A First Step Toward a Test of Smith's Inquiry into the Nature and Causes of the Wealth of Nations: The Case of the Arkansas Railroads: 1870 - 1890

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Abstract:

This paper outlines Adam Smith's argument that trade, by allowing a factory to serve a larger market, permits a firm to hire more workers and still be able to meet payroll. A firm with many employees can assign tasks so each person can specialize in one job, which should increase labor productivity. Enhanced productivity, in turn, leads to increases in wealth.   This paper identifies a potentially fruitful setting for testing Smith's theory: Arkansas railroads. Railroads represent a low cost means of transportation, which makes trade less costly. We found that the wealth increases Arkansas experienced between 1870 and 1890 were greater in areas served by railroads than they were in areas without service.

Key Words: Adam Smith, division of labor, wealth of nations

I. Introduction

Adam Smith's "Wealth of Nations" arguably established economics as a distinct academic discipline. Even today, much of economic theory is built upon the foundation laid by Smith. Although Smith's theory of the causes of a nation's wealth is a corner stone of modern economics, it has only rarely been empirically tested. This paper finds economic wealth in Arkansas during the late 1800's increased in a manner consistent with Smith's theory.

In this paper, we propose to take a first step toward testing Adam Smith's theory that a reduction in the cost of trading increases wealth. We do so by focusing on economic development in Arkansas from 1870 to 1890. This was the period in which railroad development occurred. Also, there were few changes in navigation during this period. We hypothesize that because railroads are a cheaper form of transportation, economic development should have occurred at a much faster pace in areas served by rail lines than in the remainder of the state.

Section II of this paper outlines Smith's theory in more detail. Section III describes the historical development of major Arkansas rail lines. Section IV discusses the research methodology and the data used to test Smith's theory. Section V presents the results of our empirical analysis. Section VI discusses the limitations of our empirical work, a competing hypothesis that can explain the results, and suggestions for further research.

II. Adam Smith's Theory of Economic Growth

Adam Smith wrote that trade increases the wealth of a community. To illustrate, consider Smith's example of a pin factory in a hypothetical nation composed of numerous towns that found it cost-prohibitive to trade. Each town would produce the number of pins that town consumed. Perhaps one smith in each town would be necessary to provide enough pins for local consumption. Smith identified ten different tasks associated with making pins. A smith in one of these towns would have to perform each of these tasks himself.

If the cost of trade between towns decreases because of the construction of a road, railway or some other means of transportation, a factory in one town could service all of the towns connected by the new transportation infrastructure. Now instead of one person performing all of the tasks, ten or more people could be hired. Each worker could perform a separate task. This specialization increases a worker's productivity for three reasons. First, by spending more time on a single task the person will become more dexterous at performing this task. Second, no time is wasted moving from one task to another task. And finally, by clearly delineating the steps of production, it becomes easier to invent a machine or technique to perform the one task more efficiently.

It follows that if each worker is more productive, ten workers with separate tasks can produce more than ten workers performing each and every task by themselves. The increased production per worker allows the country to produce its previous level of pin production with less labor. The extra labor, which was used to produce pins before trade, can be used to produce more pins or more of another good. The production by this extra

labor is the wealth increase attributable to trade.

Of course, a town which cannot trade could produce pins in a large factory by employing ten or more people. However, without trade the factory output would be much greater than the demand for pins. The demand for pins within one town is insufficient to provide enough sales at a breakeven price to pay all of the workers. It is only with the advent of trade that a factory can find customers to support its labor costs.[1]   In Smith's words, "As it is the power of exchanging that gives occasion to the division of labor, so the extent of this division must always be limited by the extent of that power, or, in other words, by the extent of the market."[2]   Smith uses the example of how access to water transportation can widen markets, leading to increases in real wealth:

> "As by means of water-carriage a more extensive market is opened to every sort of industry than what land-carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers, that industry of every kind naturally begins to subdivide and improve itself, and it is frequently not till a long time after that those improvements extend themselves to the inland parts of the country."[3]

The development of railroads in the nineteenth century should have led to the same widening of markets that results in a furthering of the division of labor. As Smith has noted, the economic development of areas not served by "water-carriages", the inland areas, will lag that of towns with access to such transportation. Again, there should be lags in the development of areas not served by rail lines as well.

