Changing Structure of U.S. Regions: A Historical Perspective

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Introduction

Between the nineteenth and twentieth centuries, the Midwest became the dominant manufacturing region of the United States. The Midwest's manufacturing employment rose from 144.6 thousand to 4.3 million employees between 1860 and 1947 and its share of the national manufacturing employment rose from 12.7% to 30.2%. In the latter half of the twentieth century, however, the Midwest began to decline as a center of manufacturing. Its manufacturing employment fell from a peak of 5.15 million to 4.19 million employees between 1967 and 1987; its national share also fell from 26.7% to 22.1% over those years.[1]

While the decline of the Midwest is troubling from the point of view of the residents and policymakers in the Midwest, the phenomenon is less alarming from a national viewpoint. In fact, to the extent that the loss of manufacturing employment in the Midwest is offset by corresponding gain in other regions, the decline of the Midwest may even be interpreted as efficient. In order to provide a historical framework for evaluating the state of the Midwest economy in a context of an evolving national economy, this paper examines the long-run changes in the nature of U.S. regional economic integration and how these changes have influenced the economic structure of the U.S. regional economies over time.

A Framework for Analysis

The extent of spatial economic integration significantly influences the scope and level of regional economic activities. If regions are isolated, then each region must be self sufficient. If regions are economically integrated, then each region can specialize in a subset of goods and trade with other regions. Although the extent of economic integration determines whether or not specialization is possible, the pattern of regional specialization depends upon the causes of regional specialization and interregional trade. At present, there are two competing views on the causes of regional specialization. The standard neoclassical Heckscher-Ohlin theory predicts that regions will become more specialized in order to exploit their comparative advantage. On the other hand, the increasing returns model predicts that regions will become more specialized in order to produce goods on a more efficient scale.

The two models differ significantly in their prediction of industrial location. The Heckscher-Ohlin theory predicts for each industry a particular type of location. For example, a labor intensive industry is predicted to locate in a labor abundant region. The increasing returns theory injects an element of accident and arbitrariness in the location of industries. Krugman (1990) wrote,

> Why are aircraft manufactured in Seattle? It is hard to argue that there is some unique attribute of the city's location that fully explains this. The point is, instead, that the logic of increasing returns mandates that aircraft production be concentrated somewhere, and Seattle just happens to be where the roulette wheel came to a stop. In many of the new models of trade, the actual location of production is to some degree indeterminate. Yet what the example of Seattle suggests, and what is explicit in some of the models, is a crucial role of history: Because Seattle (or Detroit or Silicon Valley) was where an industry initially got established, increasing returns keep the industry there.

According to Krugman, path dependence can also characterize the development of cities, regions and nations. Krugman (1991b), partly basing his analysis on Meyer's (1983) work, offered a broad interpretation of the development of the manufacturing belt based on increasing returns rather than on comparative advantage:

> We can now tell a stylized story of the rise of the manufacturing belt. In the early United States, with its primarily agricultural population, where manufacturing was marked by few scale economies and where transportation was costly, no strong geographic concentration could occur. As the country began its industrial transition, manufacturing arose in areas that contained most of the agricultural population outside the South—and the South was, for reasons having to do with its uniquely awful institutions, unsuited for manufacturing. During the second half of the nineteenth century, however, manufacturing economies of scale increased, transportation costs fell, and the share of the population in nonagricultural occupations rose. The result was that the initial advantage of the manufacturing belt was locked in. Even though new land and new resources were exploited to the west, even though slavery ended, for three-quarters of a century the pull of the established manufactured areas was strong enough to keep the manufacturing core virtually intact.

For policymakers, whether or not economic geography or the location of industries is determined by regional resource advantages or increasing returns has important implications concerning their approaches to industrial policies. The increasing returns model shows that subsidies may shift specialization in a way that would be favorable to the protecting region. Moreover, the subsidies need not be large. A small subsidy given to an industry at an early point in its life cycle may result in huge returns as the early small advantages quickly accumulate over time from increasing returns. Thus, a strategic industrial policy can secure for a region a larger share of industries with increasing returns, and a modest policy action at a critical point in time may cause a region to become a part of the manufacturing core rather than a part of its periphery.

This paper examines how the changes in the extent of economic integration have influenced the scope and level of U.S. regional economic activities. The paper documents the long-run trends in U.S. regional specialization, the long-run trends in industry localization, and the long-run changes in the U.S. regional manufacturing structure. The paper also examines which model of economic geography—comparative advantage or increasing returns—is most consistent with the data. The paper then concludes by exploring the policy implications of these findings.

