Did Industrialization Cause the American Fertility Decline? Evidence from South Carolina

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Draft: March 2010

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Abstract

Economists have frequently hypothesized that industrialization and its correlates played a major role in inducing fertility decline in the United States after 1850. There are several competing explanations for the precise mechanism, including increases in the costs of raising children, increased urbanization, increases in the returns to human capital, reductions in child labor opportunities, and changes in infant mortality. I exploit the unique circumstances surrounding industrialization in South Carolina between 1880 and 1900 to show that fertility rates were negatively impacted by the arrival of textile mills. Using a cross-section panel of rural locations in South Carolina, I show that textile mill arrival was associated with an 11% reduction in fertility by 1900. A falsification test shows that these patterns did not hold in the pre-industrialization period and a difference-in-difference analysis confirms the result. Controlling for migration, it appears that the in-migration of low-fertility households is responsible for this result. In order to discern which of the potential mechanisms may have been responsible for this result, I first limit my sample to rural areas and show that the results are robust to this variation. I show that textile mill arrival is not associated with changes in infant and child survival rates, eliminating this as a potential explanation. Finally, I argue that the nature of the textile industry and textile employment between 1880 and 1900 in South Carolina suggests that human capital and child labor opportunities were unlikely causes. This leaves changes in the cost of raising children as the likely driver of the industrialization result.

*I am grateful to Joe Ferrie, Joel Mokyr, Chris Taber, Xavier Duran, Matthias Doepke and Lou Cain for helpful comments and suggestions. This paper has also benefited from the input of Northwestern's Economic History Seminar, Northwestern's Labor Lunch, and the University of Tennessee's economics brownbag. Funding for this research has been generously provided by Northwestern University in the form of a Graduate Research Grant, Graduate Research Fellowship, and Presidential Fellowship. Additional funding from the Economic History Association's Research Travel Grant is gratefully acknowledged.

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1 Introduction

Scholarly interest in fertility decline has intensified in the last several years. The primary economic explanation is that fertility in the United States and elsewhere fell as industrialization progressed. According to this narrative, industrialization changed the incentives to bear children by raising the costs and lowering the benefits to childbearing. In turn, households responded to these changes by reducing the number of children they bore. Although alternative explanations appear in the demography and sociology literatures, there seems to be little challenge in the economics literature to the hypothesis that industrialization was a cause of falling fertility in the United States and elsewhere.[1]

There are a number of mechanisms by which industrialization may have altered a household's fertility outcome. First, the work of Galor, Weil, Doepke and others (collectively referred to as Unified Growth Theory, or UGT) has illuminated how an increased return to human capital resulting from industrialization would have increased the incentives of households to invest in child quality over quantity. UGT goes on to show that the resulting reduction in fertility may have accelerated the growth process by enhancing capital accumulation and reducing land and capital dilution. Second, in addition to changes in the relative return of child quality and quantity, industrialization raised the opportunity cost of female time relative to male time. Under the assumption that the child production process is female-time intensive, this would have further reduced the incentive to bear children. Third, industrialization altered opportunities for child labor. The movement away from agricultural and at-home production to centralized production, in addition to more restrictive child labor laws, may have reduced the economic return to children, again lowering fertility rates. Fourth, industrialization was associated with increased urbanization and the crowding that occurred may have increased the costs of raising children without an associated increase in the benefit. Finally, the developing economy in the United States witnessed decreases in child mortality rates, especially after 1880. The expected correlation between infant mortality and fertility is ambiguous, but some theoretical work indicates a positive correlation.[2]

The purpose of this paper is twofold. First, I provide empirical evidence to validate the underlying assumption that industrialization was a cause of reduced household fertility. Second, I show that the mech-

[1] *See Becker (1960); Forster, Tucker, and Bridge (1972); Haines (1978); and T. Paul Schulz (1985) among others.*

[2] See Doepke (2005) for a negative correlate and Sah (1991) and Kalemli-Ozcan (2003) for a positive correlate.

anism involved is most likely to be changes in the costs of children (including a rising opportunity cost of female time), rather than human capital considerations, urbanization, child labor, or changes in infant mortality, at least for this specific time and place in American history.

Previous attempts to document the impact of industrialization on fertility have been hampered by issues of simultaneity and co-linearity. An empirical observation that industrialization and fertility are negatively correlated does not tell us anything about the order of causation. UGT provides a specific mechanism whereby falling fertility may have spurred industrialization rather than vice versa. Other correlates of the industrialization process may also have been simultaneously determined. For example, empiricists observing a rise in female wages and labor force participation rates coupled with declining fertility cannot be sure which variable (if any) is exogenous and which endogenous. Changes in the opportunity cost of female time may have induced changes in fertility, or changes in fertility may have encouraged women to enter the labor force and invest in human capital (or even allowed industrialization itself to take hold). Likewise, child labor regulations may have preceded fertility declines, or they may have followed.

To solve the simultaneity problem, the empiricist must be able to identify plausibly exogenous changes in the level of industrialization. I exploit the circumstances surrounding industrialization in South Carolina between 1880 and 1900 to identify this change. The introduction of textile mills to South Carolina after the Civil War marked the beginning of the state's industrial era. I argue that the emerging geography of South Carolina's textile industry was exogenous to the characteristics of the local labor force, in particular their fertility. Comparing the fertility patterns of rural townships in South Carolina that did and did not receive textile mills over this period, I ask whether industrialization had any measurable impact on household fertility. I find that the arrival of textile mills negatively impacted marital fertility rates in South Carolina between 1880 and 1900. In the cross-section, the introduction of textile mills reduced 1900 marital fertility by as much as 11%.

A second challenge to fertility decline empirics is the co-linearity of the different mechanisms highlighted above. The late 19th and early 20th centuries brought large decreases in the fertility of American women. The level of industrialization in the United States also increased over this period, and with it came simultaneous increases in the return to human capital, increases in the opportunity cost of female time, decreases in infant mortality rates, increased urbanization, strengthened child labor regulations, and reduced l evels of agricultural employment. Because of this co-linearity, choosing between these competing drivers of reduced fertility requires that the empiricist identify dates and locations in American history where the industrialization process was accompanied by a subset of these realities, but not all (or at least not all to the same extent). For rural South Carolina between 1880 and 1900, I am able to do just that. The data shows little impact of textile mill arrival on infant mortality rates, and other research has shown that the textile industry was not associated with large changes in the returns to human capital. I limit my analysis to rural areas of the state, and exploit the fact that children were extensively employed in the mills and that child labor laws were not passed in South Carolina until 1903 to argue that an increased price of female time and other cost considerations are the most likely explanations for declining fertility rates documented herein.

2 Empirical Strategy

This paper will measure the impact of industrialization on fertility rates using data from rural areas of South Carolina between 1880 and 1900. There are several unique aspects of the South Carolina industrialization process that make it an ideal laboratory in which to test hypotheses about industrialization and fertility decline. First, prior to 1910 or so, textile mills represented the largest (and, arguably, the sole) source of industrial employment in the state. In 1900, 30% of males and 57% of females employed in manufacturing were textile workers. No other industry came close to matching the textile share of employment, and most of the runners-up involved decentralized manufacturing.[3] (e.g., carpentry at 7.5% of male employment; dressmaking and seamstresses at 32.3% of female employment) As a result, South Carolina industrialization in general can be proxied with the textile industry in particular. Second, this industrialization occurred outside of urbanization, allowing me to remove this potential explanation for fertility decline. Third, and most important, the particular locations of textile mills in the rural areas do not appear to have been driven by the demographics of the local labor force or by other characteristics of the location that would have, in turn, affected fertility.

This final point is critical for an empirical strategy which compares *ex post* fertility rates for two neighboring townships - one that receives a mill and one that does not. Ideally, to test whether industrialization

[3] Author's analysis of IPUMS 1900 1% sample

had an impact on fertility rates, the empiricist would randomly assign textile mills to townships (or industrial employment to households) and then compare the *ex post* fertility rates of the "treated" townships (households) to those not receiving the industrialization "treatment", controlling for any migration industrialization might induce. Under random assignment, any *ex post* difference in fertility rates between the two groups can be attributed to the treatment itself rather than to self-selection into the treatment.

But in the absence of random assignment, in order for these results to be meaningful it must be true that mill townships and non-mill townships did not differ in other non-observable ways *ex ante*. In particular, they must not have differed in ways that would affect fertility.