III. Railroads in Arkansas

This paper looks at the link between Arkansas railroads and economic development during 1870 to 1890. This place and time period offer a unique advantage as a setting for a test of Smith's theory.   Namely, Arkansas built a significant portion of its rail lines in a relatively short period of time, which offers us several advantages: 1) In a macroeconomy, there is a constant stream of variables that affect economic outcomes, variables that scholars cannot account for when they design empirical strategies, but which can influence their studies' results. By analyzing a relatively short period of time, we allowed less opportunity for these other macroeconomic events to influence our results; 2) Since Arkansas built its railroad tracks during such a concentrated period of time, railroads should have begun to influence the economies in many places simultaneously, so we should have a relatively easy time recognizing movements in the economic data.

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[1] Smith, (1986, p.117).

[2] Smith (1986, p.121).

[3] Smith (1986, p.122).

Arkansas built its railroad lines in a short period of time because it got a late start. At the beginning of the Civil War, it only had 38 miles of line in operation, and these tracks fell into disrepair during the war.[4] In 1869, Arkansas had fewer miles of railroad than any other state, with the exception of Oregon.[5] Eventually, the state began constructing railroad tracks at a quicker pace, operating 822 miles of track by 1880, and over 2,000 miles by the end of the decade.[6]

To help you visualize the path of this railroad construction, Figure 1 shows the major rail lines in Arkansas at the turn of the century. The first section of railroad was completed in April 11, 1871 and linked Little Rock and Memphis (M & LR). By 1874 this line extended past Fort Smith to the Oklahoma border (LR & FS).   Also, by 1874 The Little Rock to Pine Bluff line (LR & PB) ran from Little Rock to the East-Southeast border of the state. Additionally, the Iron Mountain and Southern railroads (SL & IM) had completed lines linking St Louis and Texarkana. Further railroad development occurred in the 1800s. First, the St Louis and Southwestern railroad complete a track which was south of and parallel to the line linking St. Louis and Texarkana. Second, the Kansas City, Texas and Gulf railroad (KC, T & G) ran from Fort Smith to Texarkana, down the western border of the state. Finally, the St. Louis and San Francisco railroad ran in sections of the Northwestern part of the state and another separate line in the Northeastern portion of the state.[7]

IV. Discussion of Data

Figure one presents a map of Arkansas which illustrates 1890 county boundaries[8] and major rail lines. County boundaries in Arkansas were very unstable during the period 1870 to 1890. In 1870, Arkansas was divided into sixty counties. By 1890, the state was

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4 Baker (1992, p.4)

5 Poor, (1869, p. xxv)

6 Baker, (1992, p.6)

7 The map of Arkansas rail lines can be found in Hanson, Gerald and Carl Moneyhon. *Historical Atlas of Arkansas*, Norman: University of Oklahoma Press, 1989. A description of the building of Arkansas Railroads can be found in the aforementioned book and in Ferguson, John and J.H. Atkinson. *Historic Arkansas*. Little Rock: Arkansas History Commission, 1966

8 County boundaries were found in Thorndale, William and William Dollarhide. *Map Guide to the U.S. Census, 1790-1920*. Bountiful, UT: American Genealogical Lending Library, 1987.

divided into seventy-five counties. The extra fifteen counties were created by a shifting of boundaries to accommodate the new counties. Because the boundaries of counties changed over the period of analysis, we could not simply compare changes in county wealth over time. We grouped counties into areas which had nearly identical boundaries in 1870 and 1890. Some of these groups represent individual counties whose borders did not change after 1870. Lawrence county is such a county. Other groups consist of several counties. One such group includes the 1870 counties of Crawford, Franklin, Johnson, Pope, Yell, Sebastian, and Scott counties. By 1890, this area had been repartitioned to accommodate an additional county, Logan county.   In all, there are twenty-eight areas whose boundaries were comparable between 1870 - 1890. The boundaries of the 28 areas are denoted with thick lines in Figure 1. No major railways were completed by 1870. By 1880, major rail lines cut through ten of the twenty-eight areas. By 1890, rail lines cut through twenty of the twenty-eight areas.

