Industrialization and Fertility in the 19th Century: Evidence from South Carolina

Economists have frequently hypothesized that industrialization contributed to the United States' 19th century fertility decline. I exploit the circumstances surrounding industrialization in South Carolina between 1881 and 1900 to show that the establishment of textile mills coincided with a 6-10 percent reduction in fertility. Migrating households are responsible for most of the observed decline. Higher rates of textile employment and child mortality for migrants can explain part of the result, and I conjecture that an increase in child-raising costs induced by the separation of migrant households from their extended families may explain the remaining gap in migrant-native fertility.

By the dawn of the 20th century, fertility rates in the United States had undergone a century of steady decline. In 1800, white American females could expect to bear 7.0 children on average; by 1900, this number was 3.6.[1] The factors behind the 19th century decline have been the subject of a lengthy literature highlighting the importance of intergenerational bequests, the economic value of children, and the cultural context for American family formation.

Yasukichi Yasuba initiated the literature on the importance of land availability to the bequest process, noting that those locations with lower land prices experienced higher fertility rates and vice versa.[2] William Sundstrom and Paul David and Susan B. Carter, Roger L. Ransom and Richard Sutch present alternatives to the land availability hypothesis for explaining the 19th century decline emphasizing the

[1] Total fertility rate for American females as reported by Haines "White Population".

[2] The work of Richard Easterlin and his students on the targeted bequest hypothesis is another step in this direction. See Yasuba, *Birth Rates*; Easterlin, "Does Human" and "Factors"; and Schapiro, "Land Availability".

role of economic modernization.[3] The empirical evidence seems to indicate a role for bequest and land availability explanations of fertility decline early in the 19th century while economic modernization variables (levels of industrialization, urbanization, child labor laws, average wages, literacy rates and education levels) hold better explanatory power for the postbellum era.[4] But despite these conclusions, the impact of these economic modernization correlates on fertility rates has yet to be measured in anything more than a cross-section, observational framework.

This paper is motivated by the concern that previous estimates of the relationship between industrialization and fertility were measured with simultaneity bias. An empirical observation that industrialization and fertility are negatively correlated is not informative about causation. Falling fertility may have spurred industrialization rather than vice versa, or external factors may have contributed to both simultaneously.

There are a number of mechanisms by which industrialization may have altered a household's fertility outcome. First, several models of economic growth and fertility decline highlight the role of human capital in increasing the incentives of households to invest in child quality over quantity, thereby reducing the number of children born.[5] Second, industrialization may have induced a rise in the implicit costs of raising children. In particular, industries with high rates of female employment increased the

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[3] David and Sundstrom, "Old-age Security Motives"; Carter, Ransom and Sutch, "Family Matters". In addition, see Haines, "Economic History", pp.212-13, for a discussion of the cultural concerns.

[4] See Steckel, "Fertility Transition"; Guest, "Social Structure"; David and Sundstrom, "Old-age Security"; Vinovskis, "Socioeconomic Determinants"; and Wahl, "Trading Quantity". These studies employ cross-sectional variation in state-level labor force composition, manufacturing wages, average farm values, literacy rates, school attendance, child employment, sex ratios, presence of financial intermediaries, and/or land availability to explain fertility rates and reach their respective conclusions.

[5] See Galor and Weil, "Population"; Kögel and Prskawetz, "Agricultural Productivity"; and Tamura "Human Capital".

opportunity cost of female time. Under the assumption that the child production process is female time-intensive, this would have reduced the incentive to bear children.[6] Third, 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 parental demand and fertility rates.[7] Fourth, industrialization was associated with increased urbanization and the crowding that occurred may have increased the explicit costs of raising children through higher housing and food costs without an associated increase in the benefit.[8] Finally, the developing economy in the United States witnessed decreases in child mortality rates, especially after 1880.[9]

I exploit the circumstances surrounding industrialization in South Carolina between 1880 and 1900 to identify a plausibly exogenous change in the level of industrialization. I argue that the emerging geography of South Carolina's textile industry was driven by water power concerns and was unlikely to

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[6] See Lagerlöf ,"Gender Equality"; Galor and Weil ,"Gender Gap". Schultz, "Changing World Prices"; Brown and Guinnane, "Fertility Transition"; and Crafts, "Duration", document a negative correlation between female labor force opportunities and fertility rates in Sweden, Bavaria and England/Wales, respectively.

