*The Review of Regional Studies* 2008, Vol. 38, No. 2, pp. 173–193

# City-Industry Agglomeration and Changes in the Geographic Concentration of Industry

*Todd M. Gabe*[*]

**ABSTRACT.** This paper investigates the effects of industry agglomeration on growth in U.S. metropolitan areas, and then examines whether these agglomeration effects contribute to changes in the geographic concentration of industry. Study results suggest that a high localization of industry, measured using location quotients, leads to a decrease in city-industry growth as indicated by the net change in establishment counts. Alternatively, large initial city-industry size is associated with an increase in the change in the number of establishments above or below what is explained by overall metropolitan area growth. Both of these agglomeration effects contribute to a greater dispersion of industry.

**Key Words:** industry agglomeration, geographic concentration of industry, U.S. cities

**JEL Classifications:** R11, R12, R30, L1

## 1. INTRODUCTION

Since the work of Alfred Marshall in the late nineteenth century, economists, geographers, and other regional scientists have been intrigued by the topics of industry agglomeration and the geographic evolution of industry. Much of the empirical research conducted to date suggests that industry agglomeration is associated with an increase in employment growth, worker productivity and business location (Guimarães, Figueiredo, and Woodward, 2000; Hanson, 2001; Head, Ries, and Swenson, 1995; Henderson, 1986; Henderson, Kuncoro, and Turner, 1995; Rigby and Essletzbichler, 2002; Feser, 2002). This implies that, as sectors tend to fare well in areas where they are already agglomerated, industries should become more geographically concentrated over time. From the 1940s until recently, however, industries have become more dispersed across regions of the United States (Dumais, Eliison, and Glaeser 2002; Kim, 1995). These ideas—that agglomeration enhances growth and that industries are becoming less geographically concentrated—appear to be at odds.

This paper investigates the effects of industry agglomeration on the expansion of 121 3-digit SIC industries in U.S. metropolitan areas (i.e., the growth of U.S. city-industries), and then examines whether these agglomeration effects contribute to changes in the geographic concentration of industry. For each of the sectors, we estimate the effects of city-industry localization (i.e., location quotient) and size (i.e., number of incumbent establishments), two measures of agglomeration, on the net change in the number of city-industry establishments (above or below what is predicted by overall metropolitan area growth) between 1986 and 1996. With these results in hand, we then analyze changes in the geographic concentration of the

[*] Todd M. Gabe is an Associate Professor of Economics at the University of Maine.
*Contact information:* 5782 Winslow Hall, University of Maine, Orono, ME 04469-5782, U.S.A. E-mail: todd.gabe@umit.maine.edu.

**© Southern Regional Science Association 2010.**
**ISSN 1553-0892**
**SRSA, 1601 University Avenue, PO Box 6025, Morgantown, West Virginia 26506-6025, USA.**

selected industries—also focusing on establishment count data—across U.S. metropolitan areas. Of particular interest is whether the geographic evolution of industry is influenced by the agglomeration effects associated with city-industry localization and size.

Our analysis uses the net change in the number of business establishments (above or below what is predicted by overall metropolitan area growth) to represent industry growth. This captures the location and startup decisions of new businesses that begin operations in a region less those establishments that close or move elsewhere. Growth in the number of establishments is a key economic indicator that suggests a region is providing profit opportunities to new entrants and that local conditions are not driving companies out of business or forcing them to relocate. New establishments provide employment opportunities for local residents, and "home grown" entrants can be an indicator of entrepreneurial activity. Important to policymakers and economic development officials, new businesses provide visible signs (perhaps more so than the growth of incumbent establishments) of economic vitality and the occasional "ribbon-cutting" opportunity.

Three prominent theories offer different reasons why industry agglomeration occurs, and why firms and regions may benefit from it. The theory of localization externalities, associated with Marshall (1890), Arrow (1962), and Romer (1986) suggests that agglomeration allows firms to reap a variety of benefits from operating in close proximity to others in the same industry. These include, among other things, the availability of skilled workers and specialized inputs, and information sharing among firms. Whereas Marshall, Arrow, and Romer stress the importance of external economies of scale, Krugman (1991a) suggests that internal economies of scale, combined with low transport costs, lead to a geographic concentration of manufacturing. A third explanation, based on the Heckscher-Ohlin model of international trade, is that resource endowments are largely responsible for the geographic concentration of industries (Kim, 1995; Kim, 1999).

Previous empirical studies have tested these theories and uncovered some interesting patterns of industry agglomeration. Audretsch and Feldman (1996) suggest that high-technology industries tend to agglomerate, supported by evidence that research and development expenditures and the percentage of industry workers in skilled occupations have a positive effect on the geographic concentration of industry. They also found that the geographic concentration of industry is positively related to a sector's utilization of natural resources, whereas internal economies of scale surprisingly lead to a dispersion of industry.

Ellison and Glaeser (1999) found that natural advantages related to the costs of extractive, agricultural and forest products largely explain the geographic concentration of U.S. manufacturing industries. Rosenthal and Strange (2001) found that labor market pooling positively affects the geographic concentration of industry at the state, county and zip-code levels. Likewise, an industry's reliance on natural resources and manufactured inputs leads to agglomeration at the state level, while knowledge spillovers encourage agglomeration at the zip-code level. Focusing on nonmetropolitan areas, Kim, Barkley, and Henry (2000) found that the geographic concentration of manufacturing industries is positively related to average establishment size, the importance of raw materials and the labor intensity of the industry's production process. Further, for labor-intensive manufacturing sectors, the proportions of employment in professional and technical, and low-skilled occupations have a positive effect on industry clustering.

© Southern Regional Science Association 2010.

Empirical studies have also investigated long-run trends in industry localization and the geographic evolution of industry. Kim (1999) found that regional differences in U.S. manufacturing output between 1880 and 1987 are largely explained by endowments of labor, capital, and land. Kim (1995) also found that internal economies of scale and an industry's intensity of raw material use increased the geographic concentration of U.S. manufacturing industries between 1860 and 1987. Dumais, Ellison, and Glaeser (2002) examined the contributions of plant-level startups, closures, expansions, and contractions to changes in the geographic concentration of industry. They found that new plant births reduce geographic concentration, while the locations of plant closures act to maintain industry agglomeration.

With few exceptions, the research summarized above examines the growth and geographic evolution of manufacturing sectors. However, in recent decades, much of the new activity occurring in U.S. metropolitan areas has come from services and other non-manufacturing industries. This growth has generated interest in the agglomeration and geographic dispersion of services across and within metropolitan areas (Kim, 1987; Ó hUallacháin, 1989; Coffey and Shearmur, 2002). This line of research is especially relevant to the empirical analysis presented in this paper, which focuses on industries that expanded by 1,000 or more establishments nationally between 1986 and 1996. Over one-third of the 3-digit SIC sectors included in our dataset are part of the services industry, while only 12.4 percent are manufacturers.

Some of the factors contributing to the geographic concentration of services include technological change requiring access to specialized labor and other inputs, reduced costs of service delivery to outside markets, and uncertainty related to government deregulation of transportation and financial services (Ó hUallacháin, 1989). Ó hUallacháin found that, for most of the 27 fast-growing services industries included in the analysis, sectors were more likely to expand in larger metropolitan areas than in smaller places. On the other hand, Kirn (1987) uncovered evidence of "downfiltering" in which service industries became less urbanized and more evenly distributed across large and small metropolitan areas. Within a single metropolitan area (Montreal), Coffey and Shearmur (2002) also found signs of geographic dispersion in a variety of higher-order services.