We examine two types of variables: 1) those which directly measure wealth, and 2) industry variables which measure the specialization and division of labor. The first measure of wealth is the true market value of real and personal property per acre. If rail lines make an area more prosperous, the value of real and personal property will increase. Secondly, population per acre is a proxy for wealth. As a region becomes more prosperous, it will attract more people than other less prosperous regions. The variables more directly related to the specialization and division of labor include the growth rate in manufacturing employment and the growth rate in the number of manufacturing establishments. Since Smith's argument contends that larger factories are possible with trade, cheap transportation afforded by the railways should allow the areas that they serve to support large factories. The ability of an area to support a large factory implies it can hire more workers. We contrast differentials in the rates of growth for these variables between areas served by rail lines and those not served by rail lines. We computed these rates of growth for two periods; 1870 to 1880 and 1880 to 1890.

The data was collected at the county level. Population was found in the Population Abstract of the United States.[9]   The real estate value and the two measures of employment were all found in the appropriate issue of the United States Census.[10]   The next section examines the empirical evidence to answer the question: Did wealth and employment levels increase in areas served by railways as Adam Smith's theory of the wealth of nations predicts?

V. Results

The values of the two wealth variables and the two industry variables are reported

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[9] Andriot (1983).
[10] *Census of the United States (*9th-11th Census).

in Table 1.   These variables are reported on a per-acre basis for the years 1870, 1880, and 1890. Since no major railways were completed in 1870, the 1870 numbers measure the value and manufacturing levels of land before the advent of rail lines. We show this data for areas which will be served by rail lines before 1880, and for areas which will not be served by the end of the decade.

In 1870, wealth in areas to be served by rail lines was 86 percent greater than other areas.   Population was 32 percent greater in areas served by rail lines, the number of establishments was 75 percent greater, and the number of manufacturing employees was 110 percent greater. These base line values indicate that wealth and industrialization were already greater in counties to be later served by rail lines. However, the gap between rail and non-rail areas widened between 1870 and 1890. The real market value of an acre of land about to be served by a rail line in 1870 was 86 percent greater than the price of land in the rest of the state; by 1890, the market value of land served by rail lines was 144 percent greater than it was in other areas. Population patterns tell a similar but not as dramatic story. In 1870, 32 percent more people per acre lived in areas about to be served by rail lines, but by 1890 this gap widened to 41 percent. The number of hands employed in manufacturing per acre in 1870 was approximately twice as high in the areas about to be served by railways. In 1890, nearly four times more people per acre were employed in manufacturing in areas served by the rail lines. Throughout the time period examined, the number of establishments per acre increased, but at a less stunning rate. In 1870, areas to be served by rail lines had 75 percent more establishments per acre, which increased to 88 percent more establishments per acre by 1890 when the rail service was operational. This comparatively wider disparity over time in workers employed when compared to the number of establishments suggests rail lines supported larger factories. These larger factories permitted further specialization and division of labor, leading to the wealth increases noted above. So far during the entire span of 1870 - 1890 we have shown that the gap in wealth and industry became more pronounced between the areas served by rail lines and those that were not. These gaps were comparatively less pronounced when only the time period between 1870 - 1880 is considered.

