

The Economic Role of Small Businesses Using Large Data Sets: An Analysis of the Contribution of Small Firms to Urban Growth

by

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for



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Purpose

In the past, large cities were primarily characterized by downtown centers of employment. Recent decades, however, have seen a proliferation of employment subcenters in areas outside of downtown. The rise of urban employment subcenters also coincides with a revitalization of major cities in the U.S. Thus, the role of small businesses in the formation, maintenance, and growth of employment subcenters provides an excellent window for observing the relative role of small and large firms in economic development.

The research described in this project contributes important new understanding of the role of small businesses in economic growth. It looks at the economic development of different parts of one large city (Houston, Texas) and seeks to determine whether large firms are a significant cause of urban economic growth, or alternatively, whether small firms perform a key role. This is a difficult question because if small firms are successful, they become large. Specifically, the authors examine the current level of employment decentralization in Houston as firms balance agglomeration economies with congestion costs. The authors look at the various employment centers in Houston and their differing levels of development in an attempt to infer how the role of small business changes between the older and well-established centers compared to the newer and emerging subcenters of employment.

Overall Findings

Small firms play a vital role in maintaining economic growth in urban areas. The authors find that small businesses compete effectively with large firms

for land near the employment centers. While large firms are more likely to be in employment centers in the central business district and more established subcenters surrounding downtown, firm size is less important for newer and emerging subcenters that are farther from downtown.

Highlights

- Recent research has identified six to eight employment centers in the Houston metropolitan region. In addition to the central business district (CBD) downtown, the subcenters are: the Galleria, Carillon, Greenspoint, Clear Lake, Baytown, LaPorte, and Pasadena.
- Large firms, which are defined in this analysis as being firms more than 45 employees, are significantly more likely to locate in the CBD than elsewhere. Over 84 percent of the employees in the CBD work for large firms.
- In terms of location within the subcenters, large firms are more likely to locate within the Galleria area (sometimes referred to as “Uptown”), which has the largest employment of the subcenters, but small and large firms are equally likely to be within a three-mile radius of an employment center. In addition, there is little evidence that large firms are more likely than small firms to locate actually within the emerging subcenters in Houston.
- Agriculture, mining (which in Houston includes the petrochemical industry), and wholesale trade are the only industries that are less likely to concentrate in a subcenter.
- While not decisive, the results are consistent with the view that small firms may be centrally important for urban development. As a subcenter

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gains momentum and success, small firms might grow relatively quickly. While larger firms are more likely to be within the actual employment center, it is entirely plausible that these large firms were once small entities that grew due to their success.

Scope and Methodology

In this analysis, a small firm is defined as one with 45 employees or less. The authors attempted varying definitions, including cut-offs at 25 and 60 employees. The empirical results were virtually similar.

The authors use data from Dun & Bradstreet (D&B), which contains information on 123,313 individual business establishments in the Houston metropolitan area. The D&B data is from 1990 and is matched to census information from the same year. The authors use Geographic Information System (GIS) address matching to successfully locate 101,600 of the firms and determine whether they are within one of the employment subcenters. Firms for which D&B reports unknown employment at a specific location are omitted, resulting in a data set with 63,134 individual firms. This process removes all zero-employee firms from the sample. The empirical results are essentially the same with zero-employee firms and without them. Hence, this study reports only the findings for the smaller, higher-quality data sample.

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ABSTRACT

The research in this paper empirically explores the importance of small businesses in fostering economic growth. We develop a unique data set for Houston, Texas that contains observations of over 63,000 individual firms and that has employee counts as well as location information matched to census data. The paper estimates two core urban models, bifurcated by large and small firms, examining how firms locate within and near not only the main central business district (CBD), but also the employment subcenters located around the Houston area. Our method is to compare how the relative location of large and small firms varies between the older and established centers of employment to the newly emerging employment subcenters by using the newer areas as proxies for the older areas prior to their development. The results of the paper show a clear distinction between the dominance of large firms in the CBD, and the oldest employment subcenter, the Galleria, compared to the newer areas. Further, we find that large firms are more likely to be found only in the CBD. Conversely, small firms are equally as likely as large firms to be found in the neighboring areas of the other subcenters. The results are mixed for the distribution of firm size within the subcenters themselves. Our other methodology, however, is informative in this regard. We find that a poly-centric density function, capturing the simultaneous influence of each of the employment subcenters on employment throughout the county, shows that small and large firms have equal effects on employment. We thus interpret this evidence to strongly suggest that small firms are a crucial element in urban economic development as their success is likely to lead to economic growth not only for the firm itself, but for the entire local economy.

I. Introduction¹

One of the outstanding research questions concerning economic development is the relative role played by large and small firms. On the one hand, many local and even state governments have engaged in highly visible and expensive competitions for select large industrial projects, which certainly conveys the idea that large firms are the engine of economic growth. On the other hand, a high proportion of net new job creation is known to be coming from small firms. The research we conduct here attempts to illustrate the relative role of large and small firms in an urban context. Specifically, we examine whether small businesses are important in developing and maintaining the concentrations of employment that characterize cities. In the past, large cities were primarily characterized by downtown centers of employment. Recent decades, however, have seen a proliferation of employment subcenters outside of the downtown area. The rise of urban employment subcenters also coincides with a revitalization of major cities in the U.S. Thus the role of small businesses in the formation, maintenance, and growth of employment subcenters provides an excellent window for observing the relative role of small and large firms in economic development.

Our analysis exploits the evolution of the urban economy into employment subcenters around the urban core in Houston, Texas. One of the cornerstones of our methodology is to use

¹ This research has benefited from financing by the U.S. Small Business Administration's Office of Advocacy under contract SBAHQ-04-Q-0023. We have benefited from data assistance by Xiahong Ju and Moe Kyaw Pyi Soe, from the comments of Chad Moutray from Advocacy and two anonymous readers. Finally, we wish to acknowledge the excellent research assistance of Jia-Huey Lin.

cross sectional differences to infer time series properties of urban development. Specifically, we determine the tendency of small firms to locate in or near the urban employment centers and separate this analysis between the well established employment centers and the newly emerging employment subcenters.² We compare differences in the role of small businesses that are observed in the established subcenters to those in the newly emerging subcenters in order to see how the role of small firms changes as subcenters mature. Secondly, we investigate the extent to which small and large firms are differentially attracted to employment center locations. The picture that emerges from these separate analyses is that small firms are very important to urban growth and development. In particular, small firms are at least as likely as large firms to locate in employment subcenters that are relatively new and only slightly less likely to be in older, well established centers. We interpret this as evidence that scale is not an impediment to small firms since they are more likely to grow when they can take advantage of the agglomeration economies attendant in employment concentrations.