Economic Integration of U.S. Regional Economies

Although the United States was well endowed with a system of naturally navigable waters—rivers, lakes and coastal oceans—the natural waterways had to be significantly augmented by technological advances and the addition of artificial lines of transportation before economic integration could occur between its various regions. In the eighteenth century, the most important route of domestic and inter-

national transportation was on natural waterways, mostly along the coast, and the types of transportation available were wagons over land and sailing ships, flatboats, barges and keelboats over water. Beginning in the early nineteenth century, the successive advances in transportation modes, combined with greater investments in the mileage of transport systems, progressively integrated the U.S. regional economies. In 1811, the introduction of Fulton's steamboat began to greatly increase the volume of western river traffic along the Mississippi. Water transportation became even more important with the construction of canals between the 1815 and 1840. While numerous turnpike roads were built before the canal era, the cost of inland transportation remained high until the construction of these artificial waterways.[2] The advent of the railroad and the construction of numerous railroad lines between the 1840s and 1890s dramatically reduced the cost of transportation over land. The railroad mileage in operation increased sharply from 30,626 miles in 1860 to 166,703 miles in 1890. Advances in information transmission technologies also contributed to increasing the level of regional economic integration. Between 1860 and 1890, the telegraph mileage in operation increased exponentially from 50,000 to 19,382,000 miles. While a study of the advances in transportation and communications in the twentieth century is complicated by the increases in different modes used to carry goods and transmit messages (automobiles, trucks, airlines, pipe lines, faxes, etc.), there is considerable evidence that transportation and communication costs have continued to fall in the twentieth century.

The internal transportation revolution between the nineteenth and twentieth centuries changed the nature of economic integration between the U.S. regional economies significantly. The regional economies of the British Americas were economically integrated with Europe but not with each other. British mercantile policies, similar factor endowments, and high internal costs of transportation limited inter-colonial trade and promoted trade with England. Each colony specialized in a basket of agricultural staple crops, such as tobacco, grain, whale, wood, rice, indigo, and potash, and traded them for manufacturing goods with Europe. As the series of transportation revolutions lowered internal transportation costs in the nineteenth century, however, the pattern of trade shifted from international to interregional trade. Over the same period, the American economy industrialized, first in the Northeast, and placed itself on a self-sustaining long-run growth path. Between the nineteenth and twentieth centuries, the domestic markets expanded dramatically as the set of regional economies integrated to form a national economy and as the U.S. economy became the leading industrial nation in the world. In recent years, the nature of economic integration for U.S. regions has changed once again. The American regional economies are becoming increasingly more integrated into a global economy.

Long-Run Trends in U.S. Regional Economies, 1860-1987[3]

As the regional economies of the United States integrated to form a national economy between the nineteenth and the early twentieth centuries, regional specialization rose substantially, reached a peak during the interwar years, and then fell substantially and continuously from the 1930s. Over the same period, industries

became more localized as regions became more specialized, and industries became more dispersed as regions despecialized. In 1860, the regional manufacturing structures were similar as regions specialized in a few industries such as food, tobacco, textiles, and apparel. In the early- to mid-twentieth century, the regional manufacturing structures diverged as regions became more specialized in various industries. The recent convergence in manufacturing structures has been associated with a movement toward a more balanced manufacturing structure for all regions.

Regional Specialization

The index of regional specialization used in this section is from Krugman (1991b) and is defined as:

$$SI_{jk} = \sum_{i=1}^{n} \left| \frac{E_{ij}}{E_j} - \frac{E_{ik}}{E_k} \right| ,$$

where E_{ij} is the level of employment in industry i=1, . . . , n for region j and E_j is the total industrial employment for region j and similarly for region k. If the index is equal to zero, then the two regions, j and k, are completely despecialized; if the index is equal to two, then the regions are completely specialized. If the indexes are calculated using the nine census divisions (at the two-digit manufacturing employment levels), there are thirty six bi-regional indexes. An aggregate index is derived by taking the average of these indexes [see Kim (1995a)].

The degree of U.S. regional specialization rose between 1860 and World War I after a slight decline between 1860 and 1890. The level of regional specialization reached its peak during the interwar years before falling continuously and substantially through 1987. The aggregate index of specialization for 1860, 1880, and 1890 is 0.69, 0.63, and 0.61 respectively. It increases to 0.75 in 1900, and then reaches a plateau of 0.89, 0.86, and 0.87 for 1914, 1927, and 1939 respectively. The index then falls to 0.43 in 1987. The index of specialization suggests that the extent of regional specialization was around 35% in 1860, increased to about 43% in 1927 and 1939, and then fell to 23% in 1987 (see figure 1).[4] Moreover, the movements in the aggregate index are not caused by changes in a subset of regions. If each of the bi-regional indexes is examined over time, the aggregate pattern is replicated in most bi-regional comparisons. In general, each region becomes more specialized compared with any other region between 1860 and the turn of the twentieth century and becomes less specialized compared with any other region toward the latter half of the twentieth century.

