

**THE GEOGRAPHIC DISTRIBUTION OF ECONOMIC ACTIVITY IN PENNSYLVANIA
SINCE 1790**

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ABSTRACT

The historical evolution of the geographic distribution of economic activity across Pennsylvania is examined. As the state developed, it first experienced increasing population and manufacturing spatial inequality with manufacturing concentrated in Philadelphia and, eventually, Pittsburgh. Inequality reached a peak in the 1930's. Since then, population and manufacturing have become more dispersed across the state, with the counties in the southeastern portion of the state accounting for an increasing proportion of all economic activity in Pennsylvania. Agriculture has shown the opposite pattern: initial dispersion followed by increasing concentration, again in the southeastern part of the state.

INTRODUCTION

Economic activity is unevenly distributed across Pennsylvania. High-income counties are almost entirely concentrated in the southeastern portion of the state. 48 percent of the state's manufacturing goods are produced in counties occupying just 8.5 percent of the state's land area. Counties containing 18 percent of the state's population produce 55 percent of Pennsylvania's agricultural output. This paper investigates the evolution since 1790 of this spatial inequality.

Many variables influence the distribution of economic activity across a geographic region in sometimes-contradictory ways. The neoclassical growth model, for instance, predicts convergence: the economies of low-income regions will grow faster than the economies of high-income regions so that the income levels of poor economies will tend to converge towards the income levels of rich economies. Diminishing returns to capital means that poorer regions will have a higher marginal product of capital and so a higher economic growth rate than rich regions, enabling the poor regions to catch up in the long run. Convergence implies a reduction over time in the degree of inequality in the distribution of economic activity across geographic areas.

Evidence of convergence, usually at fairly slow rates, has been found for such diverse areas as the U.S. states (Barro and Sala-i-Martin 1991; 1992a), European regions (Barro and Sala-i-Martin 1991), Japanese prefectures (Barro and Sala-i-Martin 1992b), Canadian provinces (Coulombe and Lee 1995), U.S. counties (Higgins, Levy, and Young 2006), and counties of the Great Plains states (Austin and Schmidt 1998).

The field of regional science emphasizes the existence of agglomeration economies, the benefits producers obtain when located near each other. These benefits, a combination of scale economies and network externalities, can occur on the supply side of the market from information spillovers, competing suppliers, thicker labor markets, and so on as well as on the demand side from, for example, the home market effect. Agglomeration economies cause economic activity to become increasingly geographically concentrated. At the same time, there are agglomeration diseconomies from congestion, higher input prices, and product price competition that encourage

economic activity to be dispersed over a geographic area. And, economic activity is, in fact, unevenly distributed across geographic areas. Ellison and Glaeser (1997) find that most American industries are geographically concentrated while Rappaport and Sachs (2003) observe that U.S. economic activity is concentrated at its ocean and Great Lakes coasts and that this concentration increased over the twentieth century.

In a seminal paper, Williamson (1965) hypothesized that as a country develops from low-income levels, the country first experiences increasing regional income inequality with economic activity concentrated in a limited portion of the country. As development proceeds in this limited area, diminishing returns to capital and agglomeration diseconomies set in, leading to the economic development of other regions and a decline in regional income inequality. “The expected result is that a statistic describing regional inequality will trace out an inverted ‘U’ over the national growth path . . .” (Williamson 1965, p. 9-10).

Statistical evidence on the evolution of the spatial distribution of economic activity is provided by Krugman (1991a) and Kim (1995), who looked at manufacturing specialization across U.S. states. Regional manufacturing specialization rose substantially in the late nineteenth century, reaching a peak in the 1920’s, and has fallen considerably since then. Regional agricultural specialization has increased since 1870 (Kim 1995). Easterlin (1960) found that there was a reduction in the degree of concentration of manufacturing production among U.S. states between 1869 and 1947. Although cities in the United States have become less dense since 1940 (Bryan, Minton, and Sarte 2007), population in European countries has steadily become more concentrated since the eighteenth century (Ayuda, Collantes, and Pinilla 2005).