For South Carolina between 1880 and 1900, it appears that the location of textile mills was uncorrelated with other factors that influenced local fertility. The primary reason for this is that the Piedmont region where textile manufacturing focused after 1880 was incredibly homogenous in terms of its economic activity, socio-economic characteristics, and climate prior to industrialization. (See the upper panel of Figure 2 for a map of the Piedmont area and the concentration of the textile industry therein.) Even access to railroads was fairly uniform in the rural areas, away from the industrial centers.

The area was homogenous in other, less tangible, ways as well.

> [T]he Civil War destroyed not only slavery, but any prewar county differences in the popular attitude toward agrarianism vis-à-vis industrialism. Certain postwar developments, such as the introduction of commercial fertilizers and the subsequent general spread of cotton throughout the [Piedmont] area, the breakdown of plantations, the rise of the crop-lien merchant credit system and the cropping system and their subsequent general introduction to all area counties, the completion of the rail network that blanketed the entire area with a striking uniformity, and the triumph of "Solid South" politics - also brought to the area a degree of homogeneity hitherto virtually unknown.[4]

This convergence in attitudes combined with aspects of the local populations to produce similar labor markets throughout the region.

> Because of these convergent movements during 1865-1900 among our study area counties, the

[4] Tang (1958), p.64

> Southern Piedmont had, by 1900, become remarkably homogeneous, not only in terms of labor productivity and income in agriculture, but also in terms of other socio-economic indexes.[5]

This homogeneity of local labor markets justifies the assumption that textile mill locations were random with respect to other drivers of fertility rates, especially after controlling for the presence of railroads and other township observables. In many ways, "if you build it they will come" applied to the South Carolina rural population in this period. Rural households were desperate to leave their farming professions. Cotton and tobacco prices plummeted in the 1890's and farming households were adversely impacted. Mill owners could have picked virtually any rural location and they would have found a local labor force eager to become mill workers. It seems unlikely, therefore, that mill proprietors would have chosen one location over another in order to enjoy monopsony power in the local labor market. Monopsony power would have been universal, and there was little in the labor market to distinguish one rural township from another.

Of course, mill proprietors did, in the end, choose particular locations over others in locating their mills. In the early part of the industrialization period, particularly prior to 1890, mills located on the banks of rapidly-flowing rivers. These location decisions were driven both by concerns about water power and by the need for natural humidity to support the manufacturing process. Any river location could supply humidity, so the availability of quickly flowing water capable of driving a water wheel dictated location in this early period. The demographics of the local population would have been, if anything, secondary. Writing about mill location in Georgia, Broadus Mitchell noted:

> So far as they go, statements explaining the causal character of water powers [in influencing mill location] are proper. The industry at Augusta and Columbus prior to 1880 was attributable chiefly to falls in the Chattahoochee and Savannah rivers, and plants erected after this date owed much to the presence of this asset.[6]

The first steam-powered mill was built in South Carolina in 1881 and, after 1890, steam power began to dominate as a power source.[7] "Cotton mills among the cotton fields" became possible, and mill proprietors

[5] Tang (1958), pp.64-65

[6] Mitchell (1921), p.148

[7] The 1880 "break" in Mitchell's quote given previously coincides with the introduction of steam power which freed mills *somewhat* from the water constraing.

were freed from their reliance on fast-flowing water. At first, steam and water were used in combintation to power textile mills, but by the second half of the 1890s, most mills ran on steam alone.[8] Proximity to water was still desirable for waste removal and natural humidity, but steam power also required massive amounts of coal input, and coal was an expensive commodity to transport. As a result, proximity to railroad lines likely replaced water flow as the primary driver of mill location by the late 1890's. in rural locations, railroad presence was a more-or-less idiosyncratic process.[9] Still, I control explicitly for the existence of a railroad in the empirics of Sections 3 and 4 in order to account for the possibility that railroads had an independent effect on fertility.

For these reasons, I assume (and later test) that mill location was random with respect to local fertility rates. I do not expect that mills located in townships in South Carolina where fertility was already low (or high) relative to neighboring townships. All the same, I will test whether pre-mill fertility rates in townships that eventually housed a textile mill were similar to rates in townships that did not. These *ex ante* results and initial estimates of the impact of textile mills on local fertility are contained in Section 3.2.

The results are further validated in Section 3.3 using a difference-in-difference approach. If there is some unobserved quality of textile locations that make them different from non-mill locations and that also affect fertility, an estimated impact of industrialization on fertility will be biased. But if this township-specific quality is time-invariant (i.e., a fixed effect), then two observations for the same township in two different years can be differenced in order to obtain an unbiased estimate.

In Section 3.3, I use township-level fertility rates from 1880 to 1900 to generate a difference-in-difference estimate for the impact of industrialization on fertility. The industrialization period in South Carolina began in the 1880s, and only 7 mills were extant in 1880, making it a reasonable year in which to measure *ex ante*

[8]The *Seventh Annual Report of the U.S. Commissioner of Labor on the Cost of Production: The Textiles and Glass* reports that many mills in 1890 are producing using a combination of steam and water, with a few mills operating on steam alone.

[9]If railroad location was, in turn, dependent on some aspect of local population also correlated with fertility, this exercise fails to satisfy the requirements for OLS estimation. The historical record indicates that railroads were built in the years following the Civil War for two reasons. First, railroads connected commercial centers in the state. In this case, their existence in rural communities was a byproduct of these urban connections. Connecting routes between two larger urban centers were chosen, in part, to minimize construction costs. Rural locations lying on the low-cost route would have been traversed by railroad track and therefore more likely to house a textile mill. Second, railroads were constructed to connect certain areas rich in natural resource to the major railroad networks. Short-line railroad tracks were built to service lumber mills and mines (coal and otherwise) which would have, by necessity, located near the natural resource they were extracting. Again, rural areas located between these mills/mines and the main railroad network would have been traversed by railroad track as a byproduct of this system. In either case, once the railroad track was laid, its existence drove the location of textile mills in these rural locations over those without railroad access. In the end, the final route taken by any particuar railroad line is the outcome of an idiosyncratic process involving political forces and financial incentives, in addition to construction costs and natural resource locations as discussed above. See Stover (1955)

fertility. (The 1890 Census was destroyed by fire.) After 1900, the pre-1900 drivers of location decisions were waning, and labor market considerations were becoming more important as South Carolina mills began producing a higher quality cloth that required skilled labor. At the same time, electric power was freeing firms from prior geographic constraints.[10] As a result, 1900 was chosen as the endpoint for this analysis. The difference-in-difference results confirm the OLS conclusions.

In Section 4.2, I use household-level Census data to determine the contribution of migration to the township-level results. The results indicate that the in-migration of low fertility households was an important driver of the fertility result. Finally, I discuss the interpretation of these results in Section 5 and attempt to pinpoint the mechanism for this relationship. Section 6 concludes.

3 Township Results

3.1 Township-Level Data

I begin the analysis with township-level data on fertility and industrialization in South Carolina between 1880 and 1900. Demographic and fertility data comes from the manuscript returns of the United States Census. The U.S. Census was taken at the individual level. Individuals were grouped into households which were, in turn, grouped into townships. Townships were grouped into counties and then into states. Using data from the online genealogy tool Ancestry.com, I assemble age structure and marital status data for townships in both 1880 and 1900 to measure a township-level impact of industrialization on fertility.[11] In each year (t=1880, 1900), I calculate F5 fertility rates:

$$F5_{jt} = \frac{\#\, of\ children\ < 5\ in\ township\ j\ in\ year\ t}{Married,\ divorced,\ and\ widowed\ females\ aged\ 18\ to\ 42\ in\ township\ j\ in\ year\ t}$$

I also perform sensitivity analysis in Section 3.2 using F3 fertility rates and eliminating widowed and divorced women from the denominator. (See Section 3.2.)

Industrialization data comes from Davison's Blue Book, a directory of textile mills in the United States. The directory was printed bi-annually beginning in 1888. I use the 1902-1903 edition to generate a timeline

[10] The first electrically-powered mill, Orr Mills, was built in Anderson, South Carolina in 1899. Electric adoption was slow. By 1920 only about 50% of extant mills run on electric power. (Source: Authors' analysis of 1919-1920 Davison's guide.)