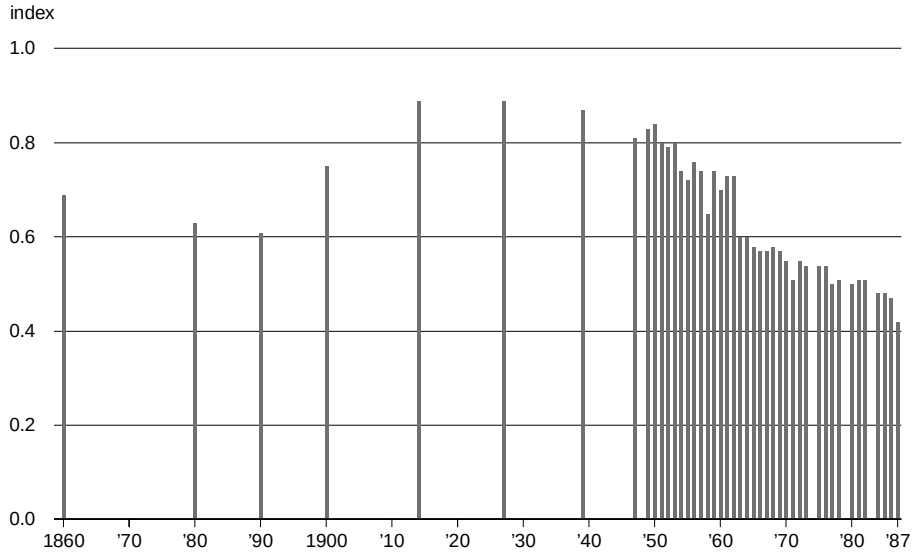
Industrial Localization

The coefficient of localization used in this section is from Hoover (1936), and is based on the location quotient which is defined as:

$$L_{ij} = \frac{E_{ij}}{E_{ius}} \Big/ \frac{E_j}{E_{us}} ,$$

where E_{ij} is employment in industry i for region j, E_j is total employment in region j, E_{ius} is employment in industry i, and E_{us} is total employment in the United States. If

Figure 1 Index of Regional Specialization: Manufacturing, 1860-1987



the L_{ij} is greater than one, then region j has a higher percentage of industry i compared with its proportion of total industry employment relative to other regions. The localization curve, which is analogous to the Lorenz curve, is then constructed as follows. First calculate the location quotient for industry i for all regions j=1, . . . , R. Then rank the regions by their location quotients in descending order and calculate the cumulative percentage of employment in industry i over the regions (Y-axis). Finally, calculate the cumulative percentage of employment in total manufacturing over the regions (X-axis). If the industry is evenly distributed across regions, then the location quotient will be equal to one for all regions and the localization curve will be a 45 degree line. If the industry is more regionally concentrated, then the localization curve will be more concave. The coefficient of localization, which is analogous to the Gini coefficient, is defined as the area between the 45 degree line and the localization curve divided by the entire triangular area. If the Hoover coefficient is equal to zero, then the industry is completely dispersed across regions; if it is equal to one, then the industry is completely localized in one region. The coefficient of localization is calculated using nine census divisions and two-digit manufacturing employment levels.

To derive an aggregate index of localization, the coefficient of localization is calculated at the two-digit SIC industry level and then averaged across the 20 industries weighted by industry employment. The aggregate index of localization indicates that industries became more localized as regions became more specialized. Conversely, industries became more dispersed as regions became despecialized. The

coefficient of localization is 0.273 in 1860, it peaks at 0.316 in 1927, and then falls sharply to 0.197 in 1987 (see figure 2). The overall trend, it appears, was driven by approximately half of the industries, and these industries (except for lumber and wood) became relatively more important in terms of employment over time.

The localization indexes at the industry level show significant variations. The industries characterized by the rising and falling trend in localization are lumber and wood, rubber and plastic, fabricated metal, non-electrical machinery, electrical machinery, transportation equipment, instruments and miscellaneous industries (see figure 3). The remaining industries do not follow the overall pattern. Some, such as tobacco, textiles, and apparel, to a lesser extent, became more regionally localized throughout the entire period. Other industries, such as food, paper, printing and publishing, and chemicals, became more regionally dispersed from 1860 to 1947 and then remained at that level through 1987. Still other industries, such as furniture and fixtures and primary metal, exhibited little change in localization throughout the entire period.

Manufacturing Structure

The regional manufacturing structure is examined using a cumulative distribution curve for each region. The cumulative distribution curves for the nine census regions are constructed as follows. On the horizontal axis, the two-digit industries are represented in numerical order from food (20) to miscellaneous manufacturing (39).