DATA AND METHODS

The objective of this paper is to examine the historical evolution of the geographic distribution of economic activity across Pennsylvania. Does Pennsylvania conform to Williamson’s inverted-U hypothesis? Williamson’s hypothesis posits three stages of regional development: increasing, stable, and decreasing regional inequality. Data, then, is needed over a long period of time. Counties are the logical unit of analysis as they are the smallest geographic entities, together covering the entire state, for which a long time series of economic data can be constructed. The first U.S. Census was conducted in 1790. Census-takers went door-to-door and recorded the number of people in each household. Population totals are reported by county. Beginning in 1810, the decennial U.S. censuses contain tabulations by county of various economic variables. Later, periodic economic censuses also provide county-level data.

County-level data is also appealing for the theoretical reason suggested by Beeson, DeJong, and Troesken (2001, p. 671): “(C)ounty borders are attractive because they better reflect the limits of local economies than do the borders of states, regions, or nations, which are aggregates of local economies; or cities, whose political boundaries often exclude a portion of the local economy . . .” City-level data fails to span the entire geographic space.

Inequality in the distribution of economic activity across Pennsylvania is measured by the gini coefficient. The gini coefficient ranges from a minimum value of zero, when all counties have the same density of economic activity, to a theoretical maximum of one when all economic activity takes place in just one county.

One difficulty with using counties as the units of analysis is that the geographic boundaries of many counties have changed over time. New counties were carved out of one or more existing counties. Pennsylvania counties did not reach their current configuration until 1878. The aim of this paper is to always use the smallest geographic units feasible. So, the county boundaries extant at the time of each decennial census, taken from Thorndike and Dollarhide’s

(1987) invaluable *Map Guide to the U.S. Federal Censuses*, are used. The units of analysis, then, are not consistent over the entire 1790-2002 study period. But, making the necessary-in-any-case assumption that economic activity is evenly distributed across an individual county, this inconsistency, while biasing the gini coefficient downwards, has little impact on observed inequality. The biggest increase in the number of counties occurred between 1790 and 1800. Using 1790 county boundaries to calculate the 1800 gini coefficient for population density yields a value of 0.69; the actual value using 1800 county boundaries is 0.72.

By 1800 the frontier had moved west out of Pennsylvania (Florin 1977, p. 89), meaning that the economic development of the state could proceed in earnest. Three measures of economic activity are constructed for each county: agricultural density, manufacturing density, and population density. All densities are per square mile of county area. Rappaport and Sachs (2003, p. 8) argue that population density captures underlying variations in local productivity and quality of life. Populations are taken from the decennial federal censuses. No single indicator of agricultural or manufacturing activity is available for over the whole study period. Tables 1 and 2 list the variables used to compute county agricultural and manufacturing densities, most often the value of farm products and the value of products in manufacturing, and the sources of the data.

Table 1. Agriculture Density Metrics and Sources

Year	Variable	Data Source
1810	neat cattle	1810 Census
1820	persons engaged in agriculture	1820 Census
1830	-	-
1840	persons engaged in agriculture	1840 Census
1850	value of livestock, animals slaughtered, orchard products, and produce of market gardens	1850 Census
1860	value of livestock, animals slaughtered, orchard products, and produce of market gardens	1860 Census
1870	estimated value of all farm products	1870 Census
1880	estimated value of all farm products	1880 Census
1890	estimated value of all farm products	1890 Census
1900	estimated value of all farm products	1900 Census
1910	total value of all crops	1910 Census
1920	total value of all crops	1920 Census
1930	total value of all crops	1930 Census
1940	total value of all crops	1940 Census
1950	value of farm products sold	1952 County and City Data Book
1960	value of farms products sold (farms with sales of \$2500 or more)	1972 County and City Data Book
1964	value of farms products sold (farms with sales of \$2500 or more)	1967 County and City Data Book
1974	value of farms products sold (farms with sales of \$2500 or more)	1977 County and City Data Book
1978	value of farms products sold (farms with sales of \$2500 or more)	1983 County and City Data Book
1982	value of farm products sold	1988 County and City Data Book
1987	value of farm products sold	1994 County and City Data Book