Now, we turn our attention to growth rates of wealth and manufacturing. We divided the areas into three groups: areas served by rail lines completed during the 1870s, areas served by rail lines completed in the 1880s, and areas not served by rail lines during this time period. Table 2 presents growth rates between 1870 and 1890 for our wealth and industry variables. Market value grew twice as quickly in areas served by railways. The growth rate in population was about 85 percent in rail areas and under 80 percent in the non-rail areas. The growth rate of the number of establishments was lowest in the areas without rail lines. The growth rate in number of employees employed in manufacturing was approximately twice as high in rail areas served by rail lines.   Growth rates between 1880 and 1890 are also reported in Table 2. The biggest difference between growth rates is in the number of establishments. In areas where the railroads were built early (1870s), the growth rate for new businesses was 63.3 percent. In contrast, the area with no railroad

service had the lowest growth rate, 34.1 percent.

Table 3 reports the wealth and industry measures in per-capita terms.   The per capita gap in the market value of real estate favored with rail lines increased from 40 percent in 1870 to 66 percent in 1890. It is also notable that the percentage difference in manufacturing employment per 1,000 residents for rail vs. non-rail areas almost doubled between 1870 and 1890. Railroads seem to widen the difference in both per capita wealth and employment per 1,000 people.

VI. Discussion

Our results are consistent with the theory that an increase in trade increases wealth because it enables workers to become more productive due to specialization.   However, our results are also consistent with the explanation that an increase in trade allows efficient firms to expand. With increased trade, these firms can now serve larger markets and they can draw workers and other inputs away from inefficient firms.[11]   In this competing narrative, the efficient firms have a comparative advantage in the goods they produce. The increase in wealth occurs because workers are allocated more efficiently, not because they found more productive ways to do tasks (as Smith's theory would suggest).

Economists generally accept the theoretical case that trade increases wealth, but as Bernhoffen and Brown note – we know very little about the empirical magnitudes of these gains or about the mechanisms that generate them.[12] Part of the problem is that in order to determine which country (or region) has a comparative advantage in producing a good, economists need to observe the prices that exist before trade takes place. However, trade almost always occurs and it is nearly impossible to observe pre-trade prices. In order to find how comparative advantage directed trade contributes to welfare gains, economists have focused on analyzing the wealth impacts of changes in barriers to trade.   These studies are problematic since economists can almost never observe the prices that would exist without trade.   Two papers by Bernhoffen and Brown analyze a natural experiment that overcomes this problem.[13]   Before 1859, Japan was a closed economy with almost no trade with other nations, so the authors were able to observe the prices that existed in the absence of trade.   They used these prices to determine Japan had a comparative advantage in certain goods. The authors estimated that if Japan had opened up a few years earlier, its real GDP would have been 8 to 9 percent higher during these years. In their study, they assumed away a dynamic element to the opening up of trade that would have allowed workers to learn how to become more productive.

Separating the Smith and Ricardo (comparative advantage) explanations of why

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11 For example see Cosar and Fajgelbaum (2016).
12 Bernhoffen and Brown (2005, p.208).
13 Bernhoffen and Brown (2004 and 2005).

trade increases wealth is difficult.   There are only so many natural experiments that allow

scholars to observe the pre-trade prices necessary to identify the role comparative

advantage plays in wealth increases.   Given the difficulties with using international trade

data, a new approach to this research question may be fruitful. Our paper suggests that

railroad construction in the late 1800s may provide another avenue to explore the

mechanism through which trade increases wealth. The main contribution of our paper is

that it identifies a setting that can be used to explore this issue, but it is only a first step.

Since Fogel's work in the 1960s, economists have used railroad construction to

carefully explore the link between increasing trade and national income.[14]   In this

literature, however, most papers focus on how railroads increased a country's income by

allowing farmers to expand their production when they have a comparative advantage.[15]

Few papers have looked at the influence of railroads on the efficiency of manufacturing

firms, but Hornbeck and Rotemberg represent a notable exception.[16]   They use county-

wide data and measure increases in firm productivity with revenue and expenditure data.