Figure 2 Hoover's Coefficient of Localization: Manufacturing, 1860-1987

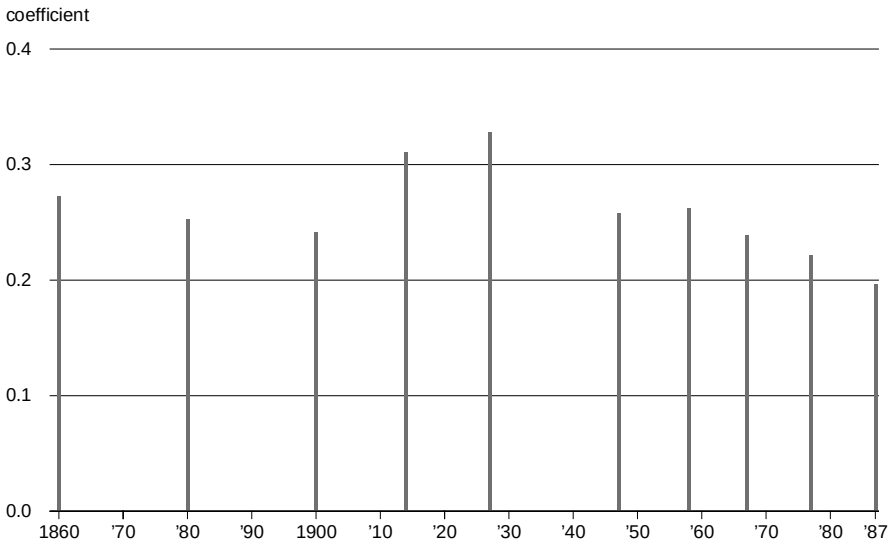


Figure 3 Localization by Industry, Manufacturing, 1860-1987