Recent urban growth theory has found that modern cities are developing not primarily through growth of the traditional center city, but instead growth is occurring through development of employment subcenters, or mini-downtowns, outside of the traditional city center. This idea goes back to Fujita and Ogawa (1982), but there has been a lot of recent research into the phenomenon, for example see McMillen (2004), McMillen and Smith (2003), and Lucas and Rossi-Hansberg (2002). The question addressed by our research is whether large

² A note on terminology: We use the term “employment centers” to refer to all locations of concentrated employment which include the central business district (CBD) and outlying employment subcenters. The term “subcenters” refers to non-CBD employment centers.

firms are the main magnet that leads to the formation of employment subcenters, or whether instead small firms pursuing a diverse set of ideas leads to subcenter formation and growth. We accomplish this objective by examining differences between the traditional downtown area (the CBD) and the five primary employment subcenters in Houston. Clearly, one problem with looking at the role of small firms is that their size does not remain constant; if successful, they will grow. This is especially problematic in employment subcenters because the primary rationale for subcenters' formation and growth is agglomeration economies. Firms that experience reduced costs due to the proximity of other firms would be expected to grow, and thus, even if small firms were essential to subcenter formation, at some point in time they will be classified as large firms.³

The flip side of agglomeration economies, however, is that the firms' desire to be proximate to each other leads to congestion, which imposes new costs on firms. These costs certainly reduce the advantages of agglomeration and may even be sufficient to offset the advantages altogether (Garreau, 1991; Glaeser et al., 1992; Anas et al., 1998). As the city center becomes very dense, transportation becomes more difficult and costly, and land and office space becomes expensive. The market solution to this process is geographic dispersal. However,

³ The underlying theoretical rationale for the growth of employment subcenters is agglomeration economies. Agglomeration economies occur when a firm is able to reduce its costs because of the proximity to other firms. For example, if many firms in an industry locate together, each firm may benefit because it has access to experienced employees or suppliers. Further, there are opportunities for information and technological spillovers just from casual contact between employees. Similarly, customers of that industry are able to develop a good match between their needs and the products of firms. Finally, agglomeration economies may occur even by the clustering of firms in different industries, again due to information and technological spillovers. See Rosenthal and Strange (2004) for a review of the empirical evidence for agglomeration economies.

many firms still desire to locate together to capture the benefits of agglomeration economies. Thus, employment subcenters have sprouted in most major U.S. cities where firms cluster outside of the traditional downtowns. Further, in separate research we have found that the employment subcenters attract firms over a sizeable area (Craig and Ng, 1998; Craig and Kohlhase, 2005). The fundamental research question is, therefore, whether the growth of employment subcenters is determined primarily by large firms and whether small firms participate in the growth and support of the employment subcenters.

The employment centers we examine in Houston are quite varied in their stage of development. We perform our economic analysis for each center separately, and we develop alternative strategies to attempt to circumvent the statistical problem of subcenter success creating large firms out of what were originally small ones. For example, as in virtually all cities, the central business district (CBD) is the oldest center of employment in Houston. The second most developed area is the Galleria, which has been in existence for an extended period of time and which has grown substantially as it has almost half as many employees as the CBD. Other subcenters have formed more recently and, as we show below, exert less influence on the surrounding urban areas. Thus, we analyze the relative frequency of small firms in the newer subcenters compared to the well established CBD and Galleria areas. Finally, a further advantage of the Houston data we bring to this problem is that the Ship Channel area is a major center of manufacturing, while the other subcenters are more prominent for administrative and service elements. This allows us to examine the impact of alternative business sector concentrations, although in the end we find that industrial sector is not important in determining the relative importance of small firms in urban economic development. In part, as we show

below, this is because the subcenters are amazingly diverse to the extent that most industries are well represented in every subcenter.

The data we will use to address the role of firm size as a stimulus to urban development is from Dun & Bradstreet (D&B). This data contains information on 123,313 individual business establishments in the Houston metropolitan area.⁴ The D&B data is from 1990, so we match it to 1990 Census information. We use Geographic Information System (GIS) address matching to successfully locate 101,600 of the firms, including whether they are within one of the employment subcenters. When we omit firms for which D&B report that employment at a specific location is unknown, we nonetheless retain a data set with 63,134 individual firms. It turns out this selection process removes all zero-employee firms from the sample. Additionally, we find that results are essentially the same when we run our models including the zero-employee firms and when we exclude them. Hence, we report here only the results for the smaller, higher-quality data sample.

Our analysis of the role of small businesses has four essential parts. In the first, we examine the role of small compared to large firms within the actual employment centers identified in Craig and Ng (2001). One potential problem with the identified employment centers is that the actual relevant economic area may not correspond to census tract boundaries as assumed. We deal with this potential problem by conducting the analysis of which firms are likely to locate within an employment center by using not only the actual tract, but also including concentric rings of between one and three miles from the tract centroid.

⁴ The observations are for establishments, which may be stand alone firms, subsidiaries, or branches. Henceforth for brevity, we will use the term “firms” interchangeably with

An important additional reason to examine the area around each center is found in the nature of urban economic theory. An important element in identification of an employment center is that it attracts firms not just to the center itself, but also to neighboring areas. Most urban models based on transportation costs, for example, predict that land prices will rise as proximity to employment centers improves. The increase in land prices is the cause of higher density (in employment or population), as economic agents capitalize on the scarce resource of center proximity. The key to higher prices for center accessibility resides in that firms within the center create a positive externality for other firms. The key for our second analysis here is whether small firms are able to compete with large firms for scarce land near the employment subcenter. Small firms will only be able to do so if they are contributing to the economic output of the subcenter in a material way.

The third leg of our empirical strategy is to examine the propensity to locate within an employment center by separate industries. This aspect gives a sense of the importance of economies of scale and allows us to look at the industries separately to determine whether they are likely to be export industries or instead those that serve exclusively local interests. Export-oriented businesses are those that are essential for economic growth as they attract resources into a region from the outside world.

The fourth element of the proposed research strategy is to estimate a poly-centric employment density function, again segmented by large and small firms. The advantage of this approach is that it allows the myriad influences of the diverse subcenters to affect a firm's location. Further, it provides a quantitative estimate of the differential willingness to pay of

“establishments.”

large versus small firms for increments of proximity to an employment center.

II. Model and Research Approach

Houston is an excellent laboratory to statistically determine whether small firms are more, or less, likely to locate within employment centers. First, the urban growth patterns are relatively unfettered by public policy interference, so the market forces are more directly observable than elsewhere. Second, Houston has been the subject of a series of recent important studies, so there is an excellent base of data and research tools available. Finally, Houston is generally known as providing a superb environment for small businesses, so if there is a key role for small firms to play in urban economic growth, that function should be visible in Houston.