1997	value of farm products sold	2000 County and City Data Book
2002	market value of agricultural products sold	2002 Census of Agriculture

Table 2. Manufacturing Density Metrics and Sources

Year	Variable	Data Source
1810	aggregate value in dollars of manufactures	1810 Census
1820	persons engaged in manufacturing	1820 Census
1830	-	-
1840	total capital invested in manufacturing	1840 Census
1850	annual value of products in manufacturing	1850 Census
1860	annual value of products in manufacturing	1860 Census
1870	annual value of products in manufacturing	1870 Census
1880	annual value of products in manufacturing	1880 Census
1890	annual value of products in manufacturing	1890 Census
1900	annual value of products in manufacturing	1900 Census
1910	-	-
1920	annual value of products in manufacturing	1920 Census
1930	annual value of products in manufacturing	1930 Census
1940	annual value of products in manufacturing	1940 Census
1947	value added by manufacture	1956 County and City Data Book
1954	value added by manufacture	1962 County and City Data Book
1958	value added by manufacture	1967 County and City Data Book
1963	value added by manufacture	1967 County and City Data Book
1967	value added by manufacture	1972 County and City Data Book
1972	value added by manufacture	1977 County and City Data Book
1977	value added by manufacture	1983 County and City Data Book
1982	value added by manufacture	1988 County and City Data Book
1987	value added by manufacture	1994 County and City Data Book
1997	value added by manufacture	2000 County and City Data Book
2002	value added by manufacture	2002 Economic Census

There are a few years for which the agricultural or manufacturing measures utilized overlap. In 1950, the correlation between the total value of all crops and the value of farm products sold is 0.94. The correlation between the number of persons engaged in manufacturing in a county and the total capital invested in manufacturing in 1840 is 0.98; the correlation in 1850 between the capital invested in manufacturing and the value of products in manufacturing in a county is 0.99. These very strong correlations give confidence to the notion that the results obtained below are not due to the choice of variables. No agricultural or manufacturing data is available for 1790, 1800, or 1830; no manufacturing data is available for 1910.

EVOLUTION OF THE CONCENTRATION/DISPERSION OF ECONOMIC ACTIVITY

The gini coefficients for the three measures of economic activity are listed in Table 3. Population density, a proxy for local productivity and quality of life, follows the inverted-U pattern. As Figure 1 indicates, following an initial dispersion up to 1840 as western

Pennsylvania became settled, population became increasingly concentrated though the nineteenth and into the twentieth century with the gini coefficient reaching a maximum in 1930. At that time, 34 percent of the Pennsylvania’s population lived in Allegheny and Philadelphia Counties. Thereafter, population slowly has become more dispersed across Pennsylvania. Now, just 23 percent of the population resides in those two counties. Still, population is more unequally distributed now than in 1800, when Allegheny and Philadelphia Counties contained only 16 percent of the state’s residents. Since 1930, the population density of Philadelphia has fallen by about 3400 residents per square mile. The aggregate population density of Delaware, Montgomery, Bucks, and Chester Counties (the counties with the largest absolute increase in population density between 1930 and 2000) has risen by nearly 760, while the population density for Pennsylvania as a whole grew by less than 60 persons per square mile. The counties that experienced the largest percentage falls in population density since 1930 are the anthracite coal counties of Schuylkill, Lackawanna, Luzerne, and Northumberland.

Table 3. Gini Coefficients for the Density of Economic Activity

Year	Population	Agriculture	Manufacturing
1790	0.680		
1800	0.718		
1810	0.733	0.520	0.912
1820	0.681	0.462	0.789
1830	0.669		
1840	0.664	0.393	0.866
1850	0.681	0.462	0.883
1860	0.697	0.428	0.906
1870	0.705	0.427	0.904
1880	0.711	0.419	0.905
1890	0.730	0.396	0.912
1900	0.752	0.389	0.886
1910	0.767	0.360	
1920	0.784	0.354	0.872
1930	0.791	0.381	0.874
1940	0.784	0.393	0.875
1947			0.856
1950	0.789	0.441	
1954			0.847
1958			0.841
1960	0.785	0.484	
1963			0.828
1964		0.443	
1967			0.810
1970	0.781		
1972			0.781
1974		0.500	
1977			0.761
1978		0.513	
1980	0.753		