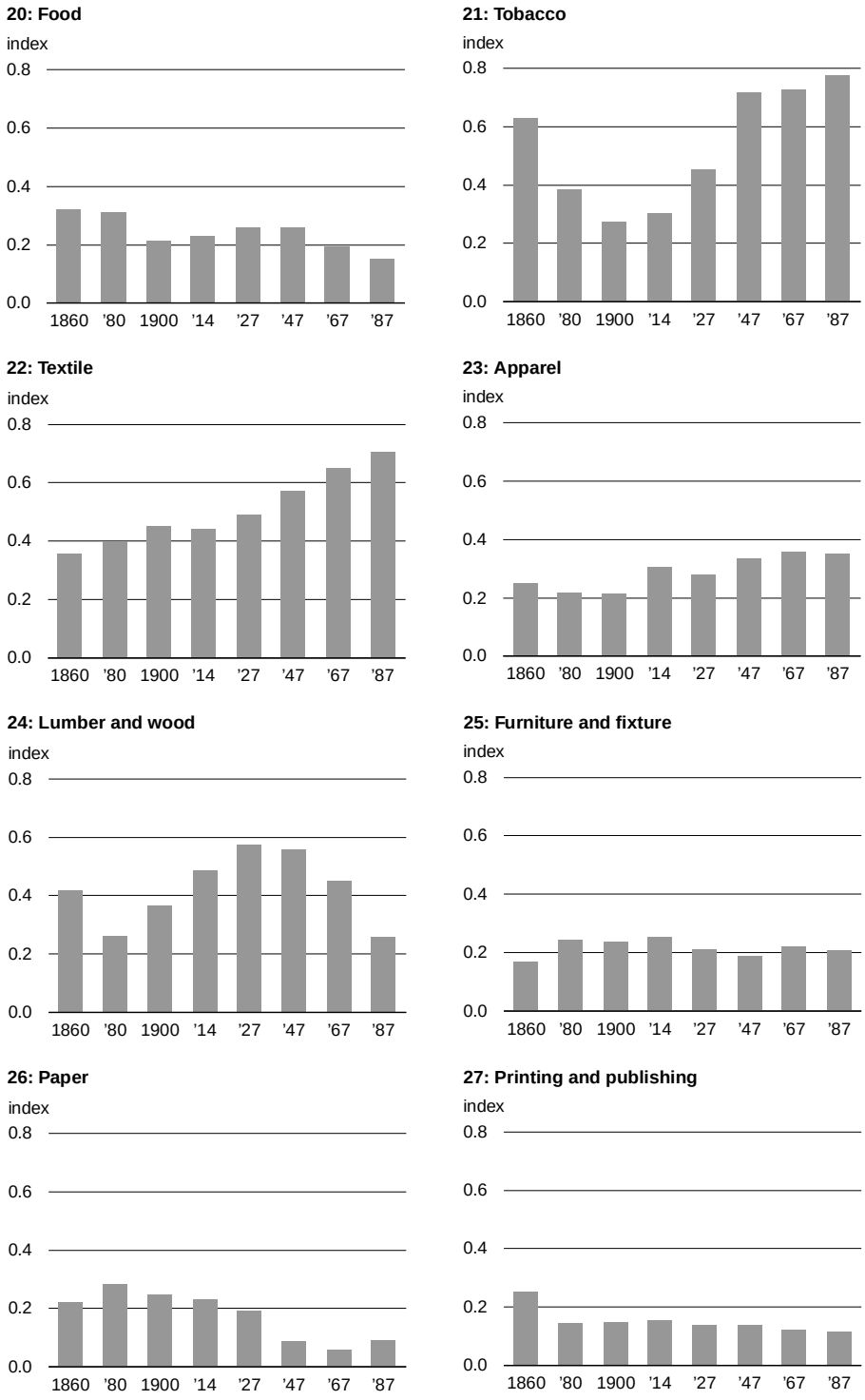


Figure 3 *(continued)* Localization by Industry, Manufacturing, 1860-1987

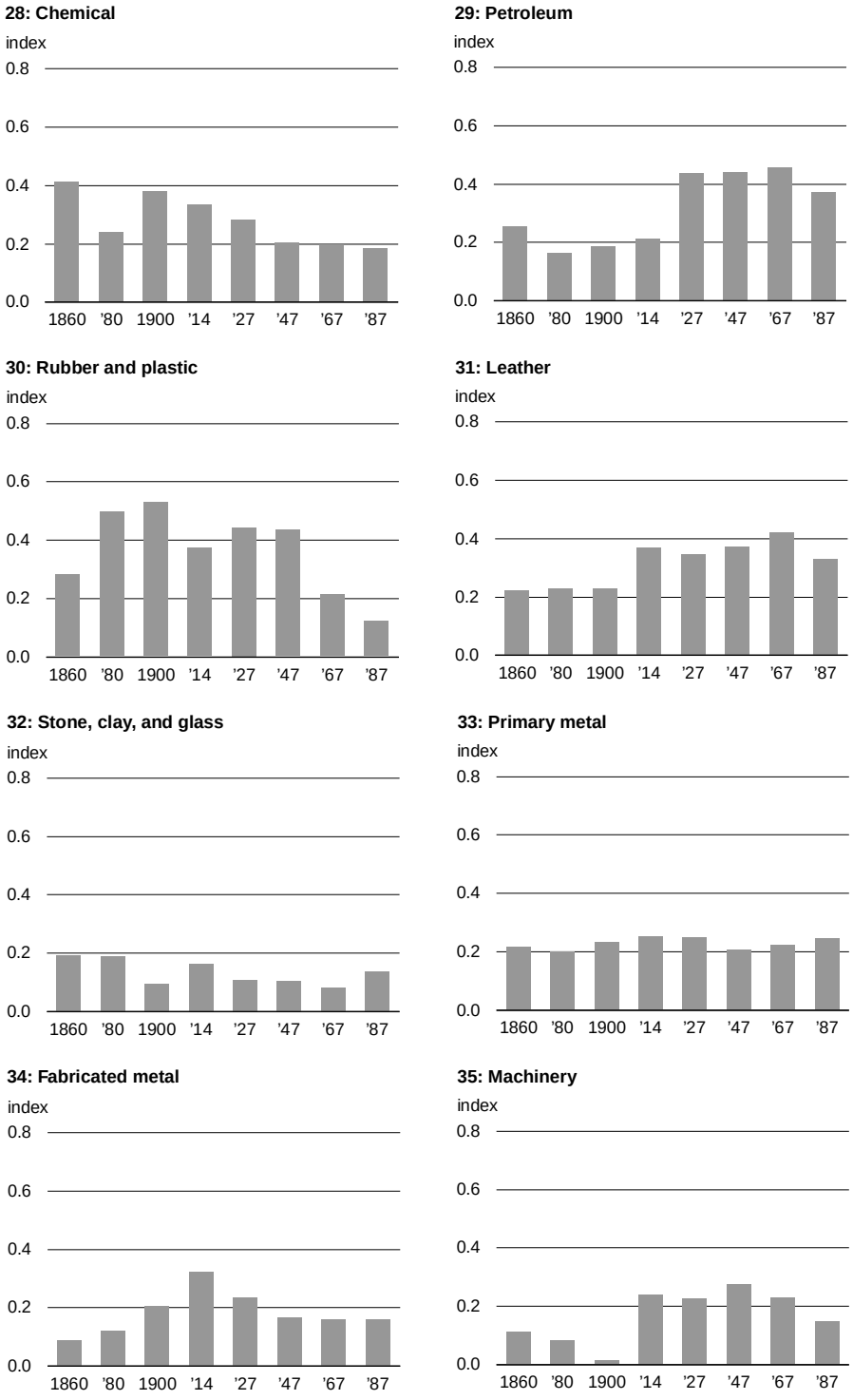
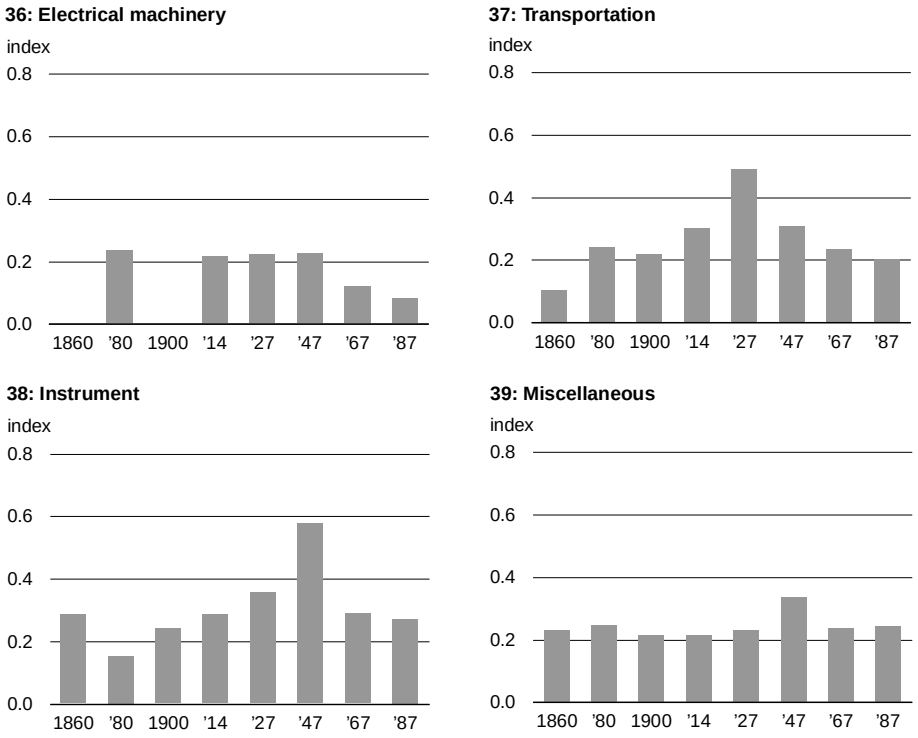