While county level data is informative, we believe that a detailed examination of the

production processes of individual firms can shed light on exactly how firms changed their

production processes and if they engaged in more division of labor.   Such a specific level

of analysis would provide an important benchmark with which to judge the aggregate level

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14 See Fogel (1962).
15 For examples see Donaldson (2018) and Metzer (1974).
16 See Hornbeck and Rotemberg (2019).

analysis of Hornbeck and Rotemberg and other papers that will surely follow.   We believe

our paper has identified an area that would be fruitful for a case study of how the

manufacturing industry responded to railroads. Additional research can use the case study

method to determine how important specialization was in increasing wealth.   Did the

establishment simply hire more workers who did the same tasks that existing workers had

been doing?   Did firms divide labor more after they increased in size?

VII. Conclusion

This paper outlines Adam Smith's argument that trade, by allowing a factory to
serve a larger market, permits a firm to hire more workers and still be able to meet payroll.
A firm with many employees can assign tasks so each person can specialize in one job
which should increase labor productivity. Enhanced productivity, in turn, leads to increases
in wealth. We found that Arkansas rail lines increased the wealth of areas they serve. Rail
lines represent a low cost means of transportation which makes trade less costly. The
cheaper transportation should make trade that was previously cost-prohibitive
economically viable. We find evidence that areas served by rail lines employed more
people per establishment. We also found that the wealth increases Arkansas experienced
between 1870 and 1890 were greater in areas served by rail lines then they were in areas
without service. In summary, the growth of wealth and industry in Arkansas during the
period 1870 - 1890 is consistent with Smith's theory of the influence of trade upon wealth.
Further research should employ the case study method to determine if the establishments
along the railroad tracks directed their workers into more specialized tasks or if they
merely hired more workers.

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FIGURE 1: Arkansas Rail Lines and County Boundaries in 1900.
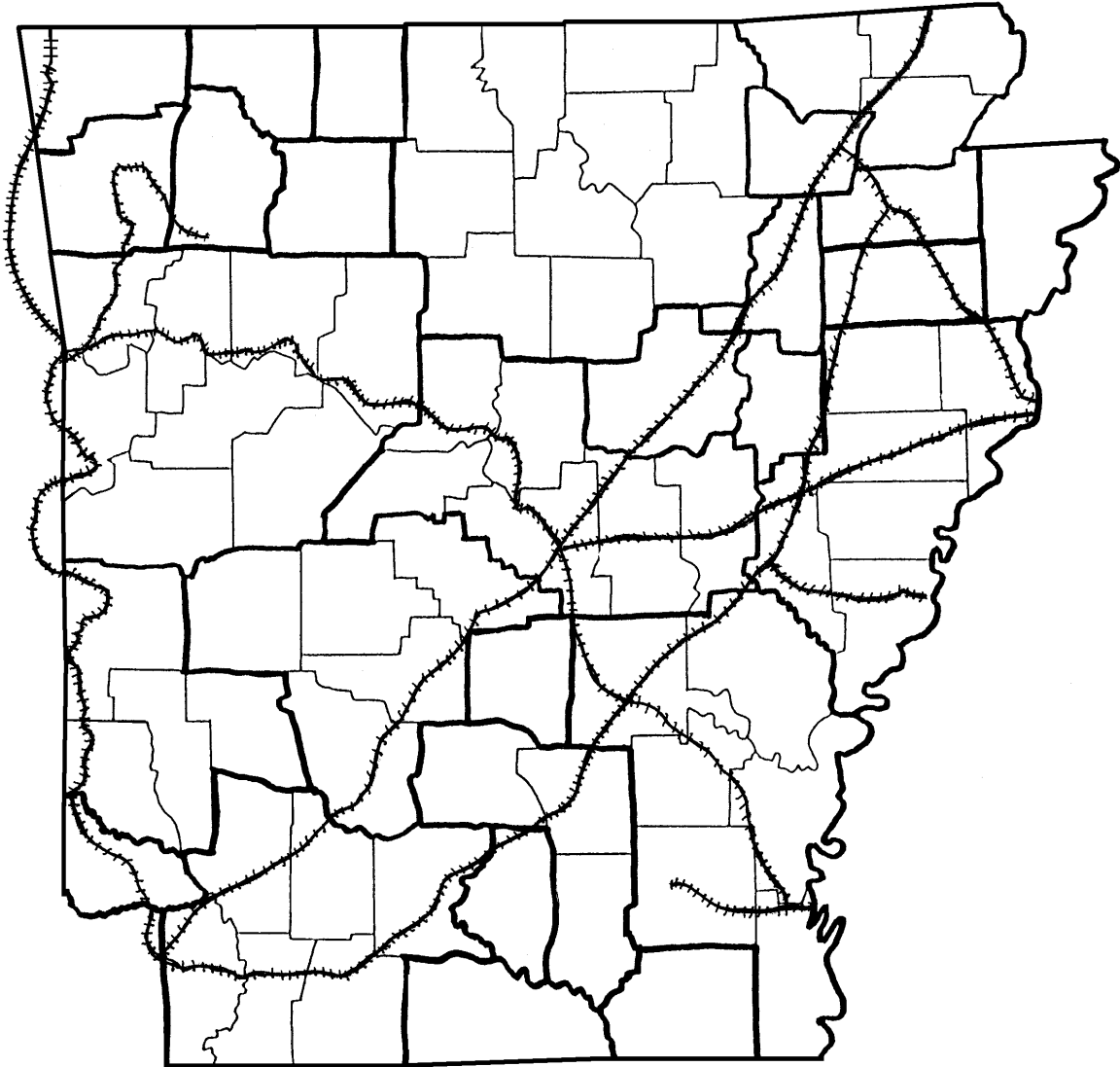
Bold lines signify counties grouped due to changing boundaries.

Table 1: Wealth and Industry per Acre by County Group

Variables	Aggregated County Groups								
	1870			**1880**			**1890**		
	rail	**non-rail**	**rail/ non-rail**	**rail**	**non-rail**	**rail\ non-rail**	**rail**	**non-rail**	**rail\ non-rail**
Market Value	$29,307	$15,696	1.867	N.A.	N.A.	N.A.	$55,706	$22,814	2.442
Population	10.3	7.8	1.321	17.3	12.6	1.373	23.0	16.3	1.41
# Establishments	.0252	.0144	1.750	.0252	.0197	1.279	.0440	.0233	1.888
# Hands	.0788	.0375	2.101	.1160	.0478	2.427	.3760	.0796	4.724

All money is reported in 1982-1984 dollars. Market value was not available for 1880.

Table 2: Growth Rates of Wealth and Industry by County Group

Variables	Growth Rate (1870-1890)			Growth Rate (1880-1890)		
	Rail Built in 1870s	Rail Built in 1880s	No Rail	Rail Built in 1870s	Rail Built in 1880s	No Rail
Market Value	43.4%	40.1%	18.9%	N.A.	N.A.	N.A.
Population	86.6%	85.6%	79.8%	34.9%	35.2%	28.9%
# Establishments	63.6%	66.0%	60.6%	63.3%	58.2%	34.1%
# Hands	171.9%	167.3%	86.0%	133.2%	128.8%	78.4%

All money is reported in 1982-1984 dollars. Market value was not available for 1880.

Table 3: Wealth and Industry Per-capita

Variables	Aggregated County Groups								
	1870			1880			1890		
	rail	non-rail	rail/ non-rail	rail	non-rail	rail\ non-rail	rail	non-rail	rail\ non-rail
Market Value	$2843	$2018	1.409	N.A.	N.A.	N.A.	$2597	$1567	1.657
# Establishments	2.44	1.85	1.319	1.46	1.57	.093	1.93	1.45	1.331
# Hands	7.64	4.83	1.582	6.7	3.7	1.811	16.05	4.97	3.229

All money is reported in 1982-1984 dollars. Market value was not available for 1880. # of hands and # of establishments are per

1,000 persons.