1982		0.530	
1987		0.531	0.739
1990	0.745		
1997		0.621	0.687
2000	0.735		
2002		0.593	0.711

Figure 1. Gini Coefficients for Population Density

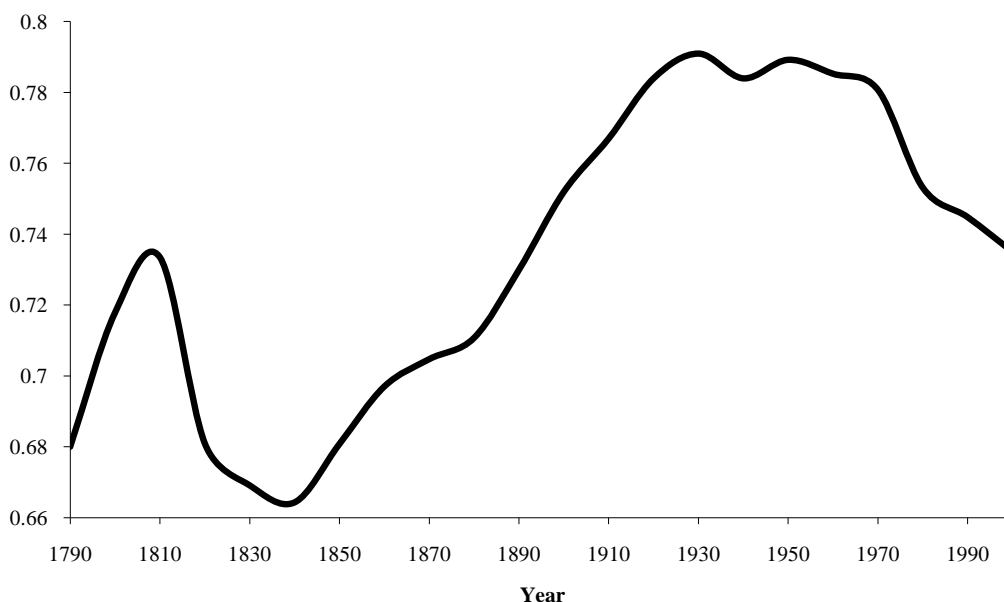


Figure 2 plots the gini coefficients for manufacturing density. Manufacturing, until recently the most concentrated of the three measures of economic activity, also trends towards an inverted-U shape. In 1810, 46 percent of manufacturing activity in Pennsylvania occurred in Philadelphia, and in 1820 the manufacturing density in Philadelphia was 17 times greater than in the second most dense county, Lancaster. Manufacturing inequality reached a peak in 1890 when Allegheny and Philadelphia Counties produced 62 percent of the state's manufacturing goods. Overall, manufacturing is much less concentrated in 2002 than in 1810. Now, Allegheny and Philadelphia Counties account for 12 percent of Pennsylvania's manufacturing production. Although Philadelphia continues to have the highest manufacturing density of all counties, over the twentieth century the concentration of manufacturing production in Pennsylvania moved from

Philadelphia and Pittsburgh to the counties outside of Philadelphia. Figure 3 shows the shares of statewide manufacturing activity accounted for by Allegheny and Philadelphia Counties (the solid line) and the aggregate shares produced in Berks, Bucks, Chester, Lancaster, Montgomery, Northampton, and York Counties (the dashed line). As manufacturing has relatively diminished in Allegheny and Philadelphia Counties, these seven counties account for an increasing portion of the state's manufacturing production. In 2002, these counties produced 45 percent of the Pennsylvania's manufacturing output.