[7] Doepke, "Accounting for Fertility Decline", argues that child labor regulation is a critical component in explaining fertility declines during periods of economic growth. This view is shared by Hazan and Berdugo, "Child Labor". Moehling, "State Child Labor Laws", on the other hand, argues that in the United States, child labor legislation was enacted only after industry's resistance had waned and thus had very little impact on actual child employment.

[8] It is an empirical regularity that urban fertility rates were lower than rural ones as early as the 19th century. See Vinovskis, "Socio-Economic Determinants" for the empirical results and Guinnane, "Historical Fertility Transition" for a more detailed discussion.

[9] See Haines, "White Population". In the short-run, industrialization brought increased population density and hazardous work conditions that may have contributed to higher child mortality rates. But in the long-run, rising incomes outweighed this effect by providing families the means for better nutrition and sanitation. The expected correlation between child mortality and fertility is ambiguous. See Doepke, "Child Mortality" for a negative correlate and Sah "Effects" and Kalemli-Ozcan, "Stochastic Model" for a positive one.

have been correlated with fertility *ex ante*. Using a sample of rural townships in South Carolina, including locations that did and did not establish textile mills over this period, I estimate a reduction in fertility of between 6 and 10 percent following textile mill establishment.

These data indicate that an increase in urbanization and the costs of raising children, including a rising opportunity cost of female time, can explain part of the observed reduction in fertility in South Carolina industrial locations. At the same time, I find no support for mechanisms relying on human capital considerations and increases in the adult/child wage differential. Differential infant mortality among industrial workers may also have been a factor in fertility reduction.

EMPIRICAL STRATEGY

This paper measures the impact of industrialization on fertility rates using data from rural areas of South Carolina between 1880 and 1900. In 1880, South Carolina was home to 14 textile mills and 84,424 spindles. By 1900, the state housed 93 mills and 1,693,649 spindles, an increase of almost 2000 percent.[10]

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 provided the overwhelming majority of industrial employment in the state. In 1900, 30 percent of males and 57 percent of females employed in manufacturing were textile workers. No other industry came close to matching the textile share of employment, and the vast majority of the runners-up involved manufacturing in a decentralized setting.[11] As a result, South Carolina industrialization in general can be proxied by the textile industry in particular.

Second, the historical record indicates that the Piedmont region where textile manufacturing

[10] Carlton, *Mill and Town*, p.40.

[11] For example, carpentry at 7.5% of male manufacturing employment; dressmaking and seamstresses at 32.3% of female manufacturing employment. Author's analysis of IPUMS 1900 1% sample.

focused after 1880 was homogenous in terms of its economic activity, socio-economic characteristics, and climate prior to industrialization.[12] Further, the particular locations of textile mills in rural areas were primarily determined by concerns about water power rather than demographic characteristics of the local population and, in particular, their fertility. 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 as cotton and tobacco prices plummeted in the 1890s. Mill owners could have chosen virtually any rural location and they would have found a local labor force eager to become mill workers. The uniformity of the Piedmont area gave mill proprietors the opportunity to select locations based on other criteria.

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.

The first steam-powered mill was built in South Carolina in 1881 and, after 1890, steam power began to dominate as a power source. “Cotton mills among the cotton fields” became possible, and mill proprietors were freed somewhat from their reliance on fast-flowing water. At first, steam and water were used in combination to power textile mills, but by the second half of the 1890s, most mills ran on steam alone.[13] Proximity to water was still desirable for waste removal and natural humidity.[14]

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[12] Tang, *Economic Development*, p.64.