[11] There are 484 townships in 1900 and 461 in 1880. In order to perform difference-in-difference analysis in Section 3.3, I must create consistent township barriers between years. I do this using the county boundary descriptions from the two census enumerations. The process is not a precise one and requires some judgement calls. To generate consistent boundaries, I must consolidate some townships in both years. The final number for estimation is 398.

of mill establishment in South Carolina prior to 1900.[12] Davison's gives an establishment date for each mill in the book. From this data, I generate two industrialization indicators: $I_{j,1895} = 1$ if township j housed a textile mill by 1895 and $I_{j,1900} = 1$ if township j housed a textile mill by 1900. Two indicators are required as a mill built in 1898 would have a very different impact on F5 than one build in 1892.

Census data also provides additional information about townships: the population of the township, the "town" population of the township (i.e., the number of individuals living in a Census-recognized town as opposed to a rural area), and a binary variable for whether the township was a county seat in 1900.[13] I add an indicator for whether the township sits in the coastal counties, which differed from the Piedmont counties in many ways.

A final control contained in X_{jt} is the existence of a railroad in township j in 1890. This data comes from a combination of printed maps of railroads and indexes constructed by railroad enthusiasts.[14] I use these two sources to generate an indicator for whether a South Carolina township was traversed by a railroad line in 1890.[15]

In Section 3.3, I add data from the 1880 Census analogous to the 1900 data detailed above in order to undertake a difference-in-difference analysis.

3.2 OLS Results - 1900

To test whether industrialization has an impact on township-level fertility rates, I first perform a simple OLS regression of F5 in 1900 (the number of children under age 5 as a percentage of the fertile married, widowed, or divorced population) on township-level characteristics, including the presence of a textile mill. The estimating equation is:

$$F5_{j,1900} = \alpha + \delta 1 I_{j,1900} + \delta 2 I_{j,1895} + \beta X_{jt} + \epsilon_{jt} \tag{1}$$

and the estimation is taken over all South Carolina townships in 1900 (grouped into 398 townships with

[12] An accessible copy of the 1900-1901 edition has not been located. The possibility remains that mills opened and closed prior to 1902, impacting fertlity but not appearing in my industrialization measure. This would tend to bias my results in Section 3.2 towards zero.

[13] I do not use the township population variableas its interpretation is ambiguous. It is population density, no population *per se* that may have an effect on fertility.

[14] *Rand McNally and Company's Indexed County and Railroad Pocket Map of South Carolina*, 1892 edition, and http://www.carolana.com/SC/Transportation/railroads/home.html

[15] 1890 was chosen as an intermediate year. This is not an entirely objective process as the township boundaries are vague and changed over time, but I believe the results to be reasonably accurate.

consistent boundaries relative to 1880). I control separately for the industrialization of the county in 1895 and in 1900 in order to account for the fact that the F5 fertility measure encompasses five years of fertility. ($I_{j,1900} = 1$ if a textile mill existed in township j by 1900 but not by 1895. $I_{j,1895} = 1$ if a textile mill existed in township j by 1895.) A textile mill built in 1898 would not have the same impact on $F5_{1900}$ as one built in 1892, and controlling separately for the two time periods accounts for this.

Components of X_{jt} include the "town population" (the number of township residents who live in a Census-defined "town"), town population squared, an indicator for whether the township contains a county seat, an indicator for the presence of a railroad by 1890, and an indicator for whether the township is located in a coastal county. This last control is included in order to account for the fact that coastal counties were not as heavily dependent on agriculture prior to the arrival of textile mills, did not participate as heavily in textile mill construction, and may have had different underlying fertility rates. (See Figure 1 for a comparison of value-added in manufacturing for the South Carolina counties in 1880, prior to industrialization.) Variable means and standard deviations are located in Table 1. Results are located in Table 2.

Table 2 contains OLS estimation results consistent with the hypothesis that industrialization induced lower fertility. In Column I, $F5_{1900}$ exhibits a strong, negative correlation with I_{1895} and a weaker, negative correlation with I_{1900}. The addition of a textile mill in a county prior to 1896 reduces 1900 fertility by 6.7% (=0.0805/1.19). As expected, the addition of a textile mill in a county after 1895 but before 1901 has a smaller impact (0.0691/1.19=5.8%). The absolute size of the census-defined town population also has a dampening impact on fertility, as does the presence of a township in a coastal county.

Column II contains the results from limiting the data to those townships with a total town population of less than 2,500. The experiment in this paper is more appropriate for townships without large population centers. In larger towns, industrialization came in many forms, not just through textile mills, and the proxies used herein (I_{1895} and I_{1900}) are inappropriate. In addition, eliminating larger towns disentangles the effects of industrialization on fertility from that of urbanization.[16]

The results in Column II validate those in Column I. After limiting the data to those townships with less than 2,500 inhabitants in Census-defined towns, $\delta 1$ and $\delta 2$ increase (although average fertility has also

[16] The United States Census Bureau, in 1910, defined an urban location to be one with greater than 2,500 inhabitants. The Bureau went on to note that in most regions, densely populated areas of 2,500 are set off from rural territory and incorporated as municipalities (cities, towns, villages, boroughs, etc.). I simply follow this standard.

increased) and $\delta2$ remains both economically and significantly significant. The presence of a textile mill built before 1895 is associated with an 11.0% (0.133/1.21) decrease in fertility rates and one built between 1896 and 1900 is associated with 7.5% (0.0912/1.21) lower fertility rates. This specification is the baseline specification for the remainder of the paper, and I will continue to limit the sample to those townships with a town population of less than 2,500.[17]

The results in Column III continue to limit the data to those townships with a town population of less than 2,500 inhabitants, but also condition on a township having a railroad in 1890. As discussed in Section 2, after the arrival of steam power, access to railroad track became a major driver of textile mill location. Comparing two locations with access to a railroad but with different industrialization patterns further clarifies the comparison being made here. In Column III, for those townships where a railroad existed, the presence of a textile mill in 1895 continued to be significantly, negatively associated with fertility.

The results of two validation exercises are located in Table 3. In Column I, to determine the sensitivity of the results to the fertility measure used, I repeat the estimation on $F3_{j,1900}$. There is little change in coefficients as reported in Table 3, Column I. In Column II, I limit the denominator to married females (excluding widowed and divorced females). Again, there is little change in the results. For both columns, the validation is relative to the Baseline specification (Column II, Table 2) which limits the data to those townships with fewer than 2,500 individuals in census-defined towns.

Table 2 results indicate that industrialization and fertility are correlated in the cross-section. But can the impact of industrialization, as proxied by a textile mill, be detected prior to the arrival of the mill itself? If so, that calls into question the randomness of location of these textile mills with respect to local fertility rates. In Table 4, I undertake a falsification test. I estimate the impact of a textile mill built between 1881 and 1900 on the fertility rate of townships *in 1880.* (I must exclude the handful of townships where textile mills existed prior to 1880 from the analysis. There are 7 such townships, 5 of which have a town population of less than 2,500.) Control variables are the 1880 analogues of 1900 variables for Tables 2 and 3. The railroad variable must be excluded as I do not have information on 1880 railroad coverage. (There is very little change in coefficients in the Baseline 1900 specification if I eliminate the railroad variable from X_{jt}.)

[17] Sensitivity tests (not shown) to setting the cutoff at 1,000, 2,000, 3,500 and 5,000 do not show any remarkable difference in conclusions relative to the baseline.

The results of the falsification test in Table 4 show only very weak evidence of differences in fertility *ex ante*. $F5_{1880}$ exhibits weak correlation with the post-1880 industrialization of a township for those townships with a town population of less than 2,500 by 1900. The point estimate, -0.0514, has a p-value of 0.137. While this number is not statistically significant, I validate the OLS results by estimating a difference-in-difference specification in the next section.

3.3 Township-Level Difference-in-Difference Results

In order to account for the possibility that townships that industrialized between 1880 and 1900 and those that did not were different in some way *ex ante*, I incorporate a difference-in-difference estimator for the impact of industrialization on fertility. I define two treatment effects for township j as follows:

$$T_{j,1900} = I_{j,1900} * 1(t = 1900)$$

and

$$T_{j,1895} = I_{j,1895} * 1(t = 1900)$$

where

$$1(t = 1900) \; is \; an \; indicator \; equal \; to \; 1 \; in \; 1900 \; and \; 0 \; in \; 1880$$

and $I_{j,t}$ was defined previously.

The difference-in-difference estimates for the effect of industrialization on fertility are the coefficients $\delta 1_D$ and $\delta 2_D$ in the estimating equation below:

$$F5_{jt} = \mu 1 I_{j,1900} + \mu 2 I_{j,1895} + \delta 1_D T_{j,1900} + \delta 2_D T_{j,1895} + \beta X_{jt} + \theta 1(t = 1900) + \epsilon_{jt} \quad (2)$$

where X_{jt} is a vector of township-level covariates, θ is the 1900-specific year effect, and ϵ_{jt} is a random error term. [18] The estimation is done over t=1880, 1900.