The rest of the paper is organized as follows. Section 2 presents the analytical framework used to examine the effects of industry agglomeration on city-industry growth. In Section 3, we describe the dataset used in the paper. Section 4 presents empirical results on the effects of city-industry agglomeration on growth. We use these results in Section 5 to analyze changes in the geographic concentration of industry. Section 6 concludes the paper.

## 2. ANALYTICAL FRAMEWORK

Previous empirical studies have considered a variety of factors to explain the growth of industries across cities (Carlton, 1982; Glaeser et al., 1992; Ó hUallacháin and Satterthwaite, 1992). These studies typically include variables that measure attributes common to all industries in an area (e.g., population size, industrial diversity, fiscal policy), as well as variables that differ by industry (e.g., industry agglomeration and competition). Carlton (1982), Guimarães, Figueiredo, and Woodward (2000), Henderson (1986), Henderson (1995), and Rigby and Essletzbichler (2002) found that industry agglomeration, however measured in the study, has a positive effect on worker productivity, employment growth, and business location. Along with these industry agglomeration effects, industry growth in cities may be enhanced by urbanization

© Southern Regional Science Association 2010.

externalities and interindustry knowledge spillovers that affect the overall level of growth occurring in the city (Glaeser et al., 1992; Henderson, Kuncoro, and Turner, 1995; Jacobs, 1969).

While much attention in the literature has been devoted to the effects of industry agglomeration (i.e., specialization), another line of research has examined the ways in which industrial diversity affects regional economic performance (Conroy, 1975; Fawson, Thilmany, and Keith, 1998; Quigley, 1998; Feldman and Audretsch, 1999). Conroy (1975) and Brewer (1985) used an industrial portfolio approach to show that regional industrial diversification lowers economic instability in U.S. metropolitan areas. Focusing on new product introductions, Feldman and Audretsch (1999) found that the presence of complementary industries (i.e., regional diversity) – but not greater industrial specialization – enhances innovation in U.S. cities.

To examine the effects of agglomeration on the growth of industries in cities, we decompose the net change in the number of establishments in each city-industry to separate out the growth or decline that can be explained by the overall growth occurring in the metropolitan area:

$$(1) \qquad E_i^* - E_i = E_i [(E^*/E) - 1] + E_i [(E_i^*/E_i) - (E^*/E)],$$

where $E_i$ is the number of establishments per city-industry *i*, and E is the total number of establishments in the metropolitan area. The superscript * denotes that the values are from the end of period, while variables without the superscript have values from the beginning of period.

The first expression in the right-hand-side of equation 1, $E_i [(E^*/E) - 1]$, is the change in the number of establishments that would be expected if the city-industry grew at the same rate as the overall metropolitan area. This change, which may be related to urbanization externalities and other place-based characteristics, is city-industry expansion or decline that is attributed to the growth of the metropolitan area. The second expression, $E_i [(E_i^*/E_i) - (E^*/E)]$, is the net change in the number of industry establishments above or below what is explained by the growth of the overall metropolitan area.[1] Our analysis examines whether this growth or decline, unique to the industry within a particular metropolitan area, is related to city-industry agglomeration.[2]

As discussed above, the net change in the number of business establishments is a key indicator of economic vitality. Business counts are the focus of analysis in many firm location and demand threshold studies (Coughlin and Segev, 2000; Guimarães Figueiredo, and Woodward, 2003; Shonkwiler and Harris, 1996). Reynolds, Story, and Westhead (1994) suggest that new firm formation is associated with job growth and innovative activity. In our analysis, we find a high correlation (0.829) between establishment and employment growth in the 11,858 selected city-industries (described in the data section below).

We use two variables to measure city-industry agglomeration: location quotients and the number of establishments per city-industry. Location quotients are calculated as $LQ = (E_i/E) / (US_i/US)$, where $E_i$ is the number of establishments per city-industry, E is the total number of establishments in the metropolitan area, $US_i$ is the number of U.S. industry establishments, and US is the total number of U.S. establishments. This variable, a measure of industry localization,

[1] This measure, expressed in levels, is similar to the "normalized percent change" that Kirn (1987) used to analyze the growth of service industries across metropolitan areas.

[2] Since this measure represents city-industry change that is not explained by the growth or decline of the overall metropolitan area, the regressions presented in the paper do not include metropolitan-level variables related to regional attributes such as urbanization, fiscal policy and labor costs.

© Southern Regional Science Association 2010.

compares the industry's relative size within a metropolitan area to its relative size in the United States. Values greater than 1.0 indicate that the metropolitan area has a specialization in the industry compared to other parts of the nation. The number of establishments per city-industry, a second measure of agglomeration, represents the absolute size of the industry in each metropolitan area.

Previous studies have included similar variables to measure city-industry agglomeration. Glaeser et al. (1992) and Kim (1995) used location quotients, while Carlton (1982), Head, Ries, and Swenson (1995), Henderson (1986), and Ó hUallacháin and Satterthwaite (1992) used measures of absolute city-industry size to represent industry agglomeration. Like the regression analysis presented in this paper, the empirical models estimated by Henderson (1997) and Henderson, Kuncoro, and Turner (1995) include separate variables that capture city-industry localization and size.

Our approach allows us to categorize industries based on the effects of the two agglomeration variables on growth. A positive effect associated with the localization variable indicates that the industry grew by a larger number of establishments in metropolitan areas with an initial specialization in the sector. This is a sign that the industry may be further expanding in areas where it already has a higher proportion of establishments than the nation as a whole. Thus, we might expect the industry to become more geographically concentrated over time. A positive effect associated with the city-industry size variable suggests that the sector grew more in places with a large initial size, often the largest metropolitan areas included in the analysis. However, this is not a sure indication that the city has increased its level of specialization (i.e., location quotient) in the industry. In some of the largest metropolitan areas, substantial industry growth could occur over time with no increase in the sector's relative size in the city.

Along with the two measures of city-industry agglomeration, the regression models also control for the level of competition within the city-industry. Following Glaeser et al. (1992) and Feldman and Audretsch (1999), we use the average employment size of establishments in the city-industry to represent the competitiveness of the city-industry. The city-industry competition variable is calculated as the number of establishments per worker in the city-industry divided by the number of establishments per worker in the U.S. industry. Values greater than 1.0 indicate that the city-industry is comprised of more competitive businesses (in terms of "competition for new ideas") than the U.S. industry as a whole (Feldman and Audretsch, 1999).

## 3. DATA

The paper uses information from *County Business Patterns* on 121 3-digit SIC sectors that grew by 1,000 or more establishments nationwide between 1986 and 1996. The importance of these industries to the overall U.S. economy increased remarkably over the 10-year period. Collectively, they accounted for 60.0 percent of all U.S. businesses in 1996, up from 48.6 percent in 1986. The regions of interest are the 100 largest metropolitan areas in the United States, based on 1990 population size. These metropolitan areas cover a total of 549 smaller geographic units (mostly counties) across 40 states and the District of Columbia.

Tables 1 and 2 present summary statistics on the industries and metropolitan areas included in the analysis.[3] As shown in Table 1, the industries grew by an average of 112.7 percent between 1986 and 1996, compared to 16.0 percent growth in the total number of U.S.

[3] Unless noted otherwise, the empirical analysis uses variables constructed from *County Business Patterns* data. In counties where employment information is suppressed, we used the midpoint of the range associated with the data suppression flag.

© Southern Regional Science Association 2010.

establishments. On average, about 70 percent of the establishments in the selected industries were located in the 100 largest U.S. metropolitan areas in both 1986 and 1996. The industries are spread across all eight major SIC categories. As noted above, about one-third of the industries are part of the services sector, and another 34.7 percent of the industries belong to wholesale trade, retail trade, or finance, insurance and real estate.

We focus on the selected growing sectors for two reasons. First, as evidenced by the increase in the importance of these industries nationwide, they are key drivers of the economy. A better understanding of the growth of these sectors could provide information about how cities expand over time. Second, the large number of business openings in these industries provides sufficient new activity to examine their geographic evolution. The average size of the sectors included in the analysis grew by over 10,000 establishments between 1986 and 1996. The location of this new business activity could, in some cases, substantially alter the geographic concentration of industry.

**TABLE 1. Summary Statistics on Growing U.S. Industries**[a]

| Characteristic | Mean | Standard Deviation |
|---|---|---|
| Number of establishments, 1986 | 23,347 | 28,752 |
| Number of establishments, 1996 | 33,399 | 36,794 |
| Percentage growth in the number of establishments, 1986 to 1996 | 112.7 | 446.7 |
| Percentage of industry establishments located in 100 largest metropolitan areas, 1986[b] | 71.5 | 12.2 |
| Percentage of industry establishments located in 100 largest metropolitan areas, 1996[b] | 69.8 | 12.4 |
| The 3-digit SIC industries included in the analysis are sub-sectors of eight 1-digit SIC categories. The major categories, and percentages of 3-digit industries that are part of each major industry, are: agricultural services, forestry and fishing (2.5%), construction (8.3%), manufacturing (12.4%), transportation and public utilities (8.3%), wholesale trade (11.6%), retail trade (10.7%), finance, insurance and real estate (12.4%), services (33.8%). | | |

[a] Statistics based on 121 3-digit SIC industries that grew by 1,000 or more establishments between 1986 and 1996. All variables constructed using *County Business Patterns* data.

[b] Largest metropolitan areas based on 1990 population size.

© Southern Regional Science Association 2010.

**TABLE 2. Summary Statistics on Large U.S. Metropolitan Areas** [a]

| Characteristic | Mean | Standard Deviation |
|---|---|---|
| Number of establishments, 1986 | 39,453 | 67,223 |
| Number of establishments, 1996 | 45,917 | 73,414 |
| Percentage growth in the number of establishments, 1986 to 1996 | 18.8 | 11.9 |
| Percentage of city establishments operating in 121 selected 3-digit SIC industries, 1986 [b] | 49.3 | 1.6 |
| Percentage of city establishments operating in 121 selected 3-digit SIC industries, 1996 [b] | 60.2 | 1.8 |

[a] Statistics based on 100 largest U.S. metropolitan areas, in terms of 1990 population size. All variables constructed using *County Business Patterns* data.

[b] Includes industries that grew by 1,000 or more establishments between 1986 and 1996.

The 100 metropolitan areas had a combined total of 3.95 million (i.e., average of 39,453) and 4.59 million (i.e., average of 45,917) establishments in 1986 and 1996, which is about 68 percent of the total number of U.S. businesses in these years. As shown in Table 2, the total number of business establishments in these cities grew by an average of 18.8 percent between 1986 and 1996. Mirroring the trends reported for the entire United States, the 121 selected industries accounted for an average of 49.3 percent and 60.2 percent of the total number of establishments per city in 1986 and 1996.

Table 3 presents descriptive statistics on the city-industries included in the analysis. The 11,858 city-industries with one or more establishments in operation in 1986 grew by an average of 69.12 businesses between 1986 and 1996. On average, about 40 percent of this change in city-industry size (27.17 establishments) is attributed to the growth of the overall metropolitan area, while the remaining 60 percent (41.96 establishments) is above what is explained by metropolitan area growth. Another statistic of note is the low correlation between the two measures of city-industry agglomeration. Using data on 11,858 city-industries that had one or more incumbent establishments, we found a correlation of just 0.086 between the city-industry location quotient and the number of establishments in the city-industry (i.e., the size of the city-industry).[4]

## 4. EFFECTS OF CITY-INDUSTRY AGGLOMERATION

We estimate separate OLS regression models for each of the 121 3-digit SIC industries that grew by 1,000 or more establishments between 1986 and 1996.[5] The regressions use data from city-industry pairs that had one or more incumbent establishments in 1986. The dependent variable is the change in the size of the city-industry above or below what is explained by metropolitan area growth. Explanatory variables include the city-industry location quotient

[4] In 110 of the 121 industries examined in the analysis, the correlation between city-industry size and the location quotient is between -0.50 and 0.50. The average value across the 121 industries is 0.17, suggesting low correlation.

[5] Poisson-type regression models are typically used to examine establishment count data (Coughlin and Segev, 2000; Guimaráes, Figueiredo, and Woodward, 2003; Shonkwiler and Harris, 1996). However, in our case, an OLS estimator is appropriate because the dependent variable is the change in city-industry size – not a count of new establishments – above or below what is explained by the growth of the overall metropolitan area. The dependent variable is less than zero in 2,831 of the 11,858 city-industries.

© Southern Regional Science Association 2010.

(localization), the number of establishments in 1986 (city-industry size), the city-industry competition variable, and a variable that measures interaction between the localization and size variables. The interaction term is used because the effect of localization on growth may differ depending on the absolute size of the city-industry.

Table 4 presents a summary of the regression results, focusing on the sign (i.e., positive or negative) of the marginal effect associated with the location quotient and the number of incumbent establishments.[6] The results suggest that the change in city-industry size, above or below what is explained by metropolitan area growth, is generally smaller in cities with an initial specialization of industry than elsewhere. This result, although inconsistent with past studies that uncovered positive industry agglomeration effects, is similar to the finding reported by Glaeser et al. (1992). They found that "industries grow slower in cities in which they are more heavily represented" (Glaeser et al., 1992, p. 1129).7 Based on Wald joint-hypothesis tests that account for the interaction term used in the regression models, we found that the location quotient has a negative and significant effect (10-percent level) on city-industry growth in 64 of the 121industries. City-industry localization has a positive and significant effect on the change in the number of establishments, above or below what is explained by metropolitan area growth, in just 24 industries.

**TABLE 3. Summary Statistics on City-Industry Growth and Agglomeration**[a]

| Variable | Mean | Standard Deviation |
|---|---|---|
| Change in the number of city-industry establishments, 1986 to 1996 | 69.12 | 215.0 |
| Change in the number of city-industry establishments, 1986 to 1996, attributed to metropolitan area growth | 27.17 | 63.23 |
| Change in the number of city-industry establishments, 1986 to 1996, above or below what is explained by metropolitan area growth | 41.96 | 195.7 |
| City-industry size, 1986 [b] | 165.5 | 508.1 |
| City-industry localization, 1986 [c] | 1.021 | 0.561 |
| City-industry competition, 1986 [d] | 1.358 | 1.902 |

[a] Statistics based on 11,858 city-industries that had one or more establishments in operation in 1986. All variables constructed using *County Business Patterns* data.

[b] Measured by the number of establishments

[c] Measured, using location quotients, as the percentage of a metropolitan area's establishments in the 3-digit SIC category divided by the percentage of U.S. establishments in the same category.

[d] Measured as the number of establishments per worker in the city-industry divided by the number of establishments per worker in the U.S. 3-digit SIC industry.

[6] Full regression results for the 121 models are available upon request. The adjusted R-squared value is greater than 0.50 in 80 of the 121 regressions.

[7] Likewise, Feldman and Audretsch (1999) found that industry specialization discourages innovation in U.S. cities. Glaeser et al. (1992) and Feldman and Audretsch (1999) included variables measuring regional diversification, which were found to have a positive effect on employment growth and innovation, respectively. Our regressions do not include a variable measuring the diversity of industries present in the metropolitan areas.

© Southern Regional Science Association 2010.

**TABLE 4. Effects of Industry Agglomeration on City-Industry Growth: Summary of OLS results** [a]

| Industry | Effect of Localization | Size | Industry | Effect of Localization | Size |
|---|---|---|---|---|---|
| Veterinary services, SIC 740 | - | + | Metalworking machinery, SIC 3540 | **NA** | - |
| Animal services, except veterinary, SIC 750 | - | + | Industrial machinery, n.e.c., SIC 3590 | **NA** | - |
| Landscape and horticultural services, SIC 780 | **NA** | + | Motor vehicles and equipment, SIC 3710 | **NA** | - |
| General building contractors, SIC 1510 | **NA** | + | Measuring and controlling devices, SIC 3820 | + | + |
| Heavy construction, except highway, SIC 1620 | **NA** | + | Medical instruments and supplies, SIC 3840 | + | + |
| Plumbing, heating, air-conditioning, SIC 1710 | **NA** | + | Toys and sporting goods, SIC 3940 | + | + |
| Painting and paper hanging, SIC 1720 | - | + | Miscellaneous manufactures, SIC 3990 | - | - |
| Electrical work, SIC 1730 | - | + | Local and suburban transportation, SIC 4110 | - | + |
| Masonry, stonework, and plastering, SIC 1740 | - | + | Trucking and courier services, except air, SIC 4210 | **NA** | + |
| Carpentry and floor work, SIC 1750 | - | + | Public warehousing and storage, SIC 4220 | **NA** | + |
| Roofing, siding, and sheet metal work, SIC 1760 | **NA** | + | Air transportation, scheduled, SIC 4510 | **NA** | + |
| Concrete work, SIC 1770 | **NA** | + | Airports, flying fields, and services, SIC 4580 | + | + |
| Misc. special trade contractors, SIC 1790 | - | + | Passenger transportation arrangement, SIC 4720 | - | - |
| Women's and misses' outerwear, SIC 2330 | **NA** | + | Miscellaneous transportation services, SIC 4780 | **NA** | + |
| Misc. fabricated textile products, SIC 2390 | - | - | Telephone communication, SIC 4810 | - | + |
| Logging, SIC 2410 | - | - | Electric services, SIC 4910 | - | **NA** |
| Millwork, plywood and structural members, SIC 2430 | - | + | Sanitary services, SIC 4950 | - | **NA** |
| Periodicals, SIC 2720 | - | + | Motor vehicles, parts, and supplies, SIC 5010 | + | **NA** |
| Miscellaneous publishing, SIC 2740 | - | + | Furniture and homefurnishings, SIC 5020 | - | + |
| Commercial printing, SIC 2750 | **NA** | - | Lumber and construction materials, SIC 5030 | - | + |
| Fabricated structural metal products, SIC 3440 | + | - | Professional and commercial equipment, SIC 5040 | - | + |

Table continues on the following page.

© Southern Regional Science Association 2010.

**TABLE 4. Effects of Industry Agglomeration on City-Industry Growth (Continued)**

| Industry | Effect of Localization | Size | Industry | Effect of Localization | Size |
|---|---|---|---|---|---|
| Metals and minerals, except petroleum, SIC 5050 | **NA** | - | Retail stores, n.e.c., SIC 5990 | **NA** | + |
| Electrical goods, SIC 5060 | + | + | Commercial banks, SIC 6020 | + | - |
| Hardware, plumbing and heating equipment, SIC 5070 | **NA** | **NA** | Savings institutions, SIC 6030 | **NA** | + |
| Miscellaneous durable goods, SIC 5090 | - | + | Federal and Federally-sponsored credit, SIC 6110 | **NA** | **NA** |
| Paper and paper products, SIC 5110 | - | + | Business credit institutions, SIC 6150 | **NA** | + |
| Drugs, proprietaries, and sundries, SIC 5120 | + | + | Mortgage bankers and brokers, SIC 6160 | - | + |
| Apparel, piece goods, and notions, SIC 5130 | - | + | Security brokers and dealers, SIC 6210 | + | + |
| Groceries and related products, SIC 5140 | **NA** | + | Security and commodity services, SIC 6280 | - | + |
| Chemicals and allied products, SIC 5160 | **NA** | + | Medical service and health insurance, SIC 6320 | - | + |
| Misc. nondurable goods, SIC 5190 | - | + | Fire, marine, and casualty insurance, SIC 6330 | **NA** | + |
| Retail nurseries and garden stores, SIC 5260 | - | + | Real estate operators and lessors, SIC 6510 | + | - |
| Miscellaneous food stores, SIC 5490 | - | + | Real estate agents and managers, SIC 6530 | **NA** | + |
| Used car dealers, SIC 5520 | + | + | Title abstract offices, SIC 6540 | + | + |
| Auto and home supply stores, SIC 5530 | - | - | Holding offices, SIC 6710 | + | + |
| Women's accessory and specialty stores, SIC 5630 | - | + | Trusts, SIC 6730 | - | + |
| Family clothing stores, SIC 5650 | - | + | Miscellaneous investing, SIC 6790 | **NA** | + |
| Misc. apparel and accessory stores, SIC 5690 | - | + | Hotels and motels, SIC 7010 | - | - |
| Furniture and homefurnishings stores, SIC 5710 | **NA** | - | Camps and recreational vehicle parks, SIC 7030 | + | **NA** |
| Radio, television, and computer stores, SIC 5730 | - | + | Laundry, cleaning, and garment services, SIC 7210 | - | + |
| Used merchandise stores, SIC 5930 | + | - | Photographic studios, portrait, SIC 7220 | - | + |
| Miscellaneous shopping goods stores, SIC 5940 | - | + | Beauty shops, SIC 7230 | **NA** | + |
| Nonstore retailers, SIC 5960 | - | + | Funeral service and crematories, SIC 7260 | **NA** | - |

Table continues on the following page.

© Southern Regional Science Association 2010.

**TABLE 4. Effects of Industry Agglomeration on City-Industry Growth (Continued)**

| Industry | Effect of Localization | Effect of Size | Industry | Effect of Localization | Effect of Size |
|---|---|---|---|---|---|
| Miscellaneous personal services, SIC 7290 | **NA** | + | Offices and clinics of dentists, SIC 8020 | - | + |
| Advertising, SIC 7310 | - | - | Offices of osteopathic physicians, SIC 8030 | - | - |
| Mailing, reproduction, stenographic, SIC 7330 | - | + | Offices of other health practitioners, SIC 8040 | - | + |
| Services to buildings, SIC 7340 | **NA** | + | Nursing and personal care facilities, SIC 8050 | - | + |
| Misc. equipment rental and leasing, SIC 7350 | - | + | Hospitals, SIC 8060 | - | - |
| Personnel supply services, SIC 7360 | - | + | Medical and dental laboratories, SIC 8070 | **NA** | - |
| Computer and data processing services, SIC 7370 | + | + | Home health care services, SIC 8080 | - | - |
| Automobile parking, SIC 7520 | - | + | Health and allied services, n.e.c., SIC 8090 | - | + |
| Automotive repair shops, SIC 7530 | - | + | Elementary and secondary schools, SIC 8210 | - | + |
| Automotive services, except repair, SIC 7540 | **NA** | + | Vocational schools, SIC 8240 | - | + |
| Electrical repair shops, SIC 7620 | - | **NA** | Schools and educational services, n.e.c., SIC 8290 | - | + |
| Miscellaneous repair shops, SIC 7690 | + | - | Residential care, SIC 8360 | + | + |
| Motion picture production and services, SIC 7810 | - | + | Museums and art galleries, SIC 8410 | + | + |
| Dance studios, schools, and halls, SIC 7910 | + | + | Business associations, SIC 8610 | + | + |
| Producers, orchestras, entertainers, SIC 7920 | + | + | Professional organizations, SIC 8620 | + | + |
| Commercial sports, SIC 7940 | - | + | Political organizations, SIC 8650 | - | + |
| Misc. amusement, recreation services, SIC 7990 | - | + | Religious organizations, SIC 8660 | - | + |
| Offices and clinics of medical doctors, SIC 8010 | - | - | | | |

[a] Results summarized in the table are the marginal effects associated with one-unit increases in the location quotient (i.e., localization) and the number of incumbent establishments (i.e., size). A "+" sign indicates a positive and statistically significant marginal effect, a "-" sign indicates a negative and statistically significant marginal effect, and "**NA**" indicates that the variable does not have a statistically significant marginal effect at the 10-percent level.

Results from the study suggest that, other things being equal, the absolute size of a city-industry generally has a positive effect on the change in the number of establishments above or below what is explained by metropolitan area growth. Previous studies by Carlton (1982), Henderson (1986), and Ó hUallacháin and Satterthwaite (1992) also found that industries tend to fare well in cities in which they have a large initial size. The city-industry size variable has a

© Southern Regional Science Association 2010.

positive and significant effect on growth in 90 of the 121 industries, compared to 24 industries in which the size variable has a negative and significant effect. In Table 5, we categorize by major industrial sector the effects of the industry agglomeration variables on city-industry growth. The largest group, by far, includes those sectors (54.5 percent) in which city-industry localization has a negative, and city-industry size a positive, effect on the change in the number of establishments controlling for metropolitan area growth. Less than one-quarter (23.1 percent) of the industries are characterized by positive agglomeration effects associated with city-industry localization and size. The remaining two categories, in which city-industry size has a negative effect on growth, contain a combined total of just over 20 percent of the sectors included in the analysis.

With the exception of manufacturing, the relative proportions of 3-digit industries within the categories shown in Table 5 are similar across the major industrial sectors. Manufacturing is different in that both measures of agglomeration have a negative effect on growth in one-third of the industries, compared to just 13.2 percent of the total number of industries. This includes the generally lower-technology sectors of logging (SIC 2410) and textile products (SIC 2390). On the other hand, both measures of agglomeration encourage growth in some of the higher-technology manufacturing sectors such as measuring and controlling devices (SIC 3820) and medical instruments and supplies (SIC 3840). Within manufacturing, only 20 percent of the industries belong to the category in which city-industry localization has a negative, and city-industry size a positive, effect on growth.

Focusing on services, we find that both measures of agglomeration have a negative effect on growth in healthcare industries such as offices and clinics of medical doctors (SIC 8010), hospitals (SIC 8060), and home health care services (SIC 8080). This is consistent with a pattern of these consumer services expanding in greater numbers in metropolitan areas where they were initially relatively less available. Alternatively, both measures of agglomeration have a positive effect on growth in services such as: dance studios, schools and halls (SIC 7910): producers, orchestras, entertainers (SIC 7920): and museums and art galleries (SIC 8410). This is consistent with a pattern of these artistic and cultural services further expanding in metropolitan areas where they were initially agglomerated.

The city-industry competition variable has a significant effect on the change in city-industry size, above or below what is explained by metropolitan area growth, in just 16 of the 121 industries included in the analysis. City-industry competition has a negative effect on growth in 9 industries and a positive effect in 7 industries. Glaeser et al. (1992) found that city-industry competition encourages industry employment growth across cities, while the competition variable has a negative effect on wage growth.

## 5. CHANGES IN THE GEOGRAPHIC CONCENTRATION OF INDUSTRY

The results presented above provide mixed evidence for the effects of industry agglomeration on city-industry growth. On the one hand, large initial city-industry size is associated with an increase in the change in the number of establishments above or below what is explained by metropolitan area growth. On the other hand, a high localization of industry generally results in a decrease in city-industry growth. In this section, we investigate whether these city-industry agglomeration effects contribute to changes in the geographic concentration of industry.

© Southern Regional Science Association 2010.

**TABLE 5. Effects of Industry Agglomeration on City-Industry Growth by Major Industrial Category**

| Industry | Localization (+) Size (+) | Localization (+) Size (-) |
|---|---|---|
| Agricultural Services, Forestry, & Fishing (*n* = 3) | 0% | 0% |
| Construction (*n* = 10) | 10% | 0% |
| Manufacturing (*n* = 15) | 26.7% | 20% |
| Transportation & Public Utilities (*n* = 10) | 20% | 0% |
| Wholesale Trade (*n* = 14) | 28.6% | 7.1% |
| Retail Trade (*n* = 13) | 15.4% | 7.7% |
| Finance, Insurance, & Real Estate (*n* = 15) | 33.3% | 13.3% |
| Services (*n* = 41) | 24.4% | 9.8% |
| Total (*n* = 121) | 23.1% | 9.1% |
| | Localization (-) Size (+) | Localization (-) Size (-) |
| Agricultural Services, Forestry, & Fishing (*n* = 3) | 100% | 0% |
| Construction (*n* = 10) | 90% | 0% |
| Manufacturing (*n* = 15) | 20% | 33.3% |
| Transportation & Public Utilities (*n* = 10) | 70% | 10% |
| Wholesale Trade (*n* = 14) | 57.1.% | 7.1% |
| Retail Trade (*n* = 13) | 61.5% | 15.4% |
| Finance, Insurance, & Real Estate (*n* = 15) | 46.7% | 6.7% |
| Services (*n* = 41) | 51.2% | 14.6% |
| Total (*n* = 121) | 54.5% | 13.2% |

Following Krugman (1991b), Kim (1995), and Audretsch and Feldman (1996), we use locational Gini coefficients to measure the geographic concentration of industry.[8] A locational Gini coefficient of zero indicates that establishments in the industry are evenly distributed across the 100 metropolitan areas, while coefficients close to 0.5 suggest that the industry is highly concentrated. This measure is similar to the index used by Black and Henderson (1999) to measure changes in the concentration of selected high-tech and capital goods manufacturing sectors between 1963 and 1992. They found that the high-tech sectors became slightly more concentrated over the period, while the capital goods sectors dispersed across U.S. metropolitan areas over time.

The dependent variable is the percentage change in the geographic concentration of industry between 1986 and 1996. Along with the effects associated with city-industry agglomeration, the regression models control for changes in internal and external economies of

[8] A limitation of locational Gini coefficients as a measure of the geographic concentration of industry employment is that they do not account for "lumpiness" in production related to plant size (Ellison and Glaeser, 1997). This problem is less relevant to our analysis since we use establishment counts as an indicator of industry size. Ellison and Glaeser (1997) developed an index of geographic concentration that is unaffected by differences in industry size, the size of industry establishments, and the geographic unit of analysis. We do not use the Ellison-Glaeser index, which requires information on the industry distribution of plant size, because Herfindahl indices are not readily available for the non-manufacturing industries included in the analysis. However, the regression models control for the effect of a change in average industry establishment size on the geographic evolution of industry.

© Southern Regional Science Association 2010.

scale, and changes in an industry's reliance on natural resources. Similar to Kim (1995) and Kim, Barkley, and Henry (2000), we use the average employment size of U.S. industry establishments to represent internal economies of scale. External economies of scale are represented by the proportion of U.S. industry workers in high-technology occupations. Arrow (1962) and Audretsch and Feldman (1996) discuss the importance of knowledge spillovers to high technology industries, and Markusen, Hall, and Glasmeier (1986) define these industries based on the proportion of U.S. industry workers in engineering, scientific, and related occupations.[9] Finally, the proportion of U.S. industry workers in extractive and agricultural-related occupations is used to represent the industry's reliance on natural resources.[10]

Table 6 shows descriptive statistics on the geographic concentration of the 121 3-digit SIC sectors included in the analysis. On average, establishments in these industries experienced

**TABLE 6. Summary Statistics on the Geographic Concentration of Industry**[a]

| Variable | Mean | Standard Deviation |
|---|---|---|
| Percentage change in the geographic concentration of industry, 1986 to 1996 [b] | -4.19 | 20.47 |
| Percentage change in average U.S. industry establishment employment size, 1986 to 1996 [c] | -4.01 | 24.54 |
| Percentage change in the proportion of U.S. industry workers in high-technology occupations, 1986 to 1996[d,e] | 16.69 | 13.21 |
| Percentage change in the proportion of U.S. industry workers in extractive and agricultural-related occupations, 1986 to 1996 [e] | 1.96 | 5.09 |
| Marginal effect associated with city-industry localization | -349.6 | 987.9 |
| Marginal effect associated with city-industry size | 0.439 | 1.642 |
| Localization (+), Size (+) | 23.1% | — |
| Localization (+), Size (-) | 9.1% | — |
| Localization (-), Size (+) | 54.5% | — |
| Localization (-), Size (-) | 13.2% | — |

[a] Statistics based on 121 3-digit SIC industries that grew by 1,000 or more establishments between 1986 and 1996.

[b] Measured using locational Gini coefficients.

[c] Variable constructed using *County Business Patterns* data.

[d] High-technology occupations include engineers, physical scientists, life scientists and computer scientists.

[e] Variable constructed using data from the *National Industry-Occupation Employment Matrix*, U.S. Bureau of Labor Statistics.

[9] The industry-occupation variables were constructed using data from the U.S. Bureau of Labor Statistics *National Industry-Occupation Employment Matrix*.

[10] Kim (1995) used the ratio of the cost of raw materials to industry value-added from the *Census of Manufacturers* to represent raw material intensity. We used industry employment data, measuring the importance of extractive and agricultural-related occupations, to construct a similar variable that is comparable across manufacturing and non-manufacturing sectors.

© Southern Regional Science Association 2010.

a 4.19 percent decrease in geographic concentration across the 100 metropolitan areas between 1986 and 1996.[11] However, 45 of the industries became more geographically concentrated over the period, and the locational Gini coefficient grew by 10 percent or more in 23 of these sectors. On the other hand, the geographic concentration of industry decreased by 10 percent or more in 50 industries.

At first glance, the geographic evolution of the 121 sectors appears to be consistent with the effects of industry agglomeration on city-industry growth reported in the previous section. The 28 industries characterized by positive agglomeration effects associated with localization and city-industry size effects experienced, on average, a 6.08 percent increase in geographic concentration across the 100 metropolitan areas. On the other hand, the 16 sectors with negative localization and city-industry size effects had an average decrease in geographic concentration of 10.5 percent.

In Table 7, we present regression results from an analysis of the change in the geographic concentration of industry. Explanatory variables include the marginal effects associated with city-industry localization and size, the change in average industry establishment employment size, the change in the proportion of workers employed in high-technology occupations, the change in the proportion of employees in extractive and agricultural-related occupations, the industry's initial level of geographic concentration in 1986, and dummy variables to control for the sector's major 1-digit SIC category. The results shown in the right-hand-side column of the table are from a model that, instead of the marginal effects, includes dummy variables indicating the sector's category with respect to the effects of the two measures of city-industry agglomeration.

Our results indicate that, other things being equal, the marginal effect associated with city-industry localization has a positive effect on the change in the geographic concentration of industry. This suggests that, as one might expect, a positive agglomeration effect attributed to city-industry localization would lead to a higher geographic concentration of industry. Conversely, the marginal effect associated with city-industry size has a negative effect on the change in the geographic concentration of industry. This means that, perhaps surprisingly, a positive agglomeration effect attributed to city-industry size would result in a greater dispersion of industry.

We find a positive relationship between the change in the geographic concentration of industry and the dummy variable indicating that the sector is characterized by positive agglomeration effects associated with localization and city-industry size. The 3-digit SIC sectors of Holding Offices (SIC 6710) and Security Brokers and Dealers (SIC 6210) are two prime examples of industries with positive localization and city-industry size agglomeration effects that became substantially more geographically concentrated across the 100 metropolitan areas between 1986 and 1996. Similarly, Kirn (1987) and Coffey and Shearmur (2002) reported that some financial services maintained or increased levels of geographic concentration. In addition,

[11] Changes in the geographic concentration varied somewhat across broad industrial categories. Eighty percent of the manufacturing (12 out of 15) and transportation (8 out of 10) sectors experienced a decrease in geographic concentration, while 70 percent of construction (7 out of 10) and 42 percent of service (17 out of 41) industries became more geographically concentrated.

© Southern Regional Science Association 2010.