[13] United States Commissioner of Labor, *Seventh Annual Report*.

[14] Steam power also required massive amounts of coal input, and coal was an expensive commodity to transport. Proximity to railroad lines likely replaced water flow as the primary driver of mill location by the late 1890's. If railroad location was, in turn, dependent on some aspect of local population also correlated with fertility, this is cause for concern. In unpublished OLS

After 1900, the pre-1900 drivers of location decisions were waning. Labor market considerations were becoming more important as South Carolina mills began producing a higher quality cloth that required skilled labor, and electric power was freeing firms from prior geographic constraints.[15] As a result, 1900 was chosen as the endpoint for this analysis.

Even given the site selection process described above, it is likely that townships with a water supply suitable for water-powered manufacturing were different from other locations *ex ante*.[16] As a result, I use a difference-in-difference estimator to account for any pre-existing differences in fertility in estimating the impact of mill establishment on fertility. Using this methodology, the estimated impact of industrialization on fertility is 6 to 10 percent.

In order to determine the importance of migration in this result, I incorporate household-level data and conclude that declining fertility can be entirely attributed to migrating households. Given this result, I evaluate the potential mechanisms at play and find that higher rates of textile employment and child mortality characterized the migrant experience. In addition, I hypothesize that the loss of an extended family raised the implicit costs of child-rearing for these households. I further argue that alternative explanations for the observed relationship between industrialization and fertility are not supported for this particular historical episode.

TOWNSHIP DATA

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,

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analysis, I explicitly control for the presence of a railroad and find no significant effect on fertility and no change in the estimated impact of industrialization on fertility. I have railroad data for 1890 only, and so do not include this variable in the reported difference-in-difference results for 1880 to 1900.

[15] The first electrically-powered mill, Orr Mills, was built in Anderson, South Carolina in 1899.

[16] See Bleakley and Lin, “Portage”, for potential differences in portage locations.

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.[17] I focus on marital fertility rates as almost all fertility occurred within marriage and declines in marital fertility, rather than declines in marriage rates, contributed most to the U.S. decline in this period.[18] In each year (t=1880, 1900), I calculate F5 fertility rates:

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

The F5 fertility rate calculated in this manner will be sensitive to child mortality, a topic I address later in the paper.[19] I also perform sensitivity analysis in the next section using F3 fertility rates and eliminating widowed and divorced women from the denominator. A comparison of F5 fertility rates for the townships included in the main results of this paper, all of South Carolina, all of the South, and the United States appears in Figure 3. Figure 3 also shows a comparison of F5 fertility rates for industrial and non-industrial townships in South Carolina in both 1880 and 1900.

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

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[17] There are 484 South Carolina townships in 1900 and 461 in 1880. In order to perform difference-in-difference analysis. 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 judgment calls. I also must consolidate some townships, and the final number for estimation is 391.

[18] Sanderson, "Quantitative aspects".

[19] There is nothing special about the 5 year cut-off here, and a sensitivity test using F3 generates similar results. Using longer fertility windows increases the probability that fertility measures will be biased by migration or mortality. Preston *et al,* "African-American Marriage", document a tendency of African American women to legitimate out-of-wedlock births by claiming a marital status of married, widowed, or divorced when the female was actually single. This should serve to make my estimate more accurate as it ensures that even out-of-wedlock fertility is appropriately captured.

a timeline of mill establishment in South Carolina prior to 1900.[20] Davison's gives an establishment date for each indexed mill, and Figure 1 shows a map of South Carolina with markers for textile mills that were established between 1880 and 1900. From this data, I generate two industrialization indicators: I_{1895}= 1 if a mill was established in township j by 1895 and I_{1900} = 1 if a mill was established by 1900 (but not by 1895). The F5 fertility measure described above, when measured in 1900, incorporates all fertility over a 5 year window from 1896 to 1900. Given this time frame, it is important to separately identify townships with mills established prior to the beginning of the fertility measure (I_{1895}) whose fertility response may conceivably be fully captured by the F5 measure and those townships with mills established within the 1896-1900 window (I_{1900}) and whose fertility response may not be fully accounted for using F5. I_{1895} includes townships exposed to industrialization for the entirety of the F5 window while I_{1900} includes townships with only partial exposure to a textile mill during that window.