The results from estimating Equation (1) in Table 2 gave a negative coefficient for $\delta 1$ and $\delta 2$. Equation (2) allows us to determine whether this negative relationship was present prior to industrialization. Again,

[18] Town populations and county seat variables are available for this earlier period, but the railroad coverage variable is not. Presence of a railroad has no notable impact on fertility in the 1900 data, and I eliminate it as a covariate in this specification.

the δ coefficients in this specification will represent the impact of a textile mill on 1900 fertility rates. $\delta 2_D$ represents the impact on F5 fertility rates in 1900 resulting from a textile mill built before 1896 and $\delta 1_D$ represents the impact on F5 fertility rates in 1900 resulting from a textile mill built between 1896 and 1900. But now $\mu 1$ represents the impact of a mill built between 1896 and 1900 on F5 fertility rates *in 1880* and $\mu 2$ represents the impact of a mill built between 1880 and 1895 on F5 fertility rates *in 1880*. In other words, $\mu 1$ and $\mu 2$ represent the difference in fertility in (future) mill towns and non-mill towns before the arrival of the mill while $\delta 1_D$ and $\delta 2_D$ represent the additional difference in fertility after arrival.

Table 5 contains the results of the difference-in-difference estimation. Again, I limit the sample to those townships with a town population of less than 2,500 individuals in the census enumeration of 1900.[19] I also add a variable, I_{1880} to control for the handful of townships where a textile mill existed prior to 1880.

Using a first-difference estimator, the μ coefficients are not identified, and the question becomes whether the size of the δ coefficients is maintained. Table 5 indicates that the estimated $\delta 1_D$ is slightly larger than the corresponding OLS estimate in Table 2 while the estimate for $\delta 2_D$ is slightly smaller than the corresponding estimate in Table 2. In addition, the t-statistic for $\delta 2_D$ is slightly smaller than for $\delta 2$ from Table 2. There does appear to have been some tendency for townships industrialized before 1895 to have had lower fertility *ex ante*, resulting in a small bias in the OLS estimation results in Table 2. Still, it is clear from the results in Table 5, Column I, that there remains a negative correlation between industrialization and fertility rates in 1900 after controlling for *ex ante* differences.

The township data presented thusfar documents a negative relationship between mill construction after 1880 and township fertility rates in 1900. Difference-in-difference estimates provide further evidence that industrialization was the first-mover, in turn affecting fertility, rather than vice-versa.

The nature of the township data, however, leaves an unresolved issue. The township-level data does not yet control for migration. If the arrival of a textile mill spurred the reallocation of households to townships such that low-fertility households moved to industrialized townships, then the pattern here could be observed without any change in local household fertility *per se*. I will deal with this issue using a sample of 1900 household-level Census data. Linking these households to their 1880 location generates a measure

[19] The results do not change remarkably if I limit the sample to those with a town population of less than 2,500 in both 1880 and 1900.

of migration as detailed in Section 4.

4 Migration Results

A remaining question is whether the estimated fertility impact of industrialization documented previously is a result of migration. If low-fertility households are moving into textile townships, while local fertility remains unchanged, this implies a different interpretation of the fertility impact. Contemporary sources believed migration to townships containing textile mills was limited. Prior to 1900, local labor markets were such that mill proprietors had no trouble filling their ranks with local workers. Indeed, local recruitment was preferred by mill owners, particularly those without skill requirements, in order to reduce the amount of turnover in the mill. A local observer concluded that, prior to the first decade of the 20th century, "there were practically no other than South Carolinians and their descendants in the cotton mills, and practically all of these came from the [nearby] farms".[20] Still, to the extent that rural households moved between townships in search of mill work, and to the extent that the fertility or of movers differed from that of stayers, the results require additional interpretation.

4.1 Data

In order to evaluate the impact of migration on the township-level results documented previously, I need to document the location of individuals at two points in time: 1900 and some year prior to 1900 (and, preferably, prior to the industrial era). Measuring migration into townships in 1900 is difficult. The 1900 Census contains information on individuals' state of birth, but not county or township. As the vast majority of South Carolina residents in 1900 were born in South Carolina, this variable has limited power to identify migrants. I remedy this problem using U.S. Census data to track individuals from one Census year to another and to use their location in both to infer migration.

I construct a sample of households between the 1880 and 1900 census. I use the 100% sample of the 1880 U.S. Census from the North American Population Project to gather information on 284,412 South Carolina resident males aged 0 to 20 in 1880. Of those, 34,841 are located in the 1900 U.S. Census using the search function of Ancestry.com and the individual's full name and age to make a match. Of those, 14,755

[20] Kohn (1907), p.22

are married with their spouse present in the household and reside in townships with fewer than 2,500 town residents in 1900. This is the subsample on which the analysis in this section is based. The 1900 Census return contains a full list of household members, their name, relationship to the head of household, age, race, marital status, marital duration, birthdate, and township location. Original manuscripts also contain occupation, but this data has not been transcribed in the Ancestry.com data. The location of the male head at two points in time (1880 and 1900) gives me a measure of household migration.

Two caveats are in order, both stemming from the absence of the 1890 Census. First, without the 1890 data, linkages must be made across 20 years instead of ten, and the tendency of individuals to mis-report their name and/or age increases with time. This reduces the matching success rate and makes "successful" matches less accurate. Second, because the objects of interest are young, fertile households in 1900, I can only link the male head as he is the only member of the household who would have been alive and with the same last name in 1880. (Females would have been enumerated under their maiden name in 1880.) That limits the amount of information I have to make a match (relative to matching entire households), again making the linkage less precise. It also presents the possibility that even though the male head did not migrate between 1880 and 1900, his wife did (or vice versa) and I will not capture that variable in the subsequent analysis.

4.2 Results

The fertility measure for the household is the number of children in that household less than age 5, analogous to the F5 fertility rates from Section 3. Table 6 contains the summary of variables. As a consistency check, F5 from Table 1 and the number of children less than 5 from Table 6 are extremely similar (1.19 and 1.16, respectively).

To measure the impact of migration on the results previously reported, I estimate an equation of the following form:

$$F5_{i,j} = \delta 1_{MIG} I_{j,1900} + \delta 2_{MIG} I_{j,1895} + \beta X_i + \theta Y_j + \alpha MOVE_i + \gamma 1 MOVE_i * I_{j,1900} + \gamma 2 MOVE_i * I_{j,1895} + \epsilon_{i,j} \quad (3)$$

X_i and Y_j are defined in Section 4.1. $MOVE_i$ is an indicator for whether household i remained in the same township between 1880 and 1900. The coefficient α measures differential fertility for "movers" (those who do not change townships between 1880 and 1900) in general, $\gamma 1$ represents the difference in fertility for movers to townships where a mill was established between 1896 and 1900, and $\gamma 2$ measures the difference in fertility for movers to townships where a mill existed prior to 1895. For households who move to a new township where $I_{j,1895} = 1$, the total impact of industrialization on fertility is $\delta 2_{MIG} + \alpha + \gamma 2$. For individuals who were in that same township in 1880 as well, the total impact on fertility is just $\delta 2_{MIG}$. For individuals who moved to a non-mill township, the differential is α. The reference group is stayers in non-mill townships.

Table 7, Column I estimates Equation (5) without the "MOVE" indicators. The results show that the household data assembled for this section match the fertility patterns documented in Section 3 for all townships. In particular, $\delta 1_{MIG}$ and $\delta 2_{MIG}$ follow the same patterns as in Table 2. (In Table 2, Column II the reduction in fertility implied by $\delta 2$ is 11%. For Table 7, it is 5%.) Just as with township-level data, the presence of a textile mill built before 1895 has a significant, negative impact on fertility rates in 1900 when estimating Equation (4) without controlling for migration.

Estimating Equation (4) in its entirety, I can determine whether this correlation reflects the impact of $\delta 2_{MIG}$ or $\gamma 1$ and $\gamma 2$. A large coefficient for $\gamma 1$ or $\gamma 2$ would indicate that lower fertility in industrial locations is the result of the in-migration of low fertility households. A large coefficient for $\delta 2_{MIG}$ would indicate native residents exhibited lower fertility as well.