Figure 2. Gini Coefficients for Manufacturing Density

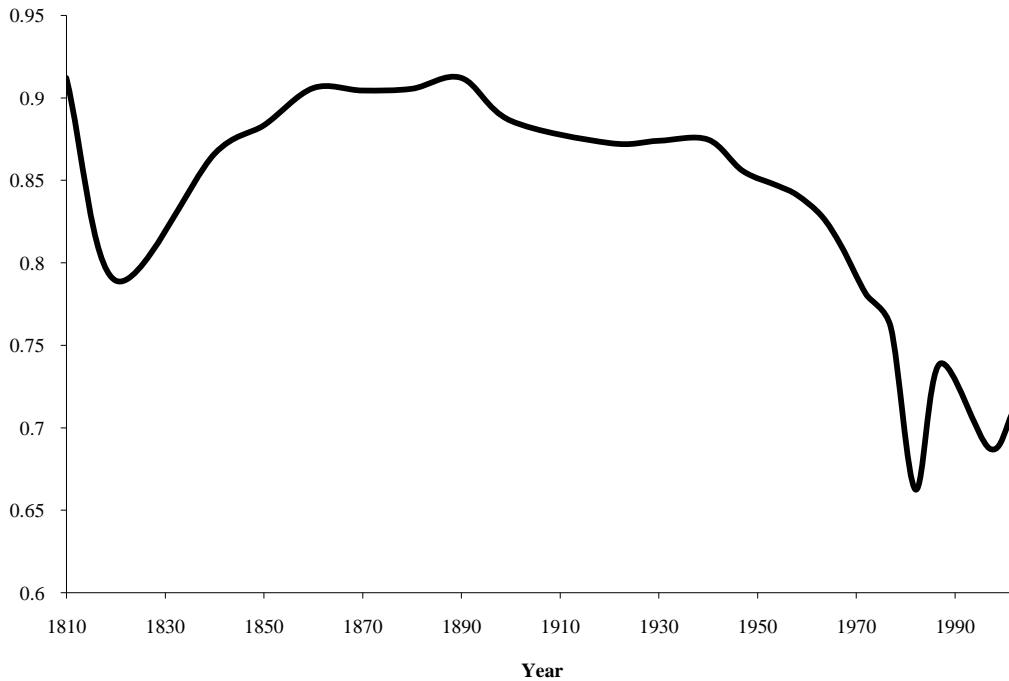


Figure 3. Share of Statewide Manufacturing Production Occurring in Allegheny and Philadelphia Counties (solid line) and in Berks, Bucks, Chester, Lancaster, Montgomery, Northampton, and York Counties (dashed line)