Figure 3 *(continued)* Localization by Industry, Manufacturing, 1860-1987

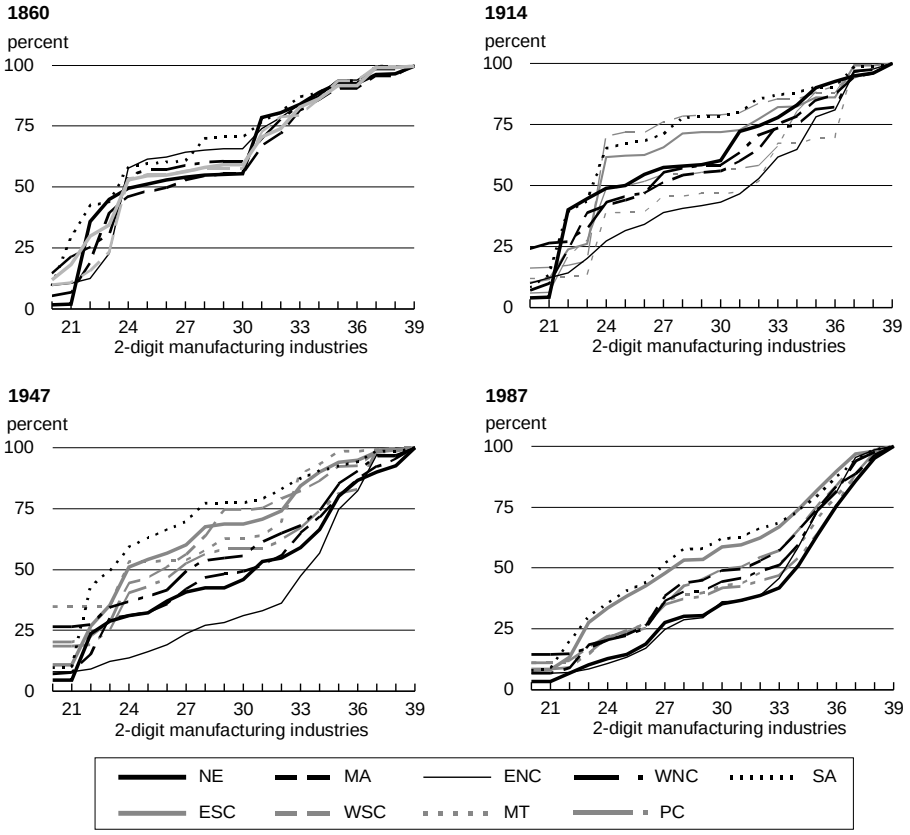


On the vertical axis, the percentage represented by each industry for each region is cumulatively summed across the two-digit industries.

The cumulative distribution curves for the nine census regions show that the U.S. regional manufacturing structures were relatively similar during the nineteenth century, diverged between the nineteenth and mid-twentieth centuries, and then converged again starting in the mid-twentieth century.

The similarity of U.S. regional manufacturing structure in 1860 is seen in figure 4. The cumulative distribution curves for all regions in 1860 were concave, reflecting the relative importance of textiles, tobacco, apparel, and lumber products in U.S. manufacturing. For most regions, these four industries represented about 40% to 60% of total employment in manufacturing. As the regional economies became more integrated between the nineteenth and twentieth centuries, the U.S. regional manufacturing structure diverged. The cumulative distribution curves changed from a concave cluster to a wider football shape. The curves for the southern regions—for the South Atlantic, East South Central, and West South Central—became more concave as they became specialized in textile production. On the other hand, the curve for the East North Central region completely inverted from a concave to a convex shape as it shifted rapidly away from textiles, apparel, and lumber and

Figure 4 Cumulative Distribution Curves, 1860-1987



Notes: NE - New England, MA - Middle Atlantic, ENC - East North Central, WNC - West North Central, SA - South Atlantic, ESC - East South Central, WSC - West South Central, MT - Mountain, and PC - Pacific. The 2-digit SIC codes are: 20 food, 21 tobacco, 22 textiles, 23 apparel, 24 lumber and wood, 25 furniture and fixtures, 26 paper, 27 printing and publishing, 28 chemicals, 29 petroleum and coal, 30 rubber and plastics, 31 leather, 32 stone, clay and glass, 33 primary metal, 34 fabricated metal, 35 machinery, 36 electrical machinery, 37 transportation, 38 instruments, 39 miscellaneous.

shifted into primary metals, fabricated metals, machinery, and transportation industries. For most other regions, the curves became linear as they shifted away from food, tobacco, textiles, and apparel industries to a broad-based manufacturing economy. Despite the continued economic integration of U.S. regions during the twentieth century, the U.S. regional manufacturing structure converged to a similar manufacturing structure since the mid-twentieth century. Thus, the 1987 cumulative distribution curves were characterized by a narrower football shape. The cumulative distribution curves for the southern regions became linear and slightly convex as they moved toward a broad-based manufacturing economy. The curve for East North Central became less convex while the curves for all other regions became more convex.

The regional manufacturing structure did not change uniformly across the nine census regions or across time. Between 1860 and 1947, the industrial composition for the East North Central region transformed the most, changing by more than 50% according to the index of structural change.[5] The Middle Atlantic region changed the least, only by about 25%, while the other regions changed by about 40%. Between 1947 and 1987, however, the industrial composition for the East North Central region transformed the least, changing by less than 17%, and the Middle Atlantic followed with just over 21%. The Mountain region changed the most, by about 58%. Most other regions changed by about 31%.