In Column II of Table 7, I estimate Equation (5) in its entirety. $\delta 2_{MIG}$ becomes less signifcant when migration controls are added, while $\gamma 2$ is large and negative. It appears, then, that lower fertility rates observed in townships with a mill built prior to 1895 are driven by the in-migration of low fertility households. Households who stayed in these townships between 1880 and 1900 experienced a very small decrease in fertility equal to $\delta 2_{MIG} = -0.0076$. This represents a reduction in fertility of 0.6%. At the same time, individuals who moved to industrialized townships had reductions in fertility of 11% ($-0.0076 - 0.057 - 0.063 = -0.13$). Both statistics are relative to an individual staying in a non-industrialized township between census years. For individuals who moved to a non-mill township, the reduction in fertility was -0.057, or 4.9%.

Thus it appears that the vast majority of the decrease in fertility observed in industrialized townships is the result of the in-migration of low-fertility households. For original inhabitants of mill townships, fertility rates were stagnant after the arrival of the mill while migrants into mill townships exhibited fertility rates approximately 6% lower than those who migrated to non-mill townships.

5 Discussion

The results presented in this paper support the hypothesis that industrialization was a catalyst for fertility decline in South Carolina between 1880 and 1900. The township-level results in Section 3 indicate that industrialization was associated with lower fertility rates among rural townships with a population of fewer than 2,500. However, controlling for the migration of households into and out of textile townships, it is the in-migration of low fertility households that generates the result. Households who remained in textile townships between 1880 and 1900 have fertility rates not much different from individuals who remained in non-textile townships.

What might explain the differential fertility of township movers? Two competing explanations can be considered: either low-fertility movers to industrial townships reduced their fertility upon arrival in the township or low-fertility movers to industrial townships had below-average fertility prior to their arrival in that township. I will address each possibility in turn.

In the first case, we look for a cause of reduced household fertility in mill townships that would have affected the mover household differentially relative to stayer households. A primary condidate would be a mover household's increased propensity (relative to native citizens) to be mill workers. These households would have felt the first-order effect of industrialization on fertility while township "stayers" who were not employed in the mills would have experienced only a secondary effect. Unfortunately, occupation information for the household sample has not been transcribed by Ancestry.com. But an analysis of the IPUMS 1% sample of the 1900 U.S. Census indicates that mill employees were more likely to be township movers than stayers.[21]

In the second case, we look for a cause of reduced household fertility for those households moving to textile townships prior to the move itself. Two possibilities come to mind. First, perhaps movers are coming from low-fertility locations (urban or otherwise) and bringing this norm along with them. But estimating Equation (4) and controlling for (a) the 1900 fertility rate of the male head's 1880 township location and/or

[21] Author's analysis of the 1900 IPUMS sample. I linked South Carolina mill workers in the fertile age range to their 1880 location using Ancestry.com to generate this result. I found that 79% of textile workers identified in this sample were not located in the same township in 1880. The sample size here is extremely small: 595 household observations, of which 14 contain mill operatives whose location in 1880 could be determined.

(b) the "town" population of the male head's 1880 township location does not change the result. It does not appear that the in-migrants were migrating from townships any different than those they moved to in terms of fertility.[22] Second, it may be the case that movers to township locations were simply idiosyncratically low fertility in their home townships and migrated to the mill townships in order to exploit a comparative advantage in mill work. High-fertility households may have found it more profitable to engage in farming and home production while low-fertility households sorted into mill work, which may have valued the labor of parents over children and have been more demanding of female time.

In any case, the negative correlation between industrialization and fertility in this data remains, and it is useful to think about the potential mechanisms at play. First, the results herein have focused on townships with small urban populations - less than 2,500 individuals in any given town. That suggests large-scale urbanization was not the driver of the fertility decline documented herein.[23] In addition, there is little evidence that textile mills would have increased the return to human capital. These mills relied on low-skilled operatives and there is no obvious impact on the return to education.[24] This seems to eliminate the a human capital explanation.

Further, although the evidence is not as strong on this point, it seems unlikely that decreases in the labor opportunities of children are driving the result. Available sources indicate that children represented a large proportion of workers in Southern mills, even when mills self-reported their employment numbers. Statistics provided by the mills themselves indicate that up to 25% of their operatives were under the age of sixteen in the earliest years of the 20th century.[25] Child labor legislation was not passed in South Carolina until 1903, well after the period examined in this paper. If changes in the labor opportunities of children drove the industrialization results, it must be that their mill employment, extensive as it was, was less well renumerated than their previous employment, generally as farm laborers. This seems highly unlikely. Presumably, households would have chosen mill employment over farm employment if their family income

[22]Importantly, however, limitations of the data imply that I can only control for the location of the male head in 1880, not the female. Thus, it remains possible that females came from lower fertility areas of the state and brought these low-fertility norms along with them.

[23]It is worth noting, however, that adding a measure of population density to the baseline regression in Table 2, Column II, reduces the significance of the $\delta 2$ variable somewhat and that the coefficient on the density variable itself is negative and significant. (I use the "town" population as a percentage of total township population as a measure of population density.) This seems to indicate that even the small amount of "urbanization" accompanying rural textile mill locations may have been responsible for some of the reduction in fertility that resulted.

[24]See Becker *et al* (2009) for evidence that the textile industry in Prussia exhibited low returns to education relative to other industries.

[25]Thompson (1906), p.223.

was expected to be higher in the mills than on the farm. The hypothesis that children would have earned less in the mill than on the farm seems incongruent with this assumption.[26] If reductions in the labor opportunities of children contributed to the fertility decline in South Carolina, it is likely to be after 1900.

A remaining possibility is infant mortality. Haines (1985) calculates an index of infant mortality among different occupational classes in the 1900 U.S. Census and gives evidence that infant mortality rates among textile workers were 1.23 times the national average.[27] Haines' calculation does not include considerations for region or urbanization, but if this result holds for rural South Carolina mills as well, then the fertility impact of industrialization documented previously may represent reductions in net fertility resulting from increases in infant mortality rates rather than decreases in gross fertility itself.

5.1 Evaluating Infant and Child Mortality as a Potential Cause of Low Mill Township Fertility

To address this concern, I examine the relationship between textile mill location and infant mortality in 1900 using the same household dataset presented in Section 4.1 to address household migration. The 1900 Census asked married women how many children they had borne and how many were surviving.[28] Taking the sample of married females from the sample of the 1900 Census described in Section 4.1, it is straightforward to calculate a child survival rate as the ratio of the number of children surviving to the number ever born, and then to examine the relationship between that number and textile mill location. A caveat is in order: this statistic will reflect the cumulative number of deaths of the household's children (in infancy or otherwise) over the entire span of the female's childbearing. It is impossible to determine from this data whether these deaths occurred in years before or after the introduction of a township's textile mills.

I estimate the relationship between a married female's reported child survival rate and the presence of a textile mill in the household's 1900 township location, conditional on other characteristics of the household. The estimating equation is:

[26] Only if the increased renumeration to parents was to be high enough to cover this loss on child renumeration would this assumption hold.

[27] Poorly-ventilated working conditions, cramped quarters in the mill and in mill housing, and prolonged exposure to cotton dust would have all contributed to lower health outcomes for mill operatives relative to their farming peers and, perhaps, for their chidlren. Higher incomes for mill workers, however, may have offset this to some degree.

[28] Unfortunately, standardized infant and child mortality statistics for South Carolina townships do not exist for this time period.

$$S_{i,j} = \tau_{CM} D_{j,1900} + \beta X_i + \theta Y_j + \epsilon_{i,j} \quad (4)$$

where $S_{i,j}$ is the observed child survival rate for household i in township j in 1900. In contrast to the fertility results in Section 3, the survival measure is not limited to the five years prior to the 1900 Census enumeration. Instead, the measure will reflect cumulative infant and child mortality over the entirety of a female's childbearing years. The I_{1895} and I_{1900} variables are no longer appropriate, and instead I construct a variable, D_{ij}, that represents the proportion of household i's marital duration for which township j housed a textile mill.[29]

X_i contains information on the ages of the male and female head of household, their ages squared, and race. Y_j is a vector of township-level attributes (as in Table 2) including an indicator for whether the township contains a county seat, an indicator for whether a railroad exists in the township, and an indicator for whether the county is a coastal county. $\epsilon_{i,j}$ is a random error term. τ_{CM} represents the impact of exposure to textile mills on child survival rates. The same town population restrictions apply as in the baseline township-level results (i.e., $\prec 2,500$).

Table 6 gives the summary of variables used in this analysis. Results, located in Table 8, indicate no discernible difference in infant and child mortality rates between mill towns and non-mill towns. The universe of households included in this regression are all South Carolina resident, married households with ≥ 1 child in which the wife is greater than 15 and less than 50. Restrictin ghte sample to younger women (Column II restricts to wife age less than 30) or newly married (Column III limits the sample to marital durations of less than 4 years) does not change the result.[30] These are exteremly small numbers, and the τ_{CM} coefficients represent reductions in survival rates of xx%, xx%, and xx% for Columns I-III, repectively. On average, if a household moves from not being exposed to a textile mill ($D_{ij} = 0$) to being exposed to a textile mill for the entirety of its marital duration ($D_{ij} = 1$), the survival rate falls by xx%.

This result leaves changes in the opportunity cost of female time and other costs of raising children as the most likely explanation for the results observed in this paper. Industrialization in South Carolina would have had both a direct and an indirect effect on the cost of female time. First, women were employed by the mill

[29] To the extent that households moved between the date of marriage and 1900, this exposure measure will be mis-measured. For example, if township j received a textile mill in 1896 and household i was married in 1894, this number is 0.67, etc.

[30] Replacing D_{ij} with $I_{j,1900}$ in this specification generates the same result.

directly, and their mill employment would have been incompatible with child-bearing. Unlike the farm where pregnant and nursing mothers could integrate childbearing and rearing, the mill setting would have prevented such an integration. Second, the arrival of a textile mill increased demand for female-provided services such as cooking, laundering, growing small amounts of crop and livestock, and boarding. Data on the employment of married females in the textile mills from the 1% IPUMS sample of the 1900 Census indicates that, of self-described cotton mill operatives, 43% were female and, of that number, 18% were married females.[31] A relatively high rate of employment in the mills themselves, coupled with higher wages in the services and agricultural goods sectors, may have been enough to generate reductions in fertility highlighted previously.

6 Conclusion

The evidence presented in this paper gives support to the hypothesis that industrialization preceded declines in marital fertility in the United States. I exploit the fact that South Carolina's industrial experience in general can be proxied by the textile industry in particular and that the location of textile mills is independent of local fertility behavior. I evaluate the impact of the arrival of a textile mill on rural, marital fertility rates in South Carolina and document a strong, negative relationship. The estimated impact is reduced somewhat using a difference-in-difference estimator to account for differences in marital fertility rates prior to the arrival of mills. I show that while the estimates are not likely to be biased by differences in infant and child mortality, migration has an important impact on the results. The in-migration of low-fertility households to industrial townships is a large driver of the observed differences in marital fertility. Households who remained in textile mill locations before and after the arrival of the mill experienced no reduction in household fertility.

Combining data on infant mortality in these same locations with evidence from the historical record, it seems unlikely that infant mortality, increases in the returns to human capital, urbanization, or decreases in the labor opportunities of children were important drivers of reduced fertility. Instead, an increased opportunity cost of female time seems the most likely explanation.

7 Tables

[31] United States Bureau of Labor: Report on Condition of Woman and Child Wage-Earners in the United States, 1910

	Sample Mean	Standard Deviation
$F5_{1900}$	1.19	0.20
$F3_{1900}$	0.42	0.15
I_{1900}	0.052	0.22
I_{1895}	0.095	0.29
Town population in 1900	637.76	3211.91
1(County seat in 1900)	0.098	0.30
1(Coastal county)	0.093	0.29
1(Railroad in 1890)	0.61	0.49

TABLE 1: 1900 Township Data Variable Summary - All Townships
For Section 3 and Tables 2-5

	I (All Townships)	BASELINE II (Town population <2500)	III (Railroad townships only)
$\delta 1$, the coefficient on I_{1900}	-0.0691	-0.0912*	-0.0837
	(0.0412)	(0.0445)	(0.0541)
$\delta 2$, the coefficient on I_{1895}	-0.0805**	-0.133***	-0.129***
	(0.0355)	(0.0376)	(0.0483)
Town population 1900 (000s)	-0.0513***		
	(0.0100)		
Town population 1900 squared (000,000s)	-0.000782***		
	(0.000185)		
1(County Seat in 1900)	-0.00525	-0.0355	0.0370
	(-0.0401)	(0.0416)	(0.0491)
1(Railroad in 1890)	-0.0316	-0.0383*	
	(0.0190)	(0.0194)	
1(Coastal County)	-0.156***	-0.153***	-0.145***
	(0.0311)	(0.0327)	(0.0510)
N	398	380	225
R-squared	0.27	0.11	0.07

TABLE 2: Estimation Results, Equation 1
Point estimates of coefficients. Standard errors in parentheses.
***=Significant at 1% level; **=Significant at 2.5% level; *=Significant at 5% level

	Sensitivity I $F3_{1900}$ as dependent variable	Sensitivity II Denominator = married females
$\delta 1$, the coefficient on I_{1900}	-0.0599	-0.104
	(0.0406)	(0.0462)
$\delta 2$, the coefficient on I_{1895}	-0.0938***	-0.151***
	(0.0264)	(0.0390)
1(County Seat in 1900)	-0.0301	-0.0187
	(0.0318)	(0.0432)
1(Railroad in 1890)	-0.0231	-0.0268
	(0.0147)	(0.0201)
1(Coastal County)	-0.0921***	-0.154***
	(0.0248)	(0.0339)
N	380	380
R-Squared	0.08	0.10

TABLE 3: Validation Results, Equation 1
See Notes to Table 2.
Note: In Sensitivity I, I_{1895} becomes I_{1897} and I_{1900} represents only those mills built between 1898 and 1900.

	Falsification I
$\delta 1$, the coefficient on I_{1900}	-0.0131
	(0.0366)
$\delta 2$, the coefficient on I_{1895}	-0.0403
	(0.0341)
1(Railroad in 1890)	-0.0592***
	(0.0159)
1(County Seat in 1880)	-0.0153
	(0.0377)
1(Coastal County)	-0.230***
	(0.0268)
N	375
R-squared	0.23

Table 4: Equation 1, Falsification Test
See Notes to Table 2.

	BASELINE I	II
	(Town population <2500)	(Railroad townships only)
$\delta 1_D$, Diff-in-Diff estimator of the effect of T_{1900}	-0.0815	-0.0793
	(0.0447)	(0.0535)
$\delta 2_D$, Diff-in-Diff estimator of the effect of T_{1895}	-0.0926**	-0.0854
	(0.0408)	(0.0508)
I_{1880}	-0.0982	-0.105
	(0.0832)	(0.104)
1(County Seat in 1900)	-0.0190	-0.0284
	(0.0932)	(0.104)
N	380	225
R-Squared	0.02	0.03

Table 5: Estimation Results, Equation 2
See Notes to Table 2.

	Mean	Standard Deviation
F_{ij} = Number of children less than 5	1.21	0.99
I_{1895}	0.12	0.33
I_{1900}	0.062	0.24
1(Coastal County)	0.093	0.29
1(County seat in 1900)	0.09	0.29
1(Railroads in 1890)	0.639	0.24
Race (1=black)	0.496	0.50
Male age	30.48	5.70
Female age	26.9	6.06
MOVE = 1(Household changes townships 1880 to 1900)	0.574	0.49
S_{ij} = Survival Rate of children ever born	0.83	0.26
D_{ij} = % of marriage duration for which textile mill is present	0.23	0.40

TABLE 6: 1900 Variable Summary for Migration Estimates
Section 6.2 and Table 9

	I	II
$\delta1_{MIG}$ - coefficient on I_{1900}	-0.009	0.0213
	(0.0337)	(0.0553)
$\delta2_{MIG}$ - coefficient on I_{1895}	-0.0552***	-0.00759
	(0.0257)	(0.0418)
α - coefficient on MOVER (=1 if township changes 1880 to 1900)		-0.0571***
		(0.0177)
$\gamma1$ - coefficient on MOVER * I_{1900}		0.0232
		(0.0816)
$\gamma2$ - coefficient on MOVER * I_{1895}		-0.0633
		0.0506
1(County Seat in 1900)	-0.104***	-0.105***
	(0.0287)	(0.0286)
1(Coastal County)	-0.153***	-0.155***
	(0.0276)	(0.0276)
1(Railroads in 1890)	-0.0659***	-0.0628***
	(0.0172)	(0.0173)
Race (1=black)	0.0273	0.0324***
	(0.0161)	(0.0161)
Male age	0.186***	0.187***
	(0.0169)	(0.0169)
Male age squared (000s)	-0.00282***	-0.00283***
	(0.000273)	(0.000272)
Female age	0.0234***	0.235***
	(0.0114)	(0.0114)
Female age squared (000s)	-0.00405***	-0.00405***
	0.000192	0.000192
N	14,755	14,755
R-squared	0.07	0.07

TABLE 7: Estimation Results, Equation 3
See Notes to Table 2.

	I	II	III
τ_{ij} - coefficient on D_{ij}	-0.0079	-0.0056	-0.00049
	(0.0079)	(0.0094)	(0.015)
1(County Seat in 1900)	-0.0062	-0.0058	-0.030
	(0.0082)	(0.010)	(0.018)
1(Coastal County)	-0.045***	-0.051***	-0.071***
	(0.0080)	(0.010)	(0.017)
1(Railroads in 1890)	-0.010***	-0.012	0.011
	(0.0049)	(0.0062)	(0.010)
Race (1=black)	-0.062***	-0.058***	-0.030***
	0.0049	0.0062	0.010
Male age	-0.014***	-0.0038	0.013
	(0.0051)	(0.0067)	(0.011)
Male age squared (000s)	0.00020***	0.000034	-0.00027
	(0.000082)	(0.00011)	(0.00019)
Female age	-0.030***	-0.036***	-0.0036
	(0.013)	(0.021)	(0.0035)
Female age squared (000s)	0.00053	0.00073	0.000076
	(0.00028)	(0.00047)	(0.000058)
N	12,282	7,963	3,200
R-squared	0.02	0.02	0.01

TABLE 8: Estimation Results, Equation 4
See Notes to Table 2.

8 Figures

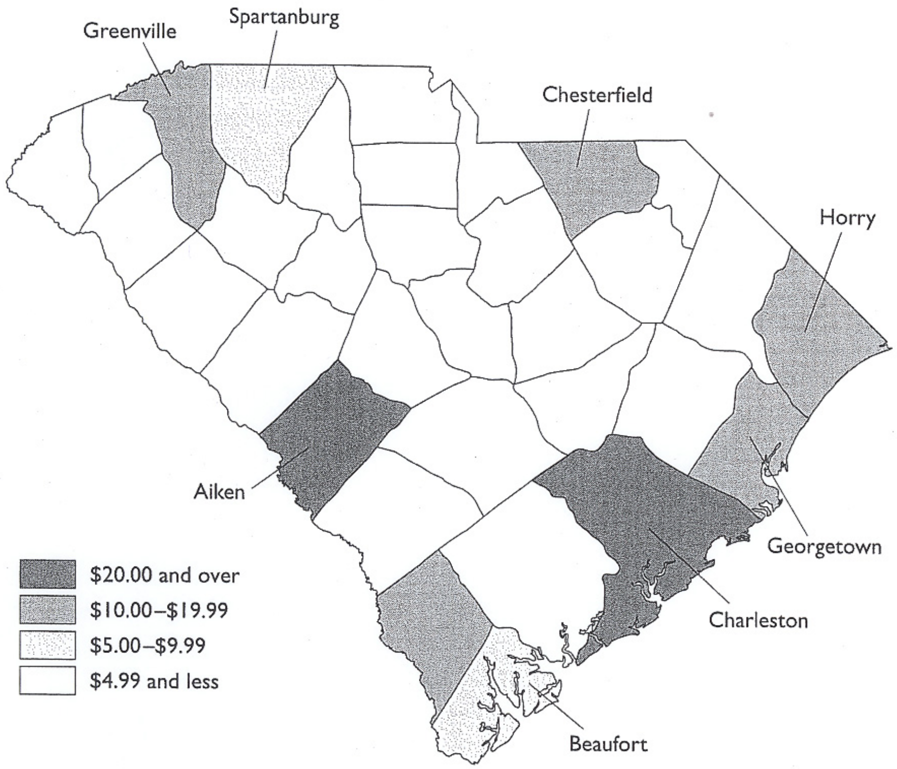

Figure 9.1: Value Added by Manufacturing Per Capita, 1880 (South Carolina, by county). Source: see note 7.