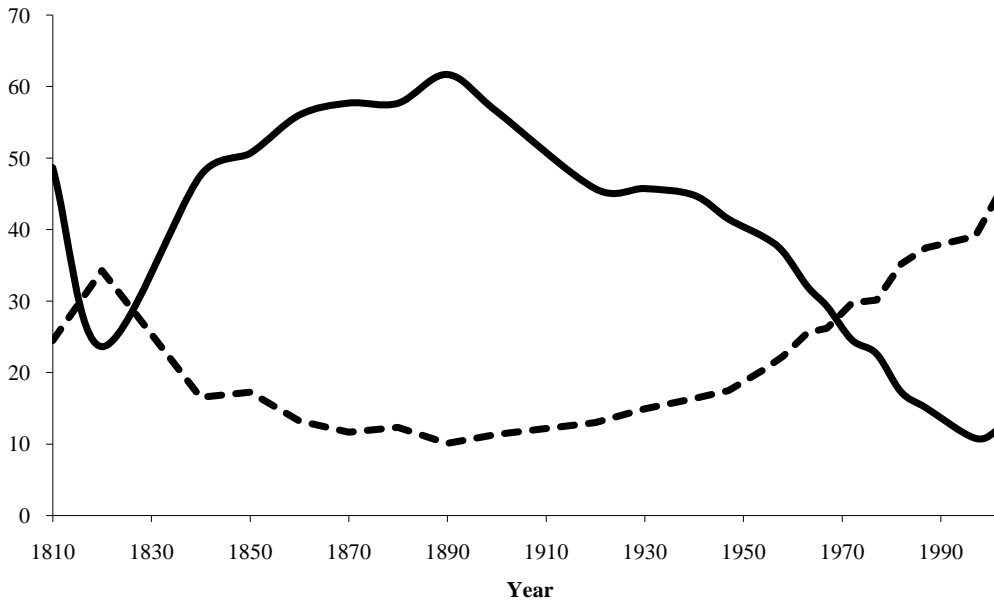


Figure 4 shows that agriculture, always the least unequally distributed of the three variables, has actually followed a U-shaped pattern: decreasing inequality, with 1920 marking the maximum dispersion of agricultural production across Pennsylvania, followed by generally increasing inequality in the distribution of agricultural production. Agricultural production is more concentrated now than in 1810. Philadelphia County had the highest agricultural density of all counties between 1810 and 1870 and again in 1900 and 1910; in 2002, it ranked 65th. Lancaster County has led the state in agricultural density since 1920. The state's leading agricultural counties in terms of production are Lancaster, Chester, and Berks Counties. Figure 5 plots the share of agricultural production in Pennsylvania occurring in these three counties. The figure demonstrates that as agriculture became less and less important in Philadelphia, Berks, Chester, and Lancaster Counties have accounted for an increasing share of the state's agricultural output. About one-third of all agricultural production in Pennsylvania now occurs in these three counties, which make up 6 percent of the state's land area.

Figure 4. Gini Coefficients for Agricultural Density

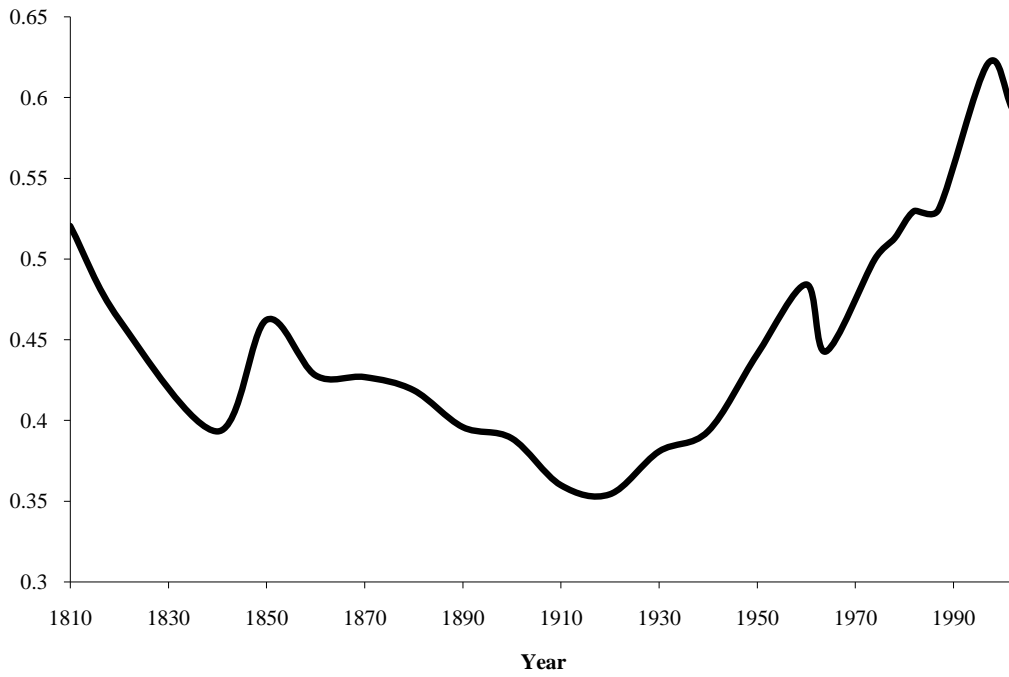
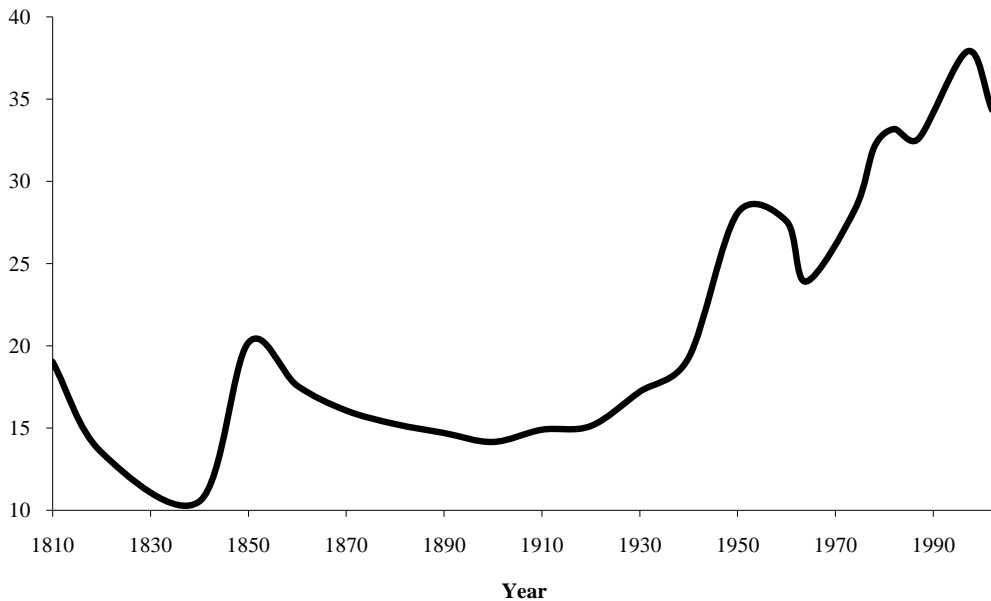