A. Houston Employment Centers

Recent research (Craig and Ng, 2001; Craig and Kohlhase, 2005) has identified six to eight employment centers in the Houston metropolitan region (see Figure 1), based not only on the extent of employment in a given census tract but on the ability of a specific center to influence surrounding areas. In addition to the central business district downtown (the CBD), the subcenters are: the Galleria, Carillon, Greenspoint, Clear Lake, Baytown, LaPorte, and Pasadena. Houston's strongest employment subcenter is the Galleria area called "Uptown" by some real estate professionals. This is a retail and office area bordering the innermost circumferential freeway (I 610) and the main southwest freeway (US 59). It contains census tracts with both the second and fifth highest employment densities in the city. Carillon essentially lies west on a line

from the CBD through the Galleria. Greenspoint is near the largest airport in Houston at the confluence of two major highways north of the CBD. Clear Lake contains National Aeronautics Space Administration (NASA), a government installation not necessarily related to industries located in the CBD. Clear Lake is also close to the recreation areas associated with the Gulf of Mexico. Finally, unlike the other subcenters, Craig and Kohlhase (2003) have shown that the Ship Channel area may best be considered as a single continuous subcenter, rather than the three separate administrative subcenters of Baytown, LaPorte, and Pasadena identified in Craig and Ng (2001).⁵ The Ship Channel is an industrial and manufacturing area with primary emphasis on ocean access. We therefore analyze both the Ship Channel line and, separately, the three administrative subcenters associated with the east side of Houston.

We use the differences in the subcenters to assist our exploration of the role of small businesses. Greenspoint and Carillon are relatively new areas with emerging economic importance. The Galleria, on the other hand, is a long established area that may someday rival the CBD in size and economic importance.⁶ The Ship Channel's distinguishing feature is that it is the center of physical manufacturing. Finally, Clear Lake is the area least connected to the CBD and has the highest concentration of consumer oriented businesses. Our main focus will be on the alternative roles for small businesses in the emerging subcenters of Carillon and Greenspoint compared to the small business role in the Galleria and in both cases compared to

⁵ The Ship Channel is unusual because it is a thick line comprised of the 25 census tracts bordering the Ship Channel. This contrasts with the rather small defined areas (single census tracts) for the other employment centers (Craig and Kohlhase, 2003). See Anas et. al, (1998) for a discussion of subcenter space.

⁶ The Galleria's total employment is already about half as large as the CBD's.

the small business role in the CBD. The contrast with the other subcenters, however, will also be illustrative of how the role of small businesses alters based on the economic function being fulfilled.

B. Statistical Approach

We implement two empirical models for building our understanding of how small firms have shaped the urban growth process. In the first model, we use the individual firm level data to build a probabilistic model of firm location. The second model is a poly-centric density function, which allows us to estimate more directly the willingness of firms, both large and small, to pay for proximity to a subcenter.

1. Dichotomous Location Model

The specification we propose to use for determining the type of firm that develops urban employment centers is a probabilistic function showing the tendency of particular sized firms to locate in, or near, the urban employment centers. We use the definition of the employment centers identified by Craig and Ng (2001) supplemented with the recent work of Craig and Kohlhase (2005). The methodology we use is first proposed in Kohlhase and Ju (2005) where they study specific two-digit Standard Industrial Classification (SIC) industries. Specifically, we model the probability that a small firm will be in an employment center, as opposed to being located elsewhere in the urban economy, as:

$$(1) \quad \text{Pr}(\text{Location}) = f(\text{FirmEmploymentSize})$$

where $\text{Pr}(\text{Location})$ is an indicator variable equal to one when a firm is located within a particular center, and zero if it is not. The size variable is the key to the estimating equation, as it indicates whether additional employees of a firm make it more likely to locate in a particular subcenter. Equation (1) is estimated for each of the subcenters, and for the central business district. We then also estimate (1) for each of the major industrial sectors, to understand whether there are any scale effects within particular industries that affect how firms agglomerate in the urban core economy.

It is not clear what to expect from estimating equation (1). On the one hand, public officials put a lot of emphasis on the largest firms, and often a large firm is identified with a particular industry in a metropolitan area. On the other hand, small firms are known to be innovative and often more aggressive. In this case, it may be that a collection of small firms is the initial catalyst that causes an employment subcenter to form. Another reason to suspect an important role for small firms is the industrial diversity we observe in existing subcenters. Specifically, irrespective of whether a large firm is the anchor, small firms may form a central part of the supply chain, and firms in a variety of industries may provide the creative energy to find ways to link to the large successful firm. The key result from (1) will be to determine whether the effect of firm size is different in the new and emerging subcenters, such as Carrillon or Greenspoint, compared to the older and established subcenters including the Galleria and the CBD.

A second method we use to estimate (1) is to define the left hand side indicator variable as pertaining not just to the employment center itself, but to a relatively close radius (three miles) around each center. The importance of such a specification is that we test the extent to which

small firms are participating in the important economic phenomenon shaping U.S. cities, that of poly-centricity. Estimation of the probability of ‘nearness’ provides an alternative specification to the density function specification presented below. Demand to be near, but not within, a center is consistent with a firm that provides a support role for employment within a center. These support roles are crucial, since they represent cost savings that are part of the agglomeration cost advantage firms need to compete nation- or world- wide. On the other hand, the probabilistic approach lacks the quantitative preciseness of the density function methodology. Nonetheless, the probabilistic method allows a detailed picture of how small businesses support employment centers.

2. The Density Function Approach

The empirical model to test whether small firms have an essential supporting role to subcenter formation is a reduced form model based on the extensive literature on firm location and employment density functions (for a review, see Anas et al., 1998; Small and Song, 1994). Through an examination of employment per unit of land area, a density function captures how important an area is to economic functions. Valuable land will be used intensely to reduce land costs. Land is valuable because of demand by firms to be near transportation nodes, customers, suppliers or other firms. Recent models have used density functions not just to show the importance of land near the CBD, but to examine the multi-centricity of an urban area. Thus, recent research uses distance to several areas to model the importance of all of the subcenters to an urban economy.

The innovation in the work proposed here is to split the study of employment density into

employment density for small firms and employment density for large firms. Such a split in the data would not be possible without the firm specific data on individual firm employment we bring to this project. The poly-centric employment density function is thus:

$$(2) \quad \text{Emp/Area}_{(\text{small/large})} = f(\text{Dist}_{\text{CBD}}, \text{Dist}_{\text{subs}}, \text{Charact})$$

where Emp/Area represents employment per acre (or equivalently, per square mile) in a census tract. The small/large subscript indicates we will estimate equation (2) separately for employment in small firms and employment in large firms. The CBD is presumed to affect all locations in the metropolitan area; thus, Dist_{CBD} is the distance to the CBD in all census tracts. For a location closer to the CBD, land prices are expected to be higher reflecting the more valuable locations, and therefore employment densities are expected to be higher.⁷

The other subcenters in the city are expected to have a more limited market area. While the distance to each of the other subcenters in Houston will be entered in the regression ($\text{Dist}_{\text{subs}}$), it will be done for a limited range. Within that range, however, each subcenter is expected to influence areas as is the CBD so that being closer to a subcenter will drive up land prices since firms value proximity. The higher prices will be reflected in more intense land use, so that employment densities are higher. The optimal range for each subcenter is where the influence of each subcenter goes to zero and is captured by a slope dummy on distance.⁸ Marginal increases

⁷ This has been found in numerous studies; see Small and Song (1994) for references.

⁸ This market area can be allowed to vary for each subcenter. Other research (Craig and Kohlhase, 2005) found this distance to be 24.3 miles for most subcenters although Carillon and Greenspoint were found to have slightly smaller market areas of 20 miles each. The Galleria is

in distance will have an estimated effect when the slope dummy is one and will have no further effect on employment density when the slope dummy equals zero.

In equilibrium, both large and small firms would be expected to pay the same land price and would be expected to exhibit equal employment densities. In fact, however, if one size firm benefits more from agglomeration economies than the other, the firm size which receives the highest value will dominate, and the low demander firms would have low resulting employment densities. Thus, segmenting the regression by large and small firms promises to yield important new insights into whether firm size is an important attribute in determining benefits to urban agglomeration. That is, it may be that only large employers value proximity to an employment subcenter, in which case only the large firm version of equation (2) will show effects on other areas. Conversely, if small firms value proximity as highly as do large firms, the coefficients in the two versions of equation (2) will be found to be statistically equal.

III. Data

Individual firm level data are taken from the Dun & Bradstreet data file for Harris County, Texas, in 1990. The full data set contains information on 123,313 individual firms. Firm specific characteristics in the data include the name and address of each firm, the number of employees, annual sales, 4-digit SIC codes and year established.

In order to create spatially detailed variables, the addresses of the individual firms are geocoded using GIS software, ArcView, and a newly available more detailed address file,

allowed a larger market area, the entire west side of the county, representing about 3/4 of the county. The Ship Channel line is allowed to influence the entire east side, while the CBD is

StarMap. StarMap covers the eight-county Houston region and was prepared by the Houston Galveston Area Council, the local Council of Governments. The address file is a significant improvement over the Wessex 92 Street Map, which the authors of this report previously used for address matching. An overall match rate of 82.4 percent was achieved as 101,600 firms were located in the GIS system. The sample was then further refined to 63,134 by excluding firms for which the employee size data were unknown; these firms are generally reported as having zero employees. The resulting sample is amazingly complete for studying the effects of firm size, as the 1,099,672 employees in the included firms represent 73.62 percent of the total employment in Harris County in 1990.⁹ Defining small firms as those that have 45 or less employees means 406,643 employees are in the 59,435 small firms from the data, while the remaining employees, over 693,000, are in only 5.86 percent of the firms.

A unique feature of the data is that they are organized by firm size. Table 1 reports descriptive statistics for the subcenters by presenting the total number of firms by employment center, and it presents the number of employees in those firms by whether the firms are larger or smaller than 45 employees. Table 2, in addition, reports the sectoral breakdown in each of the employment centers and includes the number of firms and employees in small firms using our distinction. As an example, Figure 2 shows the location of firms relative to the employment centers for one of the industrial sectors, petrochemicals.

modeled to influence the entire region.

⁹ Total 1990 Harris County employment, according to the Journey to Work Census data by place of work, is 1,493,623.

IV. Empirical Results

Table 3 presents the results of a series of logit regressions on the probability that a firm will locate in a designated employment center as a function of firm size. The important aspect of these results is how they differ between employment centers, using either the probability a firm is within a subcenter or within three miles of the census tract centroid of the employment subcenter.¹⁰ The key information in the estimation results is the comparison of the different subcenters. Specifically, large firms are expected to be the cornerstone of the established subcenters, and as discussed above, such a finding would be consistent with either small firms starting subcenters or with large firms being important from the outset. We will form a judgment on the path of economic development, therefore, by comparing the results for the large subcenters to those for the newly emerging subcenters. Thus, we will use the firm size patterns of the newest areas of employment concentration as a surrogate to understand the employment patterns by firm size for the established subcenters at an earlier stage. Clearly, an important assumption in this analysis is that the newly emerging subcenters are a reliable indicator of earlier stages of development for the older and more established subcenters.

The dominance of large firms in the traditional downtown area of Houston, the CBD, is evident in the support from Table 1, as well as in the logit regression results reported in the first rows of Table 3. In 1990, over 127,000 workers worked in the CBD, about 8.5 percent of the county's total employment. The CBD is well represented in our data, as shown in Table 1, as

¹⁰ We actually estimate the logit model including areas within one, two, or three miles. To the extent the results differ for the actual subcenter compared to the larger areas, we find the largest area is the most informative concerning the difference.

over 101,000 workers are reported by the firms in the sample. What is striking, however, is that over 84 percent of the employees in the CBD work for large firms, despite the fact that only 63 percent of workers work for large firms in the county as a whole.¹¹

The logit regression results reported in Table 3 support the conclusion from the Table 1 data. We find that large firms are significantly more likely, both in statistical significance and the size of the effects, to locate in the CBD than elsewhere. The elasticity of 0.014 suggests that if a firm doubled in size, it would be 1.4 percent more likely to locate in the CBD.

The Galleria is the densest employment center after the CBD and is quite developed. Despite that the Galleria is long established, we find a different pattern of firm size in Table 3. For location within the subcenter itself (the first columns), we find a statistically significant effect of firm size. A firm that doubled in size would be about 1.0 percent more likely to locate in the Galleria. In the three mile radius, however, we see an important distinction compared to the CBD. The effect of firm size is not statistically significantly different from zero, and the quantitative impact of the point estimate is quite small. Thus, large firms are no more likely than small firms to be within three miles of the Galleria subcenter. In contrast, the coefficient estimate for the CBD suggests a positive effect of firm size of about 2/3 the direct magnitude of being located within the center itself and different statistically from zero.

The outstanding question, however, is whether the importance of size for location in the CBD and the Galleria represents that large firms are what caused these areas to be the primary employment centers or instead whether the success of all of the firms in the employment core

¹¹ It should be noted that it is possible that this is an upper bound on the share of the workforce in large firms. As was discussed above, there is no employment data on about 37,000

caused them to become large, as we now observe. Thus, we turn to the results for the other employment subcenters.

The results for the other subcenters show that firm size is not necessarily important for employment subcenter formation; although especially when we look at actual subcenter location, firm size may still be important. The lack of effects within the three mile radius, however, leaves an open question as to when firm size begins to play a role in the economic development process.

For example, only in one of the three administrative centers of the Ship Channel, Baytown, are large firms found to be statistically significantly more likely to locate within the actual center compared to smaller firms. For La Porte, in fact, the point estimate is negative suggesting that smaller firms are more likely to be found in the center, although the results are not statistically different than zero. Similarly, when the entire length of the Ship Channel is treated as an employment subcenter, we find that firm size has no effect on whether a firm is located with the subcenter at all.¹²

When the area within three miles of the subcenter is considered, small firms are found to be relatively more important than larger firms although the results are weaker than conventional significance levels. That is, for the Ship Channel as a whole, we find small firms are more likely than large firms to be within three miles of the areas bordering the Ship Channel at the 10 percent level. In the three administrative subcenters, the results are not distinguishable from zero, but nonetheless show that smaller firms are more likely at the point estimates to be located

firms, and it appears likely that most of these are small.

¹² Here, the 26 census tracts that border the Ship Channel are considered the subcenter. This treatment is consistent with the manufacturing nature of this area of Houston as products are traded with the rest of the world all along the Ship Channel.

within three miles of the subcenters.

In a continuation of the theme of the results, the Clear Lake area shows no effect of firm size on the propensity for a firm to locate within, or near, the subcenter. We find that large firms are more likely to locate within Carrilon, although they are not more likely to locate nearby than are small firms. The employment effect is somewhat smaller than for the Galleria or the CBD, but is nonetheless significantly different from zero. Similarly, firm size is a weakly significant determinant of firm location within, or near, the Greenspoint subcenter. The magnitude of the employment effect as shown by the elasticity, however, is only about half the size of the relatively weak effect for Carrilon.

To summarize, the results seem very clear about the effect of firm size on areas that are close to an employment subcenter. Only for the CBD do we see that small firms are less likely to be within three miles of the CBD than are large firms. For the other subcenters, the average effect is that small firms are at least as likely as large firms to be in close proximity, as the marginally significant effect for large firms in Greenspoint is offset by an equally significant effect for small firms in the Ship Channel.

In contrast, large firms are often found to be more likely to locate in employment subcenters. The effects are, of course, largest and strongest for the CBD, followed by the results for the Galleria. The effects are weaker, but nonetheless generally positive, for large firms actually located within the other subcenters.

While not decisive, the results are consistent with the view that small firms may be centrally important for urban development. This analysis requires an interpretation that suggests that the results for the area within a three mile radius are most likely to be suggestive of the

initial conditions for subcenter formation. As a subcenter gains momentum and success, these small firms grow relatively quickly. Thus, we find that larger firms are somewhat more likely to be located within the actual employment centers, but this result may be because the small firms have grown rapidly with their success. The alternative hypothesis, however, is not rejected by the data, which is that large firms create subcenters as we find that large firms are more likely to be found in the core of most employment subcenters. Given our research framework, however, we believe the extrapolation result is more likely and that the large firms we find grew due to their success.

To examine the possibilities further, we turn to an analysis by industry because of the possibility that economies of scale in some industries pre-dispose some sectors to being oriented towards large firms. The logit regressions in Table 4 are based on whether firms in a specific Division-level (or 1- digit SIC) industry are more likely to be in an employment subcenter than in a more dispersed location.¹³ The results show that agriculture, mining, and wholesale trade are the only industries not tending to concentrate in a subcenter. This suggests that large firms would be expected when looking at the concentration by firm size within subcenters, and any findings that show an important role for small firms are, at least in this sense, surprising. An interesting aspect of these results, however, and one that suggests the crucial role played by small businesses is that Houston's most important industrial sector is mining, which consists of most of the petrochemical industry (manufacturing is the other). Yet, this is one of the few sectors that does not show a tendency to concentrate large firms in subcenters.

¹³ We use SIC codes because the data for our analysis pre-dates the newer North American Industry Classification System (NAICS) codes.

For reference, Table 5 presents the firm specific data by industrial category, including the number and average size of the large and small firms. In addition to the general pattern illustrated in Tables 1 and 2, it shows that there is a wide disparity in the importance of small firms by industrial category. Given the relative importance of small firms in mining, for example, it may be somewhat surprising as to how small is the relative size of the small firm element.

As a final test on the role of small business in urban economic growth, we present a polycentric density function, incorporating all of the identified subcenters in Houston, separating the results by firm size. The main purpose of this analysis is to examine the employment density in each neighborhood of the city with the purpose of determining the extent to which the employment subcenters affect that density. The expectation in such an analysis is that the CBD should exert the most influence, since proximity to the CBD should be quite valuable to a firm that wants to do business with firms in the downtown area. Nearness to each additional subcenter should also be valuable since the costs of transacting business with firms in the subcenters will be reduced by proximity.

In the empirical implementation of the density function analysis, the market area of each subcenter is restricted since the marginal effect is presumed to go to zero after a certain distance (see Craig and Kohlhase, 2005).¹⁴ In contrast, the influence of the CBD is allowed to permeate the entire region. The Galleria is modeled to affect the entire western 3/4 of the city. The Ship Channel is modeled to impact the eastern 1/4; Clear Lake and Greenspoint are modeled to impact

¹⁴ This is equivalent of saying that the influence of other subcenters becomes relatively more important. The reported results are not particularly sensitive to the definition of the market

the area within 24.3 miles from each subcenter, while Carrilon is modeled to impact the area within 20 miles. We performed a series of tests to determine the appropriate market areas and selected the largest area consistent with informative results.¹⁵

One innovative aspect of our work is to segment the poly-centric density function by firm size. Table 6 presents the results of the analysis. It shows that the parameter estimate on distance is statistically significant from zero in five of the six areas. The negative signs indicate that as distance to each subcenter grows, the employment within a specific census tract falls. The only subcenter which is not found to significantly influence the location of employment in the market area is the Greenspoint subcenter.¹⁶

The important attribute of the poly-centric density function results, however, is shown in the estimates of the density function separately for total employment located in large firms and small firms. We find that the influence on large firms is statistically equivalent to the influence of a subcenter on small firms. That is, while the density function coefficients are generally statistically different from zero, they are not found to be statistically different from each other. This finding is important in our context because it shows that small firms compete equally with large firms for space within the urban economy and for access to the centers for economic growth and vitality.

This result is stronger, in some sense, than the logit location functions discussed above.

areas.

¹⁵ An area too large causes the impact of distance to be obscured as the influence of other areas dominates.

¹⁶ These results are important for ascertaining the importance of an employment subcenter as the expectation is that a subcenter exerts significant influence on neighboring areas

Specifically, the individual subcenter analyses above examine the propensity of firms to locate in or near each subcenter. That analysis, however, does not account for the influence of multiple subcenters. The important result here is to see that the density function using only employees working in firms with 45 employees or less is virtually identical to using only employees working in firms larger than 45 employees, even while accounting for the simultaneous attraction of all of the employment concentrations in the urban economy.¹⁷

This result shows that small firms are a vitally important element of the urban economic landscape because their location is just as important to land values as is the location of large firms. Further, as the intercept terms are also of virtually the same value, the impact of small firms on the core of the subcenter is found to be equivalent to that of large firms. Thus, the polycentric density function strengthens the first hypothesis offered on the individual subcenter logit location functions. That is, small firms are found to be just as important for overall employment density as are large firms throughout the metropolitan economy.

IV. Summary and Conclusion

The research described in this project contributes important new understanding of the role of small businesses in economic growth. The key to performing this research is the large data set available that allows the researchers a unique opportunity to perform urban economic analysis that focuses on the role of firm size. This data set matches well with the available census data as the sample represents almost 3/4 of all the employment in Harris County. The perspective we

(Craig and Ng, 2001).

¹⁷ The results are not very sensitive to the line demarking the distinction between large

bring is to look at the economic development around the most established centers of economic activity in Houston, the CBD and the Galleria, and compare the observed characteristics of firms by size to the newer centers of economic concentration. The analysis is undertaken in two components. The first examines the propensity of firms to locate in specific employment subcenters, and the second is an overall density function that examines the role of the employment centers on employment location throughout Harris County.

As is well-known, the data show that there are a large number of small firms, but that large firms employ a high proportion of the workforce. The question we seek to answer is whether the large firms are a significant cause of urban economic growth or alternatively, whether small firms perform a key role. This is a difficult question because if small firms are successful, they become large. Thus, an important advantage of our approach is to compare the older established areas with newly emerging employment centers. This view is consistent with new research that describes how the economies of cities operate (Glaeser and Kohlhase, 2004). An important contribution of our research here, however, is we show the key role that small firms play in the process of economic development.

Our analysis of individual subcenters examines two parts of the role of small business in economic development. In the first, we compare the likelihood that a firm will locate within the employment subcenter itself. This examination is central since the subcenters form the economic magnet around which urban employment is organized. We also examine, in addition, the area within three miles of the subcenter. This nearby area is an important support to the subcenter and represents a necessary component to subcenter formation. We find that large firms are more

and small firms. We tried 25 and 60 employees with virtually identical results.

likely than others to locate within the established subcenters of the CBD and the Galleria. In contrast, in the newly emerging subcenters, we find that larger firms are more likely to be found in several of them, although not all. There is mixed support for the idea that large firms simply represent small firms that have grown rather than being needed to foster economic development on their own.

The areas surrounding the centers, however, provide much clearer evidence that small firms are necessary for economic development. The CBD is found to contain larger firms than otherwise would be expected within three miles. The Galleria is shown to have a statistically insignificant effect of firm size, albeit positive. The other subcenters, however, are quite consistent in showing that small firms are more likely to be close to the subcenter than others. The areas near the center, therefore, decisively show a pattern that suggests that small firms constitute the bulk of support for urban growth but that as economic development proceeds, these small firms grow substantially. To the extent the near-center areas develop later, these areas would appear to be the model that suggests that small firm growth is the key component to economic development rather than starting with large firms *de novo*.

The final piece of evidence that we find that supports the small firm growth effect on economic development is the density function estimation. This second stage of the analysis examines how employment in each area of Harris County is related to the employment centers. As with the first stage, we bifurcate the estimation into looking at only large firms and only small firms. Our evidence shows that the subcenters exert statistically equal impact on firms of either size. That is, small firms are equally able to compete with large firms for proximity to employment centers.

The fundamental policy question raised in this analysis is whether cities that are pursuing an economic development strategy should spend their scarce resources on attracting large firms from other locations or, instead, whether cities should invest in encouraging new start-ups that may eventually develop. Our analysis provides substantial support to the hypothesis that small firms are the cornerstone to economic growth. We find that small firms are key components of the support areas around each subcenter excepting only the CBD where they appear to have grown to be classified as large firms. We also find that small firms effectively compete with large firms for proximity to all of the employment centers in Harris County. We believe these pieces of evidence suggest that our mixed findings with respect to firm size in the subcenters themselves reflect that we do not have ample understanding of the earliest development stages; but that once a subcenter can be statistically identified, it will be primarily populated by larger firms reflecting their success at fostering economic development.

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Table 1: Firms and Employees by Employment Center in Houston

	<i>Total Firms</i>	<i>Large Firms</i>	<i>Small Firms^a</i>	<i>Total Employees</i>	<i>Large Firm Employment</i>	<i>Small Firm Employment</i>	<i>Emp Share in Small Firms</i>
<i>Total Houston^b</i>	63,134	3,699	59,435	1,099,672	693,029	406,643	36.98%
Employment Centers and Subcenters							
<i>CBD</i>	2,096	231	1,865	101,284	85,499	15,785	15.58%
<i>Galleria</i>	638	64	574	24,305	19,788	4,517	18.58%
<i>Clear Lake</i>	275	15	260	8,088	5,996	2,092	25.87%
<i>Carrilon</i>	444	54	390	17,180	13,832	3,348	19.49%
<i>Greenspoint</i>	320	29	291	7,304	4,662	2,642	36.17%
<i>Ship Channel</i>	1,549	154	1,395	35,346	24,147	11,199	31.68%
<i>Baytown</i>	86	7	79	3,935	3,352	583	14.82%
<i>La Porte</i>	67	5	62	1,002	526	476	47.50%
<i>Pasadena</i>	74	6	68	2,019	1,543	476	23.58%

Notes

a Small firms are defined as having 45 employees or less.

b Data source is Dun and Bradstreet. The sample is originally 123,123 firms. After address matching 101,600 remain. After deleting firms with an unknown number of employees, the sample is 63,134 firms, representing 73.62% of total Harris County employment.

Table 2: Descriptive Statistics on Subcenter Characteristics by Industry

	<i>Number of Firms</i>	<i>Total Employees</i>	<i>Small Firms^a</i>	<i>Employees in Small Firms</i>	<i>Share of Firms</i>	<i>Share of Employees</i>
<i>Total Houston</i>	63,134	1,099,672	59,435	406,643	94.14%	36.98%
<i>CBD</i>						
Agriculture	13	492	12	42	92.31%	8.54%
Mining	313	7395	275	2475	87.86%	33.47%
Construction	23	419	21	259	91.30%	61.81%
Manufacturing	72	9981	59	607	81.94%	6.08%
Transport&Comm	190	19164	160	1590	84.21%	8.30%
Wholesale Trade	107	3312	96	924	89.72%	27.90%
Retail Trade	220	4797	209	1781	95.00%	37.13%
FIRE	389	24730	344	2698	88.43%	10.91%
Services	756	21541	682	5301	90.21%	24.61%
Public Administration	13	9453	7	108	53.85%	1.14%
<i>Galleria</i>						
Agriculture	2	4	2	4	100.00%	100.00%
Mining	31	780	26	270	83.87%	34.62%
Construction	15	1068	12	113	80.00%	10.58%
Manufacturing	25	1246	22	204	88.00%	16.37%
Transport&Comm	33	7279	24	251	72.73%	3.45%
Wholesale Trade	60	388	59	328	98.33%	84.54%
Retail Trade	162	3448	148	1200	91.36%	34.80%
FIRE	152	3293	139	964	91.45%	29.27%
Services	155	6732	140	1166	90.32%	17.32%
Public Administration	3	67	2	17	66.67%	25.37%
<i>Clear Lake</i>						
Agriculture	2	5	2	5	100.00%	100.00%
Mining	0		0		n/a	n/a
Construction	4	42	4	42	100.00%	100.00%
Manufacturing	10	104	10	104	100.00%	100.00%
Transport&Comm	5	4026	4	26	80.00%	0.65%
Wholesale Trade	22	193	22	193	100.00%	100.00%
Retail Trade	80	1362	73	635	91.25%	46.62%
FIRE	15	242	14	142	93.33%	58.68%
Services	135	2030	130	910	96.30%	44.83%
Public Administration	2	84	1	35	50.00%	41.67%
<i>Carrilon</i>						
Agriculture	2	24	2	24	100.00%	100.00%
Mining	54	8306	39	377	72.22%	4.54%
Construction	15	243	13	93	86.67%	38.27%
Manufacturing	23	293	21	188	91.30%	64.16%
Transport&Comm	18	336	14	143	77.78%	42.56%
Wholesale Trade	57	550	55	407	96.49%	74.00%
Retail Trade	49	986	43	452	87.76%	45.84%
FIRE	84	1204	80	584	95.24%	48.50%

Table 2: Descriptive Statistics on Subcenter Characteristics by Industry

	<i>Number of Firms</i>	<i>Total Employees</i>	<i>Small Firms^a</i>	<i>Employees in Small Firms</i>	<i>Share of Firms</i>	<i>Share of Employees</i>
Services	142	5238	123	1080	86.62%	20.62%
Public Administration	0		0		n/a	n/a
<i>Greenspoint</i>						
Agriculture	1	40	1	40	100.00%	100.00%
Mining	38	2002	30	330	78.95%	16.48%
Construction	12	460	9	109	75.00%	23.70%
Manufacturing	29	540	26	220	89.66%	40.74%
Transport&Comm	27	651	25	246	92.59%	37.79%
Wholesale Trade	77	752	76	608	98.70%	80.85%
Retail Trade	34	1274	27	216	79.41%	16.95%
FIRE	36	911	32	311	88.89%	34.14%
Services	66	674	65	562	98.48%	83.38%
Public Administration	0		0		n/a	n/a
<i>Ship Channel</i>						
Agriculture	7	41	7	41	100.00%	100.00%
Mining	14	104	14	104	100.00%	100.00%
Construction	145	2945	133	1160	91.72%	39.39%
Manufacturing	188	12926	135	1595	71.81%	12.34%
Transport&Comm	179	4963	144	1616	80.45%	32.56%
Wholesale Trade	217	3564	203	2086	93.55%	58.53%
Retail Trade	315	2258	312	1798	99.05%	79.63%
FIRE	56	453	54	270	96.43%	59.60%
Services	422	6946	391	2517	92.65%	36.24%
Public Administration	6	1146	2	12	33.33%	1.05%
<i>Ship Channel Administrative Centers</i>						
<i>Baytown</i>						
Agriculture	1	2	1	2	100.00%	100.00%
Mining	1	7	1	7	100.00%	100.00%
Construction	3	36	3	36	100.00%	100.00%
Manufacturing	2	1810	0		0.00%	0.00%
Transport&Comm	0		0		n/a	n/a
Wholesale Trade	1	6	1	6	100.00%	100.00%
Retail Trade	22	634	21	134	95.45%	21.14%
FIRE	12	273	10	76	83.33%	27.84%
Services	44	1167	42	322	95.45%	27.59%
Public Administration	0		0		n/a	n/a
<i>Pasadena</i>						
Agriculture	0		0		n/a	n/a
Mining	2	21	2	21	100.00%	100.00%
Construction	2	6	2	6	100.00%	100.00%
Manufacturing	4	72	3	12	75.00%	16.67%
Transport&Comm	2	262	1	2	50.00%	0.76%
Wholesale Trade	3	20	3	20	100.00%	100.00%

Table 2: Descriptive Statistics on Subcenter Characteristics by Industry

	<i>Number of Firms</i>	<i>Total Employees</i>	<i>Small Firms^a</i>	<i>Employees in Small Firms</i>	<i>Share of Firms</i>	<i>Share of Employees</i>
Retail Trade	17	388	15	138	88.24%	35.57%
FIRE	15	106	15	106	100.00%	100.00%
Services	28	244	27	171	96.43%	70.08%
Public Administration	1	900	0		0.00%	0.00%
<i>La Porte</i>						
Agriculture	2	9	2	9	100.00%	100.00%
Mining	3	83	2	21	66.67%	25.30%
Construction	5	21	5	21	100.00%	100.00%
Manufacturing	8	61	8	61	100.00%	100.00%
Transport&Comm	4	35	4	35	100.00%	100.00%
Wholesale Trade	5	39	5	39	100.00%	100.00%
Retail Trade	14	117	14	117	100.00%	100.00%
FIRE	3	138	1	2	33.33%	1.45%
Services	22	246	21	171	95.45%	69.51%
Public Administration	1	253	0		0.00%	0.00%

Notes

a Small firms are defined as having 45 employees or less.