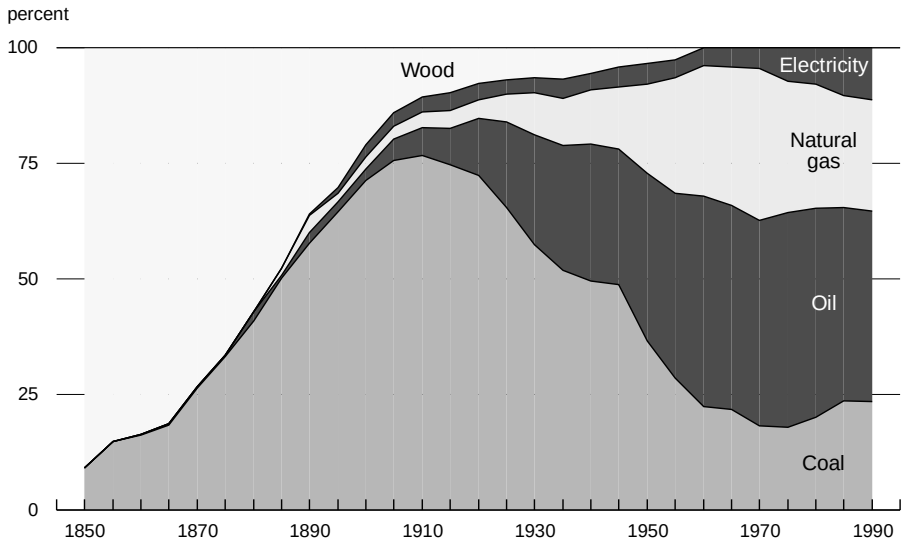
Explaining the Long-Run Trends in U.S. Regional Economies

The historical trends in U.S. regional specialization can be explained jointly by models based on scale economies and resources.[6] As transportation costs fell between 1860 and the turn of the twentieth century, firms adopted large scale production methods that were intensive in relatively immobile resources and energy sources. The rise in scale and the use of immobile resources caused regions to become more specialized. As factors became increasingly more mobile and as technological innovations favored the development of substitutes, recycling, and less resource intensive methods over the twentieth century, regional resource differences diminished. The growing similarity of regional factor endowments and fall in scale economies caused regions to become despecialized between World War II and today.

Energy consumption provides an illustrative example. As sources of energy changed from water and fuel wood to coal between the nineteenth and early twentieth centuries, the geographic mobility of energy relative to that of final goods decreased. However, as petroleum, natural gas, and electricity replaced coal during the twentieth century, the geographic mobility of energy increased (see figure 5). In addition, electricity is a processed form of energy that can be generated by many primary sources as well as by solar and nuclear means; thus, despite the diversity of U.S. regional primary energy supplies, regional differences in final energy supplies are considerably lower.

The changes in the U.S. regional manufacturing structure suggest that the models of balanced growth or the "big push" based on external economies are inconsistent with the evidence. According to Murphy, Shleifer, and Vishny (1989), the simultaneous establishment of manufacturing industries subject to increasing returns is needed to successfully industrialize a developing country. The demand and supply spillovers across manufacturing industries allow a country to simultaneously industrialize in many industries even if it could not develop by establishing one manufacturing industry at a time. While the balanced growth or the big push explanation appears to fit the U.S. experience at the national level it seems to be contradicted at the more disaggregated regional level. As the U.S. developed from a predominantly agrarian society to the leader in world manufacturing, the various regions did not simultaneously develop all manufacturing industries. Even if demand

Figure 5 Sources of Energy Consumption: Percentage Distribution, 1850-1990



and supply spillovers played an important role in industrializing the East North Central's region between 1860 and 1914, its rapid industrialization would not have been possible without the support of the broad U.S. interregional specialization in manufacturing and agriculture. As the East North Central region, and the Middle Atlantic and New England regions to a lesser extent, industrialized rapidly toward heavy manufacturing industries such as primary metal, fabricated metal, machinery, electrical, and transportation, other regions further specialized in different industries. West North Central increased its specialization in food, South Atlantic in textiles, and West South Central in food and petroleum. Most of these other regions started to converge to a more broad-based industrial economy only after U.S. industrialization had long been accomplished.[7]

Conclusion

This paper finds that both the rise and decline of the Midwest as a manufacturing belt can be explained by changes in the regional comparative advantage of manufacturing rather than increasing returns.[8] As the U.S. regional economies became more integrated between the nineteenth and twentieth centuries, manufacturing became more regionally specialized. The Midwest became the "manufacturing belt" because it had comparative advantage in manufacturing activities based on coal, iron, and steel.[9] However, as material and energy intensities in manufacturing fell and as factors of manufacturing became increasingly more mobile, manufacturing became regionally despecialized. The Midwest declined as a center of manufacturing as its sources of manufacturing comparative advantage dissipated. Today, while some

regional differences still exist, the Midwest economy no longer looks very different from the rest of the United States.