FIGURE 1: From Carlton and Coclanis (2003), p.137

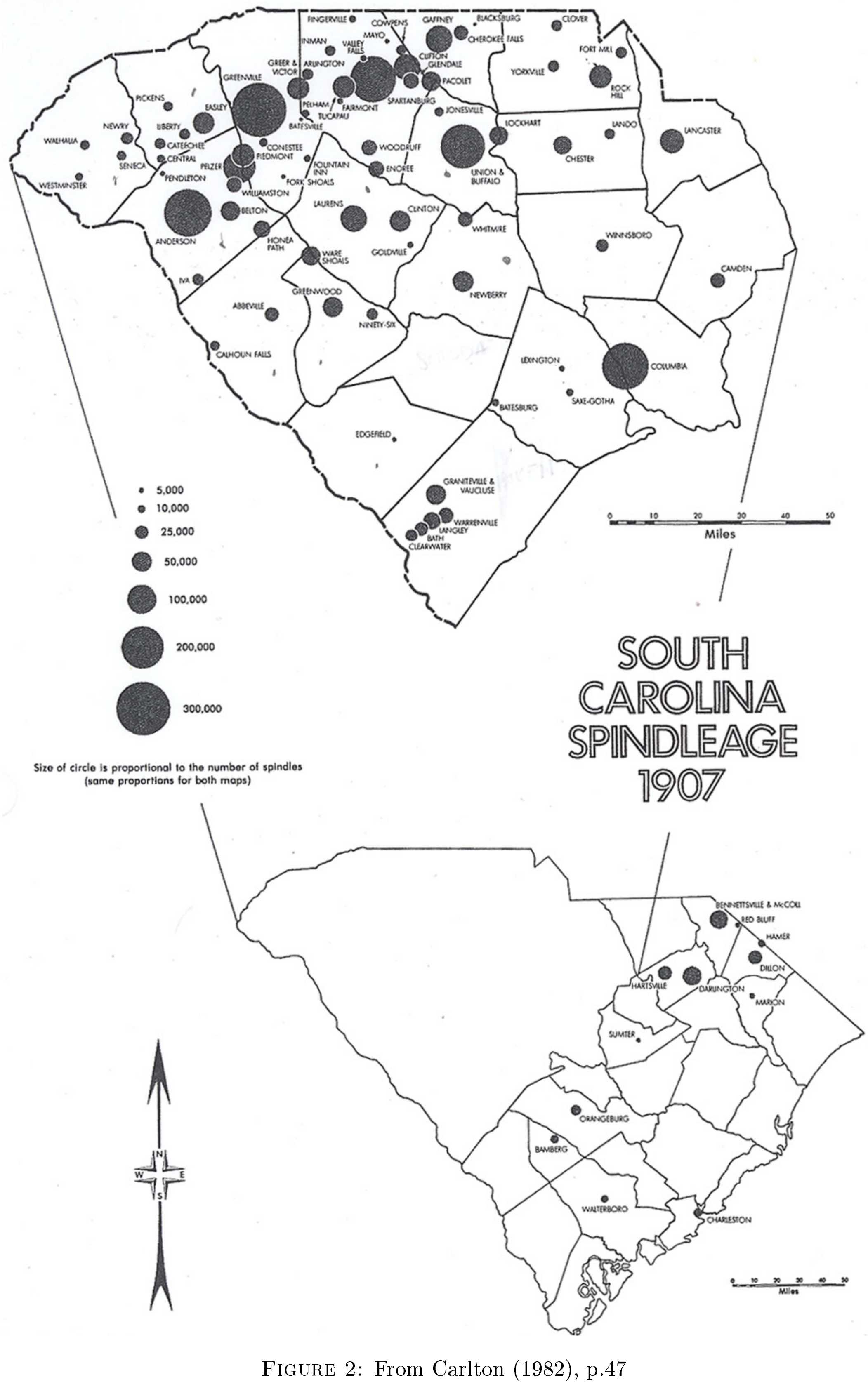

FIGURE 2: From Carlton (1982), p.47

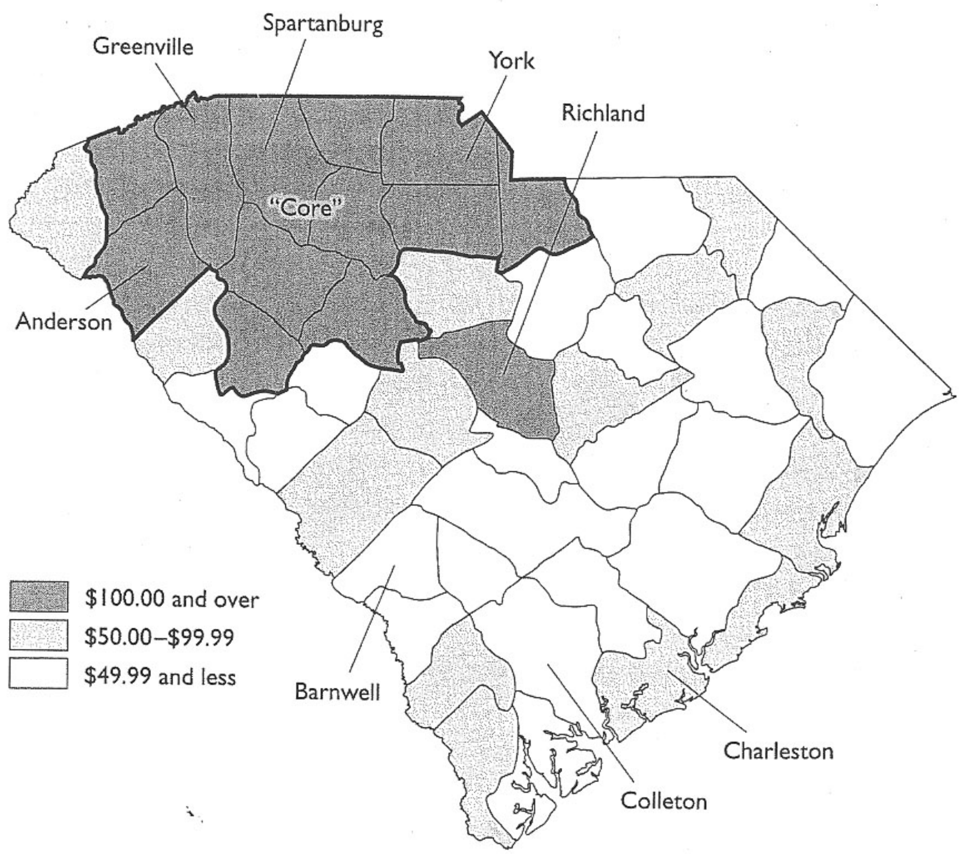

Figure 9.2: Value Added by Manufacturing Per Capita, 1930 (South Carolina, by county).
Source: See notes 7 and 8.

FIGURE 3: From Carlton and Coclanis (2003), p.138

References

Aldrich, M. (1982): "Determinants of Mortality Among New England Cotton Mill Workers During the Progressive Era," *The Journal of Economic History*, 42(3), 847–863.

Becker, G. (1960): "An Economic Analysis of Fertility," in *Demographic and Economic Change in Developed Countries*, ed. by Universities-National Bureau Committee for Economic Research, pp. 209–231, Princeton, NJ. Princeton University Press.

Becker, S., E. Hornung, and L. Woessmann (2009): "Catch Me If You Can: Education and Catch-up in the Industrial Revolution," *Working Paper*.

Carlson, L. (1981): "Labor Supply, the Acquisition of Skills, and the Location of Southern Textile Mills, 1880-1900," *Journal of Economic History*, 41(1), 65–71.

Carlton, D. (1982): *Mill and Town in South Carolina: 1880-1920*. Louisiana State University Press, Baton Rouge.

Carlton, D., and P. Coclanis (2003): *The South The Nation and the World; Perspectives on Southern Economic Development*. University of Virginia Press, Charlottesville.

David, P., and W. Sundstrom (1988): "Old-age Security Motives, Labor Markets and Farm Family Fertility in Antebellum America," *Explorations in Economic History*, 25(2), 164–97.

Davison Publishing Company (multiple years): *Davison's Textile Blue Book*Ridgewood, N.J.

Doepke, M. (2004): "Accounting for Fertility Decline During the Transition to Growth," *Journal of Economic Growth*, 9, 347–383.

——— (2005): "Child Mortality and Fertility Decline: Does the Barro-Becker Model Fit the Facts?," *Journal of Population Economics*, 18(2), 337–366.

Forster, C., G. Tucker, and H. Bridge (1972): *Economic Opportunity and White American Fertility Ratios, 1800-1860*. Yale University Press, New Haven.

Galor, O., and D. Weil (2000): "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond," *American Economic Review*, 90(4), 806–828.

Haines, M. (1978): "Fertility Decline in Industrial America: An Analysis of the Pennsylvania Anthracite Region, 1850-1900, Using 'Own Children' Methods," *Population Studies*, 32(2), 327–354.

Haines, M. (1985): "Inequality and Childhood Mortality: A Comparison of England and Wales, 1911, and the United States, 1900," *The Journal of Economic History*, 45(4), 885–912.

Hall, J., J. Leloudis, R. Korstad, M. Murphy, L. Jones, and C. Daly (1987): *Like a Family: The Making of a Southern Cotton Mill World*. University of North Carolina Press, Chapel Hill.

Kalelmi-Ozcan, S. (2003): "A Stochastic Model of Mortality, Fertility, and Human Capital Investment," *Journal of Development Economics*, 70(1), 103–18.

Kohn, A. (1907): *The Cotton Mills of South Carolina*. South Carolina Department of Agriculture, Columbia.

McHugh, C. (1988): *Mill Family: The Labor System in the Southern Cotton Textile Industry, 1880-1915*. Oxford University Press, New York.

Mitchell, B. (1921): *The Rise of Cotton Mills in the South*. Johns Hopkins Press, Baltimore.

Mitchell, B., and G. Mitchell (1930): *The Industrial Revolution in the South*. Johns Hopkins Press, Baltimore.

North Atlantic Population Project and Minnesota Population Center (2008): *NAPP: Complete Count Microdata. NAPP Version 2.0 [computer files]*. Minnesota Population Center [distributor], Minneapolis, MN.

Oates, M. (1975): *The Role of the Cotton Textile Industry in the Economic Development of the American Southeast: 1900-1940*. Arno Press, New York.

Phillips, W. (1985): "Southern Textile Mill Villages on the Eve of World War II: The Courtenay Mill of South Carolina," *Journal of Economic History*, 45(2), 269–275.

Ruggles, S., M. Sobek, T. Alexander, C. Fitch, R. Goeken, P. Hall, M. King, and C. Ronnander (2008): *Integrated Public Use Microdata Series: Version 4.0 (Machine-Readable Database).* Minnesota Population Center, Minneapolis, MN.

Sah, R. (1991): "The Effects of Child Mortality Changes on Fertility Choice and Parental Welfare," *Journal of Political Economy*, 99(3), 582–606.

Saxonhouse, G. (2006): "Hachiro Fukuhara: The Scholar-Statesman and Industrial Spy?," University of Michigan Working Paper.

Schultz, T. (1985): "Changing World Prices, Women's Wages, and the Fertility Transition: Sweden, 1860-1910," *Journal of Political Economy*, 93, 1126–49.

Stover, J. (1955): *The Railroads of the South, 1865-1900.* North Carolina University Press, Chapel Hill.

Tang, A. (1958): *Economic Development in the Southern Piedmont, 1860-1950: Its Impact on Agriculture.* University of North Carolina Press, Chapel Hill, NC.

Terrill, T., E. Ewing, and P. White (1976): "Eager Hands: Labor for Southern Textiles, 1850-1860," *The Journal of Economic History*, 36(1), 84–99.

Thompson, H. (1906): *From the Cotton Field to the Cotton Mill: A Study of the Industrial Transition in North Carolina.* The MacMillan Company, New York.

United States Bureau of Labor (1910): *Report on Condition of Woman and Child Wage-Earners in the United States.* Government Printing Office, Washington, D.C.

United States Commissioner of Labor (1892): *Cost of Production: The Textiles and Glass.* Government Printing Office, Washington.

United States of America, Bureau of the Census (1880): *Tenth Census of the United States, 1880.* Washington, DC.

——— (1900): *Twelfth Census of the United States, 1900.* Washington, DC.

Wright, G. (1979): "Cheap Labor and Southern Textiles before 1880," *The Journal of Economic History*, 39(3), 655–680.

——— (1986): *Old South, New South: Revolutions in the Southern Economy Since the Civil War*. Basic Books, New York.

Young, J., and M. Young (1963): *Textile Leaders of the South*. R.L. Bryan Company, Columbia, SC.