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Industrialization and urbanization: Did the steam engine contribute to the growth of cities in the United States? ☆

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Abstract

Industrialization and urbanization are seen as interdependent processes of modern economic development. However, the exact nature of their causal relationship is still open to considerable debate. This paper uses firm-level data from the manuscripts of the decennial censuses between 1850 and 1880 to examine whether the adoption of the steam engine as the primary power source by manufacturers during industrialization contributed to urbanization. While the data indicate that steam-powered firms were more likely to locate in urban areas than water-powered firms, the adoption of the steam engine did not contribute substantially to urbanization.

Keywords: Industrialization; Urbanization; Factory; Steam power; Water power

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1. Introduction

Industrialization and urbanization are seen as interdependent processes of modern economic development. In the United States, industrialization began in the early nineteenth century as manufacturing re-organized from artisanal shops to non-mechanized factories in a handful of industries; however, in the second half of the nineteenth century, manufacturing activity rose in scale, became more mechanized and spread to numerous industries. The rise of a manufacturing sector, especially in the second half of the nineteenth century, coincided with a significant growth in urban population. As the domestic labor force in manufacturing doubled from 10 to 20% between 1850 and 1880, so too did the share of the population in urban places, from 15 to 30%.

One of the major developments associated with industrialization was the shift in primary power sources for manufacturing from hand and water power to steam power, particularly in large factories. This shift towards greater use of steam power by manufacturers is believed to be explained by a sharp decline in the relative user cost of steam compared to other power sources. According to Atack's (1979) estimates, the annual costs per horsepower of steam fell below that of water power in the 1840s. By 1870, steam power capacity in manufacturing was greater than that of water-power (Fenichel, 1979 and Rosenberg and Trajtenberg, 2004). While rigorous comparisons of hand and steam power costs do not exist, the relative cost of using hand power may have risen as wages were increasing over this period (see Margo, 2000).

In a recent paper, Rosenberg and Trajtenberg (2004) argue that the adoption of the steam engine by manufacturers, and in particular the Corliss engine, was responsible for the rapid rise in urbanization.[1] By releasing firms from the locational limitations of topography and climate and offering them the freedom to locate in cities, they argue that the deployment of the Corliss steam engine served as a catalyst for the relocation of firms from rural locations to cities. While the idea that the steam engine contributed to urbanization is not new, and indeed many early promoters of the steam engine proclaimed locational freedom as one of its major benefits, Rosenberg and Trajtenberg's paper represents the first serious empirical estimate of this hypothesis.[2] In sum, they

[1] Rosenberg and Trajtenberg believe that the Corliss steam engine was a general purpose technology that was responsible for triggering economic growth in the late nineteenth century. They argue that the steam engine, by fostering urbanization, allowed the economy to capture significant benefits of agglomeration economies. However, previous studies that use the growth accounting framework suggest a limited role of general purpose technologies on economic growth. For example, Crafts (2004) and Crafts and Mills (2004) find that the impact of the steam engine on UK economic growth was rather modest. A social savings calculation suggests that the steam engine's contribution to growth was about 0.05% per year between 1870 and 1910.

[2] For example, the *Scientific American*, in their May 12, 1849 issue, wrote: "A water-mill is necessarily located in the country afar from the cities, the markets, and the magazines of labor, upon which it must be dependent. Water appears to run very cheaply, but it always rents for a high price, and the [capital] cost of dams, races, water wheels etc. is on the average quite as great as that of a steam engine and equipage... A man sets down his steam-engine where he pleases—that is, where it is most to his interest to plant it, in the midst of the industry and markets, both for supply and consumption of a great city—where he is sure of always having hands near him, without loss of time in seeking for them, and where he can buy his raw materials and sell his goods, with adding the expense of double transportation." See Hunter (1985, p.104).