The Midwest's fortunes turned south during the latter half of the twentieth century. But from a national standpoint, the current changes in the Midwest manufacturing structure were optimal responses to changing economic conditions. As the factor endowments became more similar across the U.S. regions, regional manufacturing employment also converged. This process of convergence translated to a relative decline of the Midwest as a center of manufacturing and a rise of manufacturing in the rest of the United States. The Midwest is however unlikely to face further significant decline relative to other regions. The extent of convergence of U.S. regional manufacturing structure seems nearly complete.

Finally, the findings of the paper shed some light on the causes and consequences of the recent increase in regional industrial subsidies. While some types of regional competition, especially in the provision of local public goods, are likely to be efficient from a national standpoint, other types of subsidies are likely to be inefficient from both the regional and national perspectives.[10] Moreover, the growth of these subsidies is likely caused by politics and changes in the balance of power between local governments and manufacturing plants rather than the success of these programs. Given the increased mobility of manufacturing plants, firms are able to extract greater surplus from local governments in the form of tax breaks by pitting regions against one another. Unfortunately, given the prisoner dilemma nature of these subsidies, these local concessions to manufacturing firms are likely to continue for some time.

Footnotes

1 There is no consensus definition of the Midwest. In this paper, the Midwest is defined as the East North Central region (Ohio, Indiana, Illinois, Michigan, Wisconsin) defined by the Bureau of the Census. Various states from the West North Central (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas) and the Middle Atlantic (New York, New Jersey, Pennsylvania) regions have also been identified as residing in the Midwest by other studies. The historical trend is replicated even if the Midwest is defined as the WNC and ENC regions. In 1860, the two regions accounted for 172.1 thousand employees and 15.1% of total employment; in 1947 the figures were 5.1 million and 35.7%; in 1967 they were 6.4 million and 32.9%; and in 1987 they were 5.5 million and 29.1%.

2 According to Fishlow (1972) the cumulative turnpike construction in the New England and Middle Atlantic states almost doubled between 1810 and 1820 as mileage increased from 4,684 miles to 9930 miles. However, only five or six out of 230 turnpikes were profitable (Taylor 1949, p. 27).

3 This section borrows heavily from Kim (1993, 1995a).

4 The qualitative pattern of regional specialization found at the two-digit level using census divisions seems robust to how regions and products are defined. The index of regional specialization calculated using states (at two-digit level) and three-digit manufacturing employment (using census divisions) also gives similar results. See Kim (1995a).

[5] To measure the speed of regional structural change over time, the following index is used:

$$SC_{t,t-1} = \sum_{i=1}^{n} \left| \frac{E_{i,t}}{E_t} - \frac{E_{i,t-1}}{E_{t-1}} \right| ,$$

where $E_{i,t}$ is the level of employment in industry i=1..n, for a particular region at time t, and E_t is the total employment for that region at time t. If the index is equal to zero, then the region undergoes no structural change over time; if the index is equal to two then the region undergoes complete structural change. Both the cumulative distribution curves and the index of regional structural change are calculated using nine census divisions and two-digit manufacturing employment levels.

[6] The data provide little support for the importance of external economies. The dynamic trends and cross-sectional industry localization patterns, however, seem to be negatively correlated with measures associated with high-tech industries. First, despite the rising trends in the intensities in research and development, information, and skilled workers in manufacturing between World War II and 1987, the level of regional specialization in manufacturing fell rather than rose over that period. Second, skill intensity, research and development, and rates of technological innovations for tobacco and textile industries fell, while those for machinery, electrical machinery and transportation rose. Yet localization levels for the former rose over time but fell for the latter industries. Third, in 1987, localization levels for high-tech industries were comparably for lower than for low-tech industries such as tobacco and textiles.

[7] The growing literature on the sources of manufacturing productivity growth during the early American industrialization also raises skepticism as to the importance of the big push doctrine. Works by American economic historians who share the view of a more gradualist path of U.S. industrialization and development, suggest that productivity increases in U.S. manufacturing came from a variety of means spurred by expansion of markets. These means include more "intensified use of resources, scale economies, the introduction of new or higher-quality products, learning by doing and other forms of human capital accumulation, as well as increased specialization by factors of production." Moreover, Sokoloff (1992) argues that U.S. manufacturing industries drew on different sources of productivity growth at different phases of American industrial development.

[8] The changes in the economic structure of the economy have also amplified the rise and decline of the Midwest. The rise of the Midwest coincided with a general structural shift from an agricultural to a manufacturing economy and the decline of the Midwest coincided with a shift from a manufacturing to a service economy.

[9] Kim (1995b) attempts to identify the long-run sources of U.S. regional comparative advantage by estimating the Rybczynski coefficients.

[10] The growing use of tax breaks to lure manufacturing is one example. Wilson (1993) provides some examples: "In the late 1970s and 1980s, the competition was no longer limited to low-wage manufacturing but broadened to include automotive manufacturing plants and electronic manufacturing, both domestic and foreign. In 1978, Pennsylvania successfully outbid Ohio with an incentive package worth $71 million to attract the first foreign automotive manufacturing facility, a Volkswagen plant, to Westmorland County, southeast of Pittsburgh. In 1980, Tennessee attracted a Nissan plant with an incentive package that amounted to about $11,000 per job and in 1985 lured GM's Saturn plant with a package worth $26,000 per job (p. 6)."

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