Figure 5. Share of Statewide Agricultural Production Occurring in Berks, Chester, and Lancaster Counties



CORRELATION BETWEEN AGRICULTURAL AND MANUFACTURING DENSITY

In Krugman's (1991b) two region model of the geographic concentration of manufacturing, mass production and lower transport costs can cause a region to develop an increasingly concentrated manufacturing sector and an agricultural periphery. This suggests that it might be interesting to investigate the correlation between county agricultural and manufacturing densities over time as Krugman's model implies that counties with a high manufacturing density ought to have a low agricultural density and vice versa.

The correlation between a county's agricultural density and its manufacturing density is calculated for each year. Figure 6 plots these agriculture/manufacturing density correlation coefficients since 1810. Although there is a clear downward trend, there was a positive correlation between agricultural density and manufacturing density until the 1960's. Since the mid-1970's, there has been a weak positive correlation between the two variables. In other words, in the early stages of the state's development, counties with a dense manufacturing sector also had a dense agricultural sector. Most economic activity in Pennsylvania, both manufacturing and agricultural, took place within a handful of counties. Over time, perhaps as shipment of agricultural products from distant points became more feasible, agricultural production moved to rural counties with the share of total farm output produced in the state's rural counties rising from 41 percent in 1850 to 54 percent in 1920. Manufacturing remained concentrated in the urban counties located in the southeastern portion of the state, weakening the correlation between agricultural and manufacturing densities.

Figure 6. Correlation Coefficients Between Agricultural and Manufacturing Densities



CONCLUSIONS

Economic activity is unevenly distributed across geographic areas, including Pennsylvania. This paper examined the historical evolution of the geographic distribution of economic activity across Pennsylvania. As the state developed, it first experienced increasing population and manufacturing spatial inequality with manufacturing concentrated in Philadelphia and, by 1840, Pittsburgh. Inequality reached a peak in the 1930's. Since then, population and manufacturing density have become more dispersed across the state, with the counties in the southeastern portion of the state accounting for an increasing proportion of all economic activity in Pennsylvania. Agriculture has shown the opposite pattern: initial dispersion followed by increasing concentration, again in the southeastern part of the state. The evidence also indicates that in the nineteenth century counties with a high manufacturing density also had high agricultural densities. Philadelphia had the one of the highest agricultural and manufacturing densities of all Pennsylvania counties until 1910. Philadelphia still has the highest manufacturing density but now has one of the lowest agricultural densities. Over time, maybe as transportation of agricultural products improved, agricultural production moved to outlying regions and manufacturing remained concentrated in those areas where it initially sprang up.

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