I incorporate into the analysis several additional explanatory variables: a binary variable for whether the township was a county seat in year j ($CTYSEAT_j$), a proxy for urbanization ($TOWNPOPPCT_j$) measuring the inhabitants of a census-defined town divided by all township inhabitants, the non-white population percentage ($PCTNONWHITE_j$), the male to female sex ratio for individuals aged 18 to 42 ($MALETOFEM_j$), and the marriage rate among females aged 18 to 42 ($PCTFEMMARR_j$).

DIFFERENCE-IN-DIFFERENCE RESULTS

Table 1 summarizes these variables for both 1880 and 1900 for the sample townships, tabulated by the period in which the first mill was established. By 1900 the average fertility rate in industrialized townships was well below the sample average, and a simple OLS estimate of the effect of industrialization (measured by I_{1895} and I_{1900}) on $F5_{1900}$ is negative and significant (not shown). But, as

[20] Davison Publishing Company, *Davison's Textile Blue Book.*

is evident from Table 1, townships that industrialized between 1881 and 1900 also had somewhat lower fertility rates *ex ante*, as measured by FS_{1880}. While a "falsification test" which repeats the OLS exercise for FS_{1880} identifies no significant impact on *ex ante* fertility, the estimated coefficients are large enough to motivate alternative estimators.

To take into account the difference in 1880 fertility levels, I evaluate the impact of mill arrival on fertility rates using a difference-in-difference approach with 1880 and 1900 data.[21] A difference-in-difference estimator compares the change in fertility between 1880 and 1900 for industrializing townships to the change in fertility between 1880 and 1900 for townships where no textile mill was established. The underlying assumption is that, in the absence of industrialization, the rate of change for these two groups would have been the same and any difference in these rates of change is due to the industrialization process itself.

To examine the assumption of similar trends in fertility in both groups, I calculate an annual fertility rate retrospectively from 1881 to 1900 for each township in my sample using the 1900 Census returns.[22] I regress these annual fertility rates from 1881 to 1900 for townships that do not contain a

[21] I have also performed the analysis using a propensity score matching estimator that derives an estimated probability of textile mill establishment between 1881 and 1900 based on 1880 characteristics of the township. Matching procedures are then used to estimate the fertility impact. The estimates of the impact of industry on fertility from this matching exercise are larger in absolute value than the difference-in-difference estimates.

[22] The strong caveat here is that the accuracy of this fertility measure will be lower during the early years of this 20 year window. The 1881 fertility rate, for example, is calculated as the number of 19 year olds observed in a township in 1900 (who would have been born in 1881) divided by the number of women aged 37 to 61 in 1900 (who would have been 18 to 42 in 1880). This number will clearly be subject to bias from migration and mortality if those rates differ by industrial status, but the bias likely diminishes over time such that values closer to 1900 are more accurate of township-level fertility than earlier dates. This issue, plus the unavailability of other covariates (sex ratio, marriage rate, urbanization, racial composition, etc.) for years between 1881 and 1899, precluded the possibility of performing detailed panel data analysis.

textile mill *in that year* on a township fixed effect and a constant and calculate the residuals.[23] In Figure 2, I plot these smoothed residuals for two types of townships: those that do not industrialize in the 20-year window ("Not industrialized by 1900") and those that industrialize at some point before 1900 but have not done so by year t ("Industrialized, but not yet"). The strikingly similar trend lines indicