	Likelihood Ratio	2.53	0.18	0.72	2.53

Source: Author's calculations based on data from *LRD* and the *SAE*
( ): Z-statistics
$*$: Significant at **10**% Level
$**$: Significant at **5**% Level
$***$: Significant at **1**% Level
Note: industry (2-digit SIC) dummies are also included to control for these variables.

Advertising, Bookkeeping and Accounting, and Legal Services: For these three services, $\tilde{\boldsymbol{\theta}}$ obtained positive and significant coefficients, which is consistent with my hypothesis. In addition, while they appear insignificant, the coefficients of $\tilde{\boldsymbol{N}}$ have the expected sign. Recall that $\tilde{\boldsymbol{\theta}}$ and $\tilde{\boldsymbol{N}}$ are both negatively associated with the market price at the CAO location. Thus, the result suggests that, for these three services, the lower the market price that a CAO faces the more likely a plant is to have its CAO outsource the services. Given the size of the market at a plant's location, the greater scale of the market surrounding the CAO makes it more cost effective to outsource services at the CAO location.

Note that, in contrast to $\tilde{\boldsymbol{\theta}}$ and $\tilde{\boldsymbol{N}}$, both $\boldsymbol{\theta}$ and $\boldsymbol{N}$ of a plant's location have negative signs, which are again consistent with my hypothesis. A plant's probability for a local outsourcing increases with the size of its own local market and decreases with the size of the market surrounding its CAO. Plants benefit from agglomeration economies in both their own and their CAO's localities. Recall that, by definition given in (17), the potential demand shifter represents the intensity of the use of a service averaged over the industries in a market. Therefore, the statistically significant coefficients obtained for both $\boldsymbol{\theta}$ and $\tilde{\boldsymbol{\theta}}$ indicate that a plant's outsourcing decision is influenced by the industrial composition not only of its local market but also of its CAO's. High concentration of industries that require intensive use of a given service will attract more suppliers and lower the market price of the service. Through intra-firm linkage, a plant can enjoy the concentration of such industries in both its CAO's locality and its own.

Based on Table 5, I calculate the elasticities of the probability of a plant's direct outsourcing w.r.t. $\tilde{\boldsymbol{\theta}}$ and $\boldsymbol{\theta}$. Differentiating $\boldsymbol{Pr^{os}}$ w.r.t $\tilde{\boldsymbol{\theta}}$ and $\boldsymbol{\theta}$ in (15), I obtain:

$$\frac{\partial \boldsymbol{Pr^{os}}}{\partial \tilde{\boldsymbol{\theta}}} = \boldsymbol{\Phi_1}[(\mathbf{1}, \boldsymbol{\theta}, \boldsymbol{N}, \boldsymbol{A})\boldsymbol{\beta}]\boldsymbol{\phi_2}[(\mathbf{1}, \boldsymbol{\theta}, \boldsymbol{N}, \tilde{\boldsymbol{\theta}}, \tilde{\boldsymbol{N}})\boldsymbol{\tau}]\boldsymbol{\tau_{\tilde{\theta}}} \tag{18}$$

$$\begin{aligned} \frac{\partial \boldsymbol{Pr^{os}}}{\partial \boldsymbol{\theta}} &= \boldsymbol{\Phi_1}[(\mathbf{1}, \boldsymbol{\theta}, \boldsymbol{N}, \boldsymbol{A})\boldsymbol{\beta}]\boldsymbol{\phi_2}[(\mathbf{1}, \boldsymbol{\theta}, \boldsymbol{N}, \tilde{\boldsymbol{\theta}}, \tilde{\boldsymbol{N}})\boldsymbol{\tau}]\boldsymbol{\tau_{\theta}} \\ &+ \boldsymbol{\Phi_2}[(\mathbf{1}, \boldsymbol{\theta}, \boldsymbol{N}, \tilde{\boldsymbol{\theta}}, \tilde{\boldsymbol{N}})\boldsymbol{\tau}]\boldsymbol{\phi_1}[(\mathbf{1}, \boldsymbol{\theta}, \boldsymbol{N}, \boldsymbol{A})\boldsymbol{\beta}]\boldsymbol{\beta_{\theta}}. \end{aligned} \tag{19}$$

Based on these expressions, I calculate the elasticities presented in Table 6. These numbers are evaluated at the mean of the characteristics of 19,788 plants with CAOs, which are summarized in Appendix A. In Table 6, $\hat{\boldsymbol{Pr_1}}$ is the hypothetical outsourcing probability if a plant did not have a CAO. $\hat{\boldsymbol{Pr}}^{\boldsymbol{os}}$ is the predicted outsourcing probability, taking into account that a plant actually has a CAO. $\hat{\boldsymbol{Pr}}^{\boldsymbol{os}}$ is much smaller than $\hat{\boldsymbol{Pr_1}}$, reflecting the fact that a CAO plays a significant role in sourcing services. For advertising, the probability drops by as much as 27 percentage points, for bookkeeping and accounting, 38 points, and legal services, 30 points. The numbers in the last two rows show the elasticities of $\hat{\boldsymbol{Pr}}^{\boldsymbol{os}}$ w.r.t. $\tilde{\boldsymbol{\theta}}$ and $\boldsymbol{\theta}$, respectively. Doubling the intensity of use of a service at a CAO location decreases a plant's likelihood of outsourcing by 10% to 34. Doubling the intensity of use of a service at a plant location increases a plant's likelihood of outsourcing by 8% to 24. For example, suppose there are two plants A and B with average characteristics, located in the same city, but with CAOs in different cities. If, in plant A's CAO's locality, the intensity of use of advertising services is twice as large as that in plant B's CAO's locality, then plant A's probability to directly outsource advertising in its own locality is lower than that of plant B by 10%. However, the outsourcing probabilities for both plants A and B are increased by 8% if the intensity of use of advertising is doubled in their own city.

Table 6: Effect of $\boldsymbol{\theta}$ and $\tilde{\boldsymbol{\theta}}$ on the Probability of Outsourcing

	Advertising	Bookkeeping and Accounting	Legal Services
$\hat{\boldsymbol{Pr_1}}$	0.64	0.54	0.70
$\hat{\boldsymbol{Pr}}^{\boldsymbol{os}}$	0.37	0.16	0.40
Elasticity w.r.t. $\tilde{\boldsymbol{\theta}}$	-.104	-.307	-.335
Elasticity w.r.t. $\boldsymbol{\theta}$	.076	.26	.24

Source: Author's calculations based on data from *LRD* and the *SAE*

Software & Data-Processing Services: Let us now examine the result obtained for software and data-processing services. From Table 5, we can see that the coefficient for $\tilde{\boldsymbol{\theta}}$ and $\tilde{\boldsymbol{N}}$ obtain positive and significant coefficients, suggesting that, for software and data-processing services, the lower the market price a CAO faces, the more likely it is that a plant will outsource the service by itself instead of relying on the CAO. This is contrary to my hypothesis. One might suspect that this was caused because some data-processing performed at CAOs might have been reported by a plant. However, the inquiry that the Census Bureau sent out to each plant clearly asked the plant to exclude the services provided by other establishments of the same company, including a separate central data processing unit. I performed the same estimation while controlling for whether a plant has a separate data-processing center in addition to CAOs. The result, however, was qualitatively the same.

It could be the case that the costs reported by plants include the significant amount of costs spent to purchase software and computer-programming services which directly help their manufacturing. Examples of such purchases are computer-aided design (CAD), computer-aided engineering (CAE), computer-aided manufacturing (CAM), digital data representation, flexible manufacturing system, technical data network and so forth. When a plant requires new manufacturing software, the plant will also require its employees (software users) to be trained by a software vendor so that they can implement the new software.

For training purposes, it would be convenient for a plant to deal with local suppliers who are more accessible than those who are in the market surrounding its CAO. In such a case, when a CAO learns the market price is low, it would just advise its plant to outsource the service instead of performing it in-house. Such effects could in principle also exist for advertising, bookkeeping and accounting, and legal services. The result shows that, however, for these three services, the effect that the lower market prices of a CAO make the CAO outsource these services for its plants, dominates the effect that a CAO advises plants to outsource.

Summary of the Effects of Other Plant Characteristics: Finally, I summarize some interesting findings on the effects of plant size and plant age shown in Table 5. While it is not a focus of this paper, further examination of these attributes would make interesting future research.

For plant size, I obtain positive and significant coefficients. As discussed in Ono [20], this indicates the possible existence of scale economies in outsourcing services, which probably arise from fixed costs in service transactions and the searching process for compatible suppliers.

The coefficients for plant age are also positive and significant even after controlling for plant size. This indicates that older plants have a relative advantage in outsourcing services. While this might just reflect the possibility that older plants renew their outsourcing contracts, it also suggests that younger plants face difficulties in finding compatible suppliers.

6 Conclusion

While many firms have CAOs which deal with management and administration of firms, little empirical testing has been performed to identify their influence on total efficiency of firms. In this paper, I examine one aspect of the CAOs role and provide empirical evidence that a CAO helps its plants source services inexpensively. In particular, by examining manufacturing plants' decisions to outsource business services and how those decisions are influenced by local market conditions surrounding a CAO, I find that, for advertising, bookkeeping and accounting, and legal services, the lower the market price to which the CAO has access, the more likely it is for a plant to rely on the CAO in outsourcing services.

I use industrial composition to construct an index to capture the market price in local markets. The results show industrial composition has significant impact in determining the market price of service. Moreover, it is shown that not only the industrial composition surrounding the plant but also the composition surrounding the CAOs are important for cost effectiveness of the plant. In particular, this result suggests that, when a CAO is located in the city with industries which use a given service intensively, suppliers of that service will be attracted into the city, and lower the market price that the CAO faces. Through the intra-firm provision of services from CAOs to plants, the lower market price at the CAO location will benefit plants located elsewhere.

The empirical finding of this study can be also interpreted as the result of a firm's choosing its CAO's location so that the CAO can better serve the rest of the firm by sourcing services inexpensively. The choice of the CAO's location might be important, especially when locations of operating plants are restricted by factors such as proximity to the consumer market and accessibility to resources. Having a CAO which specializes in supporting the rest of a firm might enable the firm to take advantage of a wider range of intermediate service markets and thus to overcome the limited choices of the location for operating plants.

Then, what are the variables which make a firm decide whether or not to separate business administration from operation? How does a firm's size, industrial type, and the number of plants influence such decisions? Examination of these topics would require a model in which a “firm” is an explicit decision maker which simultaneously chooses both the CAO and the plant location and where to outsource services. Such research is important for a greater understanding of the role of CAOs as well as understanding various phenomena such as geographical concentration and the relocation of headquarters to suburban areas,[26] as well as location decisions of business service industries.[27] Studying CAOs would also provide insight into the role of other supporting establishments such as research & development, data-processing, and trucking services, and how the location of these establishments influences the efficiency of the overall firm. These will be investigated in future research.

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[26]See Aksoy and Marshall [3], Brecher et al. [4], Rogerson [21], Semple et al. [22], and Semple and Phipps [23]

[27]See Kolko [15].

Appendix

A Selected Services included in the *1992 ASM*

	mean	s.d.
ln (Beginning-of-year asset (thou.))	8.9	1.8
ln (County population)	12.2	1.6
ln (Age)	2.8	.7

These numbers are calculated for the sample of 19,788 plants with a CAO

References

[1] K. G. Abraham and S. K. Taylor. "Firms' Use of Outside Contractors: Theory and Evidence", *Journal of Labor Economics*, 14(3), July 1996, pp.394–424, 1996.

[2] H. Abdel-Rahman and M. Fujita. "Product Variety, Marshallian Externalities, and City Sizes", *Journal of Regional Science*, Vol.30, No.2, pp.165–183, 1990.

[3] A. Aksoy and N. Marshall. "The Changing Corporate Head Office and its Spatial Implications", *Regional Studies*, Vol. 26.2, pp.149–162, 1992.

[4] C. Brecher, R. Cohen, M. Drennan, E. Ginzberg, and T. Stanback. "The Corporate Headquarters Complex in New York City", The Conservation of Human Resources Project, Columbia University, December 1977.

[5] A. Ciccone and R. E. Hall. "Productivity and the Density of Economic Activity", *American Economic Review* Vol.87, No.1, pp.54–70, 1996.

[6] J.C. Davis "Headquarters, Localization Economies and Differentiated Service Inputs," Brown University mimeo, 2000.

[7] E. Glaeser, H. D. Kallal, J. A. Scheinkman, and A. Shleifer "Growth in Cities", *Journal of Political Economy*, Vol.100, Issue.6, Centennial Issue, pp.1126–1152. 1992.

[8] M. Fujita and M. Ota. "Communication technologies and spatial organization of multi-unit firms in metropolitan areas", *Regional Science and Urban Economics*, Vol.23, pp.695-729. 1993.

[9] Z. Grilliches and D. Siegel. "Purchased Services, Outsourcing, Computers, and Productivity in Manufacturing", in Zvi Griliches ed.,*Output Measurement in the Service Sectors*, The University of Chicago Press. 1992.

[10] J. V. Henderson. "Efficiency of Resource Usage and City Size", *Journal of Urban Economics*, Vol.19, pp.47–70, 1986.

[11] S. R. Holloway and J. O. Wheeler. "Corporate Headquarters Relocation and Changes in Metropolitan Corporate Dominance, 1980-1987", *Economic Geography*, Vol.67, No.1, pp.55-72, 1991.

[12] T. Holmes. "Localization of Industry and Vertical Disintegration", In *Federal Reserve Bank of Minneapolis Research Department Staff Report* 190. 1995.

[13] W. J. Howe. "The business services industry sets pace in employment growth", *Monthly Labor Review*, April 1986.

[14] T. N. Hubbard. "Contractual form and market thickness in trucking", *RAND Journal of Economics*, Vol.32, No.2, Summer 2001, pp.369-386

[15] J. Kolko. "Can I Get Some Service Here?: Transport Costs, Cities, and the Geography of Service Industries", 1999.

[16] N. V. Long and A. Soubeyran. "Existence and Uniqueness of Cournot Equilibrium: a Contraction Mapping Approach", *Economic Letters*. 2000, Vol.67, pp.345-348

[17] J. Mike. *Outsourcing in brief*, 1997, Butterworth-Heinemann

[18] R. L. Moomaw. "Productivity and City Size: A Critique of the Evidence", *The Quarterly Journal of Economics*, November, pp.675–688. 1981.

[19] J. D. Murphey. "Business Contracting-Out Practice: Evidence from a BLS survey", presented at the Eastern Economic Association Meetings, March 3-5, 1989.

[20] Y. Ono. "Outsourcing Business Services, the Scope of Local Markets, and Agglomeration Economies", 2001, Working Papers Series WP-01-09, Federal Reserve Bank of Chicago

[21] C. M. Rogerson. "Dispersion within concentration: The changing location of corporate headquarter offices in South Africa", *Development Southern Africa*, Vol 13. No 4. August, 1996.

[22] R. K. Semple, Diane J. F. Martz, and M.B. Green. "Perspective on Corporate Headquarters Relocation in the United States," Urban Geography, Vol.3, pp.258-79, 1982

[23] R. K. Semple and A. G. Phipps. "The Spatial Evolution of Corporate Headquarters within an Urban System," *Urban Geography*, Vol.6, pp.370-91, 1985

[24] L. Shilton and J. R. Webb. "Headquarters, Office Employment, and the Wave of Urbanization in the New York City Region", *Journal of Real Estate Finance and Economics*, Vol.10, pp.145-159, 1995.

[25] L. Shilton and C. Stanley. "Spatial Patterns of Headquarters", *Journal of Real Estate Research*, Vol 17, pp.341-364, 1999

[26] U.S. Census Bureau, the *1997 County Business Patterns*

[27] U.S. Census Bureau, the *1990 Census of Population*

[28] U.S. Census Bureau, the *1992 Enterprise Statistics*

[29] U.S. Census Bureau, Longitudinal Research Database (LRD). Confidential data set maintained by the U.S. Census Bureau's Center for Economic Studies. The LRD may be used only at secure Census Bureau facilities by researchers with approved projects. For more information, see http://www.ces.census.gov.

[30] U.S. Census Bureau, Survey of Auxiliary Establishments. Confidential data set maintained by the U.S. Census Bureau's Center for Economic Studies. The Survey of Auxiliary Establishments may be used only at secure Census Bureau facilities by researchers with approved projects. For more information, see http://www.ces.census.gov.

[31] U.S. Census Bureau, Statistical Abstract 1997

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