Table 3: Probability of Location by Subcenter by Firm Size

	<i>Subcenter^a</i>				<i>Three Mile Radius^b</i>				
		Constant	Employees	t ^d	Elasticity ^c	Constant	Employees	t ^d	Elasticity ^c
CBD	Parameter	-3.39*	0.000845*		0.0142	-2.1395*	0.0006505*		0.0101
	Std Error	0.023	0.000164	5.17		0.013	0.000117	5.55	
	n ^e		63,134						
Galleria	Parameter	-4.404*	0.000624*		0.0100	-1.9119*	0.000127		0.0018
	Std Error	0.0399	0.000131	4.76		0.013	0.000090	1.42	
	n ^e		52,091						
Ship Channel	Parameter	1.812655*	-0.0000172		-0.0003	0.2303627*	-0.0004155*		-0.0043
	Std Error	0.02753	0.0001143	-0.15		0.020	0.000224	-1.86	
	n ^e		11,043						
Baytown	Parameter	-5.23*	0.000511*		0.0087	-2.9614*	-0.000133		-0.0022
	Std Error	0.108	0.000198	2.58		0.037	0.000401	-0.33	
	n ^e		15,968						
La Porte	Parameter	-5.612*	-0.000623		-0.0125	-3.8555*	-0.000055		-0.0011
	Std Error	0.123	0.00103	-0.60		0.052	0.000272	-0.20	
	n ^e		18,596						
Pasadena	Parameter	-6.508*	0.000313		0.0057	-3.3606*	-0.000899		-0.0157
	Std Error	0.1165	0.000229	1.37		0.026	0.000584	-1.54	
	n ^e		49,349						
Clear Lake	Parameter	-4.499*	0.000219		0.0046	-3.2566*	0.000018		0.0004
	Std Error	0.0611	0.000249	0.88		0.034	0.000221	0.08	
	n ^e		24,876						
Carrilon	Parameter	-4.704*	0.000471*		0.0085	-2.6129*	-0.000181		-0.0031
	Std Error	0.00011	0.000108	4.36		0.018	0.000201	-0.90	
	n ^e		48,874						
Greenspoint	Parameter	-5.042*	0.000211*		0.0039	-3.7281*	0.000153*		0.0027
	Std Error	0.0561	0.000106	1.99		0.030	0.000080	1.90	
	n ^e		49,628						

Notes:

* indicates coefficient is statistically different from zero at the 10% level.

a Logit regression on the probability a firm locates in the designated subcenter, as a function of the number of employees of a firm.

b Logit regression that a firm locates within a subcenter, or within a three mile radius of the subcenter, as a function of the number of employees of a firm.

c For employees, calculated at the means.

d t statistic on the employee coefficient relative to zero.

e Number of firms in the market area of the regression (see notes to Table 2 for market areas). Note that the total number of firms is less than the the sum, as many of the market areas overlap.

Table 4: Logit Results by Industrial Sector^a

		Coeff	Std Err	t	Elasticity
<i>Agriculture</i>	Const	-3.546*	0.212		
	Employees n ^b	0.000887	0.000889	1.00 809	0.011
<i>Mining</i>	Const	-0.8754*	0.058		
	Employees n	0.000214	0.00031	0.69 1,494	0.006
<i>Construction</i>	Const	-4.345*	0.1141		
	Employees n	0.0021*	0.00074	2.84 5,962	0.024
<i>Manufacturing</i>	Const	-3.388*	0.08		
	Employees n	0.00137*	0.000305	4.49 4,990	0.039
<i>Transport and Communications</i>	Const	-2.239*	0.066		
	Employees n	0.00155*	0.00047	3.30 2,720	0.046
<i>Wholesale Trade</i>	Const	-3.064*	0.0565		
	Employees n	0.000494	0.000439	1.13 7,393	0.006
<i>Retail Trade</i>	Const	-3.029*	0.04268		
	Employees n	0.0021*	0.000643	3.27 12,599	0.023
<i>FIRE (finance, insurance, and real estate)</i>	Const	-2.058*	0.0421		
	Employees n	0.00264*	0.000994	2.66 5,989	0.035
<i>Services</i>	Const	-2.689*	0.0282		
	Employees n	0.00033*	0.00011	3.00 21,057	0.006
<i>Public Administration</i>	Const	-1.815*	0.2675		
	Employees n	0.00074*	0.000363	2.04 121	0.118

Notes:

* indicates coefficients are statistically different from zero at the 10% level.

a Logit regressions for one digit SIC codes.

b The number of observations varies for each industry.

Table 5: Sector Description by Large and Small Firms

	<i>Total Firms</i>	<i>Large Firms</i>	<i>Small Firms^a</i>	<i>Total Employees</i>	<i>Employees in Large Firms</i>	<i>Employees in Small Firms</i>
<i>Agriculture</i>	809	16	793	10,019	5,309	4,710
Avg Firm Size					331.8	5.9
Share of Emp Small				47.01%		
<i>Mining</i>	1,494	192	1,302	56,380	46,805	9,575
Avg Firm Size					243.8	7.4
Share of Emp Small				16.98%		
<i>Construction</i>	5,962	241	5,721	69,720	31,388	38,332
Avg Firm Size					130.2	6.7
Share of Emp Small				54.98%		
<i>Manufacturing</i>	4,990	549	4,441	147,171	104,953	42,218
Avg Firm Size					191.2	9.5
Share of Emp Small				28.69%		
<i>Transport and Communications</i>	2,720	286	2,434	89,796	68,977	20,819
Avg Firm Size					241.2	8.6
Share of Emp Small				23.18%		
<i>Wholesale Trade</i>	7,393	314	7,079	93,468	41,501	51,967
Avg Firm Size					132.2	7.3
Share of Emp Small				55.60%		
<i>Retail Trade</i>	12,599	554	12,045	146,563	68,013	78,550
Avg Firm Size					122.8	6.5
Share of Emp Small				53.59%		
<i>FIRE (finance, insurance, and real estate)</i>						
Avg Firm Size	5,989	249	5,740	89,246	51,531	37,715
Share of Emp Small				42.26%	207.0	6.6
<i>Services</i>	21,057	1,258	19,799	374,417	252,697	121,720
Avg Firm Size					200.9	6.1
Share of Emp Small				32.51%		
<i>Public Administration</i>	121	40	81	22,892	21,855	1,037
Avg Firm Size					546.4	12.8
Share of Emp Small				4.53%		
<i>Total for Houston Data</i>	63,134	3,699	59,435	1,099,866	693,029	406,643
Avg Firm Size					187.4	6.8
Share of Emp Small				36.97%		

a Small firms are defined as having 45 employees or less.

**TABLE 6: Employment Density Functions for all Subcenters
by Small and Large Firms**

Parameter Estimates		<i>Small Firms</i>	<i>Large Firms</i>	t Statistic on Difference
Intercept	Parameter Std Error	7.97176* 0.18313	7.77789* 0.25702	0.613
Slope ^a on Distance to:				
CBD	Parameter Std Error	-0.11164* 0.01137	-0.12992* 0.01596	0.933
Galleria	Parameter Std Error	-0.05247* 0.00969	-0.07363* 0.01359	1.268
Ship Channel	Parameter Std Error	-0.06258* 0.01047	-0.05258* 0.0147	-0.554
Clear Lake	Parameter Std Error	-0.04013* 0.00692	-0.04181* 0.00971	0.141
Carrilon	Parameter Std Error	-0.00425 0.01342	-0.01306 0.01884	0.381
Greenspoint	Parameter Std Error	0.01735* 0.00748	0.01981* 0.0105	-0.191

Notes:

* indicates coefficient is statistically different from zero at the 10% level.

There are 469 census tract observations, based on data for 63,134 firms.

a Parameter estimate on distance to each employment subcenter, where the left hand side variable is employment density based on total employment in either small firms (≤ 45 employees), or large firms.