**TABLE 7. OLS Regression Results: Changes in the Geographic Concentration of Industry, 1986 to 1996 (*n*=121)**

| Variable | Estimated Coefficients | |
|---|---|---|
| Constant | 0.135** | 0.106 |
| | (2.090) | (1.313) |
| Marginal effect associated with city-industry localization | 3.82e-05** | — |
| | (2.018) | |
| Marginal effect associated with city-industry size | -0.029*** | — |
| | (-2.662) | |
| Localization (+), Size (+) | NA | 0.168*** |
| | | (2.736) |
| Localization (+), Size (-) | NA | 0.132* |
| | | (1.798) |
| Localization (-), Size (+) | NA | -0.014 |
| | | (-0.252) |
| Percentage change in average U.S. industry establishment employment size, 1986 to 1996 | 0.146* | 0.199** |
| | (1.714) | (2.411) |
| Percentage change in the proportion of U.S. industry workers in high-technology occupations, 1986 to 1996 | -0.086 | 0.030 |
| | (-0.491) | (0.179) |
| Percentage Change in the proportion of U.S. industry workers in extractive and agricultural-related occupations, 1986 to 1996 | 0.650* | 0.623* |
| | (1.836) | (1.802) |
| Geographic concentration of industry, 1986 | -0.403*** | -0.406*** |
| | (-2.986) | (-3.058) |
| Agricultural services, forestry and fishing | -0.241* | -0.215* |
| | (-1.926) | (-1.789) |
| Manufacturing | -0.089 | -0.143 |
| | (-1.011) | (-1.621) |
| Transportation and public utilities | -0.098 | -0.131 |
| | (-1.050) | (-1.463) |
| Wholesale trade | -0.003 | -0.075 |
| | (-0.040) | (-0.888) |
| Retail trade | -0.127 | -0.191** |
| Finance, insurance and real estate | 0.005 | -0.061 |
| | (0.059) | (-0.697) |
| Services | -0.052 | -0.122* |
| | (-0.704) | (-1.720) |
| $R^2$ | .258 | .314 |
| Adjusted $R^2$ | .167 | .224 |

*, **, and *** indicate variable is significant at the 10-percent, 5-percent, and 1-percent levels, respectively.

© Southern Regional Science Association 2010.

the regression results reveal a positive relationship between the change in the geographic concentration of industry and the dummy variable indicating that the sector is characterized by a positive localization effect, and a negative effect is associated with city-industry size. Thus, relative to the omitted category, the geographic concentration of industry increases in both sets of sectors with positive industry localization effects.

Other results of note presented in Table 7 suggest that an increase in the average employment size of industry establishments leads to a higher geographic concentration of industry. This is consistent with findings reported by Kim (1995), who found that differences in the geographic concentration of industry over time are driven by differences in the average size of establishments. The results also imply that an increase in the proportion of workers employed in extractive and agricultural-related occupations results in an increase in the geographic concentration of industry. Finally, the initial size of the locational Gini coefficient has a negative effect on the change in the geographic concentration of industry.

## 6. SUMMARY AND CONCLUSIONS

Two themes have emerged from previous studies on regional industry agglomeration and the geographic evolution of industry. First, a high agglomeration of industry generally leads to an increase in employment growth, worker productivity, and business location (Guimarães, Figueiredo, and Woodward, 2000; Hanson, 2001; Head, Ries, and Swenson 1995; Henderson, 1986; Henderson, Kuncoro, and Turner, 1995; Rigby and Essletzbichler, 2002). Second, industries have become more dispersed across regions of the United States since World War II (Dumais, Ellison, and Glaeser, 2002; Kim, 1995). These seemingly contradictory findings raise the question of whether industry agglomeration effects, uncovered at the regional level, are consistent with changes in the geographic concentration of industry.

Our results offer empirical evidence on the extent to which growth (or decline) associated with industry agglomeration in metropolitan areas contributes to the geographic evolution of industry. The relationship between the city-industry localization effect and the change in the geographic concentration of industry is relatively straightforward. Analysis of 121 growing sectors suggests that industry localization generally has a negative effect on city-industry growth. This implies that industries expanded by a smaller number of establishments in metropolitan areas with an initial specialization in the sector, which could lead to a dispersion of industry.

A second analysis revealed, as one might expect, a positive relationship between the change in the geographic concentration of industry and the estimated effect on city-industry growth associated with industry localization. This suggests that industries with positive localization effects became more concentrated while those with negative localization effects became more dispersed. Our results from both sets of analyses, considered together, suggest that the negative effects of city-industry localization on growth are, in fact, consistent with a lower geographic concentration of industry across the selected metropolitan areas.

The connection between the agglomeration effect attributed to city-industry size and the geographic evolution of industry is somewhat less intuitive. Initially, we found that city-industry size generally has a positive effect on the change in the number of establishments controlling for overall metropolitan area growth. This suggests that sectors grew by more establishments in metropolitan areas with a large initial city-industry size, often the biggest U.S. cities. However, we then found that this agglomeration effect results in a decrease in the geographic concentration

© Southern Regional Science Association 2010.

of industry. In other words, the growth occurring in the largest metropolitan areas did not translate into an increase in the geographic concentration of industry.

Similarly, as shown in Table 8, the substantial city-industry growth that occurred in large metropolitan areas rarely led to an increase in industry specialization. The left-hand-side column shows the aggregate change in city-industry size, summed across all 121 industries, controlling for overall metropolitan area growth. Table 8 focuses on the ten places that rank highest by this measure of growth, which happen to be some of the largest U.S. cities. The right-hand-side column shows the number of industries, out of 121, in which the metropolitan area increased its specialization between 1986 and 1996. Results indicate that substantial growth occurred in large metropolitan areas such as New York, Los Angeles, and Chicago, but these places became more specialized in a relatively small number of industries.

These findings provide insights into how industries and cities expand and evolve over time. First, for the industries considered in the study, fewer new businesses tend to locate (or more shut down operations) in metropolitan areas with an initial specialization of industry than in places with a lower percentage of industry establishments (compared to the national average). This suggests that, instead of being attracted by the benefits of industry localization, firms and entrepreneurs in many of the fastest-growing industries seek out opportunities in places where there are fewer similar operations. As this occurs, industries become more spread out across metropolitan areas.

Second, more businesses tend to locate (or fewer shut down operations) in metropolitan areas with a large initial absolute size of industry, often the biggest U.S. cities, than in places with fewer incumbent establishments. This suggests that firms and entrepreneurs prefer places with abundant (input and output) market opportunities, such as those found in big cities.

**TABLE 8. Metropolitan Areas with the Largest Growth in Aggregate City-Industry Size**

| Metropolitan Area | Change in Aggregate City-Industry Size [a] | Number of Industries with Increased Specialization [b] |
|---|---|---|
| New York, NY | 63,656 (1) | 41 (99t) |
| Los Angeles, CA | 38,535 (2) | 46 (95) |
| Chicago, IL | 23,154 (3) | 51 (90t) |
| Washington, D.C. | 19,295 (4) | 42 (97t) |
| San Francisco, CA | 18,058 (5) | 45 (96) |
| Boston, MA | 16,796 (6) | 53 (85t) |
| Philadelphia, PA | 15,831 (7) | 41 (99t) |
| Dallas, TX | 13,223 (8) | 58 (60t) |
| Atlanta, GA | 12,111 (9) | 53 (85t) |
| Miami, FL | 12,010 (10) | 58 (60t) |

[a] Calculated as the aggregate change in city-industry size, summed across all 121 industries, above or below what is explained by overall metropolitan area growth. Figures shown in parentheses are the city's ranking out of 100 metropolitan areas

[b] The number of industries, out of 121, in which the metropolitan area increased its specialization between 1986 and 1996. Figures shown in parentheses are the city's ranking out of 100 metropolitan areas.

© Southern Regional Science Association 2010.

However, the substantial industry growth that took place in the largest U.S. metropolitan areas did not generally translate into a higher specialization of industry. In other words, big cities can accommodate substantial growth in the number of new businesses without developing an increase in the specialization of industry.

When considering these results, it is important to keep in mind that the analysis focused on a wide variety of industries that experienced substantial nationwide growth (i.e., net change of more than 1,000 establishments) between 1986 and 1996. This includes many services and retail industries, while only a small percentage of the sectors analyzed in the study are manufacturers (12.4 percent of the industries). For some services (e.g., automotive repair shops, laundry services) and retail (e.g., family clothing stores, nurseries, and garden stores) industries, it makes intuitive sense that firms and entrepreneurs would locate in places with relatively fewer competitors (i.e., a lower initial specialization). Likewise, it is no surprise that these types of industries experienced substantial growth in places with a large number of incumbent establishments (i.e., big cities).

However, as mentioned earlier in the paper, the results show that the benefits of industry localization are attractive to firms and entrepreneurs in certain industries. These include some of the higher-technology manufacturing sectors, such as measuring and controlling devices and medical instruments and supplies. Likewise, we found a positive effect of industry specialization on growth in artistic and cultural services such as museums and arts galleries, dance studios, schools, and halls. In these types of industries, firms and entrepreneurs seek out places with a relative abundance of similar businesses to share workers and technology, and—in the case of artistic and cultural services—to attract larger audiences through shared marketing and promotion.

## REFERENCES

Arrow, Kenneth. (1962) "The Economic Implications of Learning by Doing," *Review of Economic Studies*, 29, 155–173.

Audretsch, David B. and Maryann Feldman. (1996) "R&D Spillovers and the Geography of Innovation and Production," *American Economic Review*, 86, 630–640.

Black, Duncan and Vernon Henderson. (1999) "Spatial Evolution of Population and Industry in the United States," *American Economic Review*, 89, 321–327.

Brewer, H. L. (1985) "Measures of Diversification: Predictors of Regional Economic Instability," *Journal of Regional Science*, 25, 463–470.

Carlton, Dennis W. (1983) "The Location and Employment Choices of New Firms: An Econometric Model with Discrete and Continuous Endogenous Variables," *Review of Economics and Statistics*, 65, 440–449.

Coffey, William, Richard Shearmur. (2002) "Agglomeration and Dispersion of High-order Service Employment in the Montreal Metropolitan Region, 1981-96. *Urban Studies*, 39, 359–378.

Conroy, Michael. (1975) "The Concept and Measurement of Regional Industrial Diversification," *Southern Economic Journal*, 41, 492–505.

© Southern Regional Science Association 2010.

Coughlin, Cletus and Eran Segev. (2000) "Location Determinants of New Foreign-owned Manufacturing Plants," *Journal of Regional Science*, 40, 323–351.

Dumais, Guy, Glenn Ellison, and Edward Glaeser. (2002) "Geographic Concentration as a Dynamic Process," *Review of Economics and Statistics*, 84, 193–204.

Ellison, Guy and Edward Glaeser. (1997) "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach," *Journal of Political Economy*, 105, 889–927.

_____. (1999) "The Geographic Concentration of Industry: Does Natural Advantage Explain Agglomeration?," *American Economic Review*, 89, 311–316.

Fawson, Christopher, Dawn Thilmany, John E. Keith. (1998) "Employment Stability and the Role of Sectoral Dominance in Rural Economies," *American Journal of Agricultural Economics*, 80, 521–533.

Feldman, Maryann and David B. Audretsch. (1999) "Innovation in Cities: Science-based Diversity, Specialization and Localized Competition," *European Economic Review*, 43, 409–429.

Feser, Edward. (2002) "Tracing the Sources of Local External Economies," *Urban Studies*, 39, 2485–2506.

Glaeser, Edward, Hedi Kallal, José A. Scheinkman, and Andrei Shleifer. (1992) "Growth in Cities," *Journal of Political Economy*, 100, 1126–1152.

Guimarães, Paulo, Octávio Figueiredo, and Douglas Woodward. (2000) Agglomeration and the Location of Foreign Direct Investment in Portugal." *Journal of Urban Economics*, 47, 115–135.

_____. (2003) "A Tractable Approach to the Firm Location Decision Problem," *Review of Economics and Statistics*, 85, 201–204.

Hanson, Gordon H. (2001) "Scale Economies and the Geographic Concentration of Industry," *Journal of Economic Geography*, 1, 255–276.

Head, Keith, John Ries, and Deborah Swenson. (1995) "Agglomeration Benefits and Location Choice: Evidence from Japanese Manufacturing Investments in the United States," *Journal of International Economics*, 38, 223–247.

Henderson, J. Vernon. (1986) "Efficiency of Resource Usage and City Size," *Journal of Urban Economics*, 19, 47–70.

_____. (1997) "Externalities and Industrial Development," *Journal of Urban Economics*, 42, 449–470.

Henderson, J. Vernon, Ari Kuncoro, and Matthew Turner. (1995) "Industrial Development in Cities," *Journal of Political Economy*, 103, 1067–1090.

Jacobs, Jane. (1969) *The Economy of Cities*. Vintage: New York.

Kim, Sukkoo. (1995) "Expansion of Markets and the Geographic Distribution of Economic Activities: The Trends in U.S. Regional Manufacturing Structure, 1860-1987," *Quarterly Journal of Economics*, 110, 881–908.

© Southern Regional Science Association 2010.

_____. (1999) "Regions, Resources, and Economic Geography: Sources of U.S. Regional Comparative Advantage, 1880 – 1987," *Regional Science and Urban Economics*, 29, 1–32.

Kim, Yunsoo, David Barkley, Mark S. Henry. (2000) "Industry Characteristics Linked to Establishment Concentrations in Nonmetropolitan Areas," *Journal of Regional Science*, 40, 231–259.

Kirn, Thomas J. (1987) "Growth and Change in the Service Sector of the U.S.: A Spatial Perspective," *Annals of the American Geographers*, 77, 353–372.

Krugman, Paul. (1991a) "Increasing Returns and Economic Geography," *Journal of Political Economy*, 99, 483–499.

_____. (1991b) *Geography and Trade*. MIT Press: Cambridge, MA.

Markusen, Ann, Peter Hall, and Amy Glasmeier. (1986) *High Tech America*. Boston, Massachusetts: Allen & Unwin.

Marshall, Alfred. (1890) *Principles of Economics*. Macmillan: London.

Ó hUallacháin, Breandán. (1989) "Agglomeration of Services in American Metropolitan Areas," *Growth and Change*, 20, 34–49.

Ó hUallacháin, Breandán and Mark A. Satterthwaite. (1992) "Sectoral Growth Patterns at the Metropolitan Level: An Evaluation of Economic Development Incentives," *Journal of Urban Economics*, 31, 25–58.

Quigley, John M. (1998) "Urban Diversity and Economic Growth," *Journal of Economic Perspectives*, 2, 127–138.

Reynolds, Paul, David Storey, and Paul Westhead. (1994) "Cross-national Comparisons of the Variation in New Firm Formation Rates," *Regional Studies*, 28, 443–456.

Rigby, David L. and Jürgen Essletzbichler. (2002) "Agglomeration Economies and Productivity Differences in U.S. Cities," *Journal of Economic Geography*, 2, 407–432.

Romer, Paul. (1986) "Increasing Returns and Long-run Growth," *Journal of Political Economy*, 94, 1002–1037.

Rosenthal, Stuart S. and William C. Strange. (2001) "The Determinants of Agglomeration," *Journal of Urban Economics*, 50, 191–229.

Shonkwiler, J. Scott, Thomas R. Harris. (1996) "Rural Retail Business Thresholds and Interdependencies," *Journal of Regional Science*, 36, 617–630.

© Southern Regional Science Association 2010.