

Explaining an Industry Cluster: The Case of U.S. Car Makers from 1895–1969

By David A. Price and Zhu Wang

The geographic clustering of companies within an industry is often attributed to several agglomeration economies: intra-industry spillovers (benefits from proximity to firms in the same industry), inter-industry spillovers (benefits from proximity to firms in related industries), and spinoffs (firms established by former employees of a company in the same industry). Analysis of data on the U.S. auto industry in its first 75 years sheds light on the relative importance of those forces to the clustering of car makers.

Geographic clustering of industries is common. For example, the American film industry is concentrated disproportionately in the Los Angeles area; finance in Manhattan; and computer technology in Silicon Valley. In some cases, clustering is readily explained. For example, in the Fifth District, the concentration of federal contractors in the Washington, D.C. metropolitan area reflects their desire to be near federal agency customers. In other cases, particularly in the manufacturing and energy sectors, clustering may result in part from proximity to transportation (such as waterways or railways) or natural resources.

In addition to essentially exogenous factors such as these, the emergence of industry clusters is believed to be influenced substantially by the interplay of several forces that reward geographic concentration. Economists have studied these forces, known as economies of agglomeration, at least since Alfred Marshall's *Principles of Economics* in 1890, in which Marshall sought to explain what he called the "localization of industries."¹ The study of agglomeration economies, and their importance

in relation to one another, helps to explain differences in worker income and productivity in different geographical areas. It may assist economists in tracing the role of urbanization and in accounting for the rise of industrial centers. It also may help national and regional policymakers understand how to promote—or, at least, not stifle—the development of industry clusters that may lead to increased incomes. For example, to the extent that agglomeration is positively affected by the mobility of employees to found start-ups that compete with their former employers, policies that strongly enforce non-compete agreements may inhibit a region's growth and overall industry productivity.

Recent research by one of the authors of this article (Wang), together with Luís Cabral of New York University and Daniel Xu of Duke University, seeks to explain the clustering of the U.S. auto industry in its first 75 years.² They evaluate the relative contributions of three agglomeration forces:

- Intra-industry spillovers are benefits that a firm receives from the presence of firms in the same industry, such as labor pooling

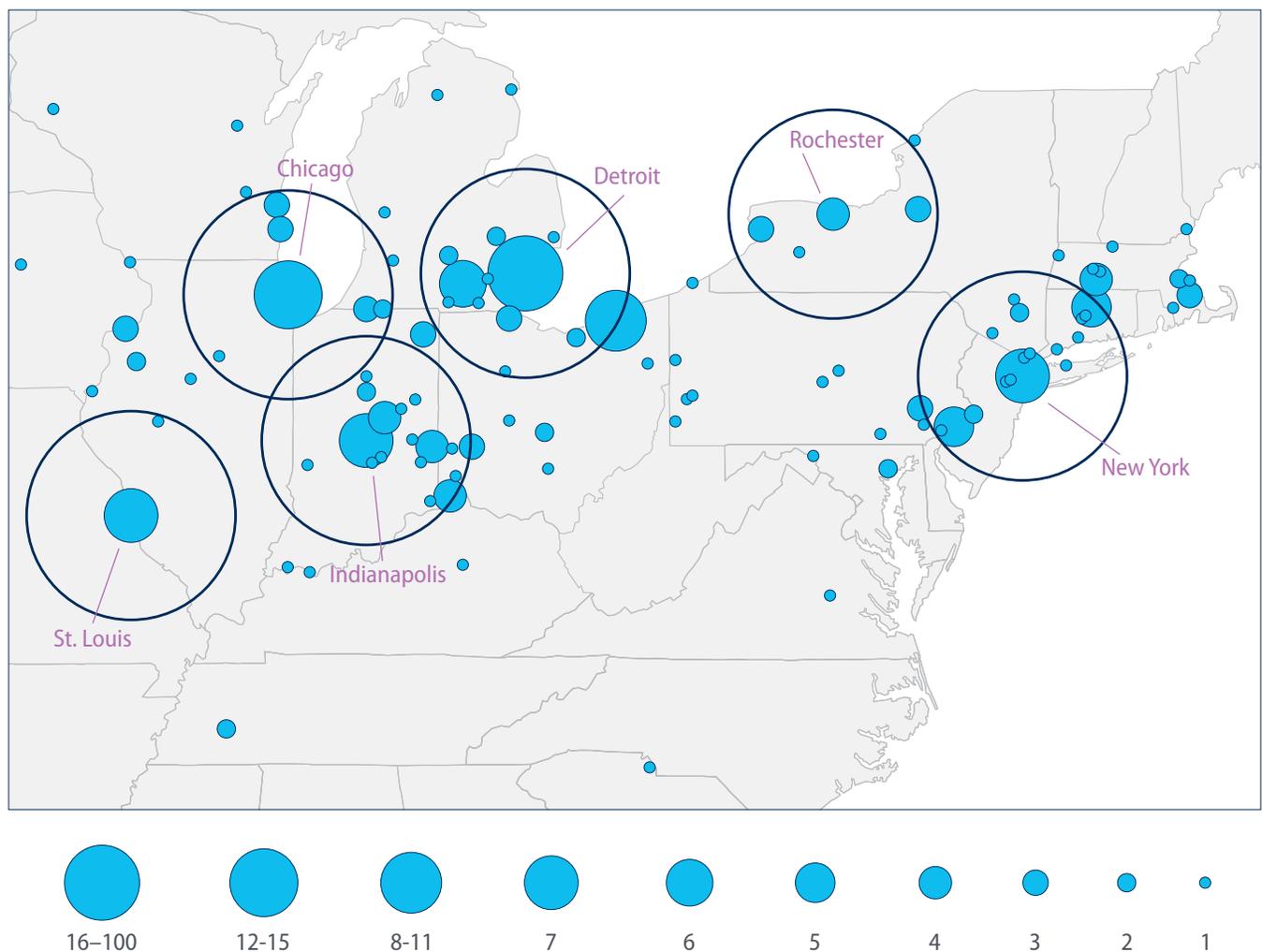
(access to a concentrated pool of skilled workers who are drawn to the area by demand for their skills), sharing of knowledge, and access to needed inputs and supporting services.

- Inter-industry spillovers are benefits that a firm receives from the presence of firms in related industries, especially the sharing of knowledge across industries. The identification of this effect is most often associated with Jane Jacobs' 1969 book *The Economy of Cities*.³
- Spinoffs are new companies formed by one or more high-level, high-skilled employees who defected from a company in the same industry,

perhaps because they became dissatisfied with the prospects of their initial company or because they believed they could succeed as entrepreneurs. A well-known example of agglomeration from spinoffs is the Silicon Valley computer technology cluster, which arose largely through spinoffs in the 1960s from Fairchild Semiconductor—a firm that had itself spun off from Shockley Semiconductor in 1957.⁴

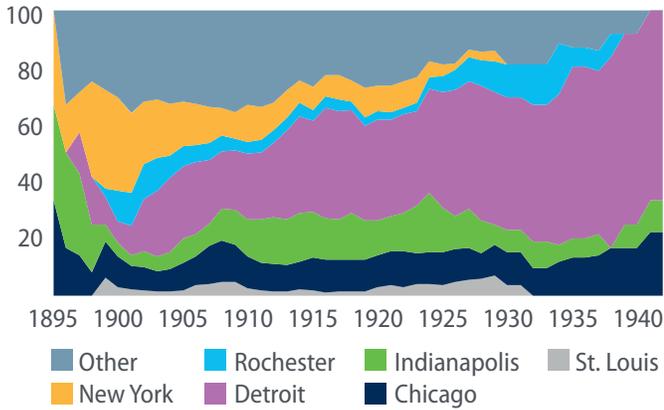
While earlier work has considered the effects of these forces on various industries, including the auto industry, the research by Wang, Cabral, and Xu is unique in quantifying the extent to which each effect has influenced the industry's

Figure 1: Clusters of Car Makers in 1910



Sources: Philip H. Smith, *Wheels within Wheels: A Short History of American Motor Car Manufacturing*, New York: Funk & Wagnalls, 1968; and Luis Cabral, Zhu Wang, and Daniel Xu, "Competitors, Complementors, and Parents: Explaining Regional Agglomeration in the U.S. Auto Industry"

Figure 2: Percentage of Car Makers in Each Cluster



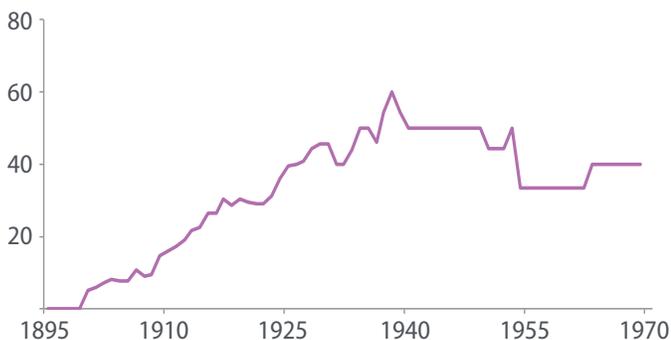
Sources: Philip H. Smith, *Wheels within Wheels: A Short History of American Motor Car Manufacturing*, New York: Funk & Wagnalls, 1968; and Luís Cabral, Zhu Wang, and Daniel Xu, "Competitors, Complementors, and Parents: Explaining Regional Agglomeration in the U.S. Auto Industry"

Figure 3: Geographic Concentration of Car and Carriage Industries



Sources: Census of U.S. Manufacturers, 1904; and Philip H. Smith, *Wheels within Wheels: A Short History of American Motor Car Manufacturing*, New York: Funk & Wagnalls, 1968

Figure 4: Percent of Car Makers that Started as Spinoffs



Sources: *Standard Catalog of American Cars, 1890–1942*; and Luís Cabral, Zhu Wang, and Daniel Xu, "Competitors, Complementors, and Parents: Explaining Regional Agglomeration in the U.S. Auto Industry"

geographic concentration. Their research also examines how the importance of the forces in relation to one another has changed over the industry's life cycle.

The Auto Industry's Evolution

The number of U.S. car makers during the industry's early decades swung widely, from a handful in the late 1890s to more than 200 in 1910 and then back down to eight survivors in the 1940s. The number and locations of the industry's centers of production also varied over time. In the late 1890s, Chicago and New York City were the most important clusters. By 1910, other production centers emerged, namely Indianapolis, Rochester, St. Louis, and Detroit. (See Figure 1.)⁵

The industry's geographic concentration—in terms of both the number of firms and the firms' output—grew over time. (See Figure 2.) By 1905, one-quarter of all active firms were in the Detroit area, producing more than half of the industry's output; 16 percent of the firms were in New York City; 10 percent in Chicago; 8 percent in Indianapolis; 7 percent in Rochester; 2 percent in St. Louis; and the remaining 32 percent were scattered in other locations. Fifteen years later, Detroit had 35 percent of all active firms and more than 70 percent of output. By 1938, two-thirds of U.S. car makers were headquartered in Detroit.

The industry's early production clusters were also centers of a related industry, carriage and wagon manufacturing. A center's activity in the carriage and wagon industry, as measured by employment, correlates with the number of car makers in that area. (See Figure 3.) One possible explanation of this relationship is the fact that many leaders in the infant auto industry, such as William Durant (founder of General Motors), had been veterans of the carriage and wagon industry. Their experience in the older industry may have given them engineering, manufacturing, or marketing know-how that was beneficial to them as automobile entrepreneurs.

Many of the firms in the study (about 17 percent) originated as spinoffs. Wang, Cabral, and Xu found that over the course of the study period (1895 to 1969), there were more than 50 spinoff "families"—

that is, groups of car makers with spinoff relationships. The largest of these was GM, which yielded 10 first-generation spinoffs and another five second-generation spinoffs, or spinoffs of spinoffs. Among the first-generation spinoffs from GM were Chevrolet (later absorbed into GM), Chrysler, and Lincoln. The percentage of car makers that were spinoffs increased from zero in the industry's first five years to a high of 60 percent in 1938, declining steadily to 33 percent in the 1950s, and finally stabilizing at 40 percent in the 1960s. (See Figure 4.)

What Explains the Clustering?

Wang, Cabral, and Xu analyze the history of the industry—including its entrepreneurs, spinoff families, and production centers—using data on every make of car produced commercially in the United States from 1895 through 1969. They consider 775 firms, together with data on the relevant regional economies, including carriage and wagon industry employment. They incorporate these data into regressions of firm entry and exit, thereby testing the extent to which the various agglomeration forces were associated with greater clustering.⁶

With regard to intra-industry spillovers, they find no measurable overall effect on industry clustering; that is, the presence of other car makers did not appear to increase firm entry rates or decrease exit rates. At least in the context of the U.S. auto industry through 1969, this result contrasts with the view that clustering, in and of itself, induces other firms to locate in an area in pursuit of benefits such as labor pooling. While positive externalities from clustering may exist, negative effects from the concentration of firms (such as greater competition for labor and other inputs) appear to offset the positive externalities.

The researchers did find evidence for important effects from inter-industry spillovers (in this case, from the carriage and wagon industry). The number and quality of non-spinoff entrants, even including entrants from outside the carriage and wagon industry, were significantly affected by the size of the carriage and wagon industry in the area. While the researchers' models do not seek to pinpoint the mechanism by which a strong presence of the carriage and

wagon industry was associated with the development of the infant auto industry in a given area, the correlation is clearly strong.

The researchers also find that spinoff effects matter. According to their analysis, spinoffs accounted for approximately one-third of the industry clustering during the period, but contributed to agglomeration primarily in later stages of the industry's life cycle. The data also yield some indications of when a spinoff was most likely to take place. The researchers find that older firms were more likely to give birth to a spinoff than younger firms. To the extent that firms' longevity may have reflected some threshold of firm quality, this relationship suggests that higher-quality firms were more likely to give birth to spinoffs. The likelihood of a spinoff was also associated with the size of the family; the greater the number of spinoffs that had already been formed within a family, the higher the probability that another spinoff would emerge. Again, the size of the family also may indicate the quality of the family, with high-quality families generating more spinoffs. The likelihood of a spinoff from a family was also associated with other measures of the quality of the family, such as the number of top automobile producers within the family.⁷

These proxies for quality of the family were associated not only with the number of spinoffs, but also with significantly increased survival rates of the spinoffs. To investigate this phenomenon further, the researchers look into the nature of the spinoff family effect. They consider whether the effect was present regardless of the spinoff's location or only for spinoffs located near their relatives; they find that family size and quality matter only in the latter case. This finding suggests that the family effect can be viewed as a special form of local externality, requiring local proximity, rather than an effect arising only from the family relationship itself.

Conclusion

In the setting of the U.S. auto industry, the researchers' analysis suggests certain refinements of traditional views of agglomeration. It highlights the importance of inter-industry spillovers; the significant, but lesser,

importance of spinoffs; and no measurable overall contribution by intra-industry spillovers.

Future directions for research on comparative agglomeration effects could include pursuing other measures of firm performance and family quality, such as net income, output, employment, or product variety. Further research could extend the analysis to other, more recent industries. It also could assess whether spinoff effects have become more important with the emergence of new forms of financing for entrepreneurship, such as the large and active venture capital industry. ■

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Endnotes

- ¹ Alfred Marshall, *Principles of Economics*, London: Macmillan and Co., 1890, p. 271.
- ² Luís Cabral, Zhu Wang, and Daniel Xu, "Competitors, Complementors, and Parents: Explaining Regional Agglomeration in the U.S. Auto Industry," Manuscript, February 2012.
- ³ Jane Jacobs, *The Economy of Cities*, New York: Random House, 1969.
- ⁴ See Steven Klepper, "The Origin and Growth of Industry Clusters: The Making of Silicon Valley and Detroit," *Journal of Urban Economics*, January 2010, vol. 67, no. 1, pp. 15–32; also see Christophe Lécuyer, *Making Silicon Valley: Innovation and the Growth of High Tech, 1930–1970*, Cambridge: MIT Press, 2007.
- ⁵ Wang, Cabral, and Xu defined a production center city as a city with at least five car producers in 1910. They then define a region within a 100-mile radius of the center city as the production center named after the city.
- ⁶ On account of the small number of firms from 1943 onward, and the lack of new entrants from 1943–69, the regressions cover only the 1895–1942 period.
- ⁷ Wang, Cabral, and Xu defined "top automobile producers" as those whose sales ranked in the top 15 in the United States in any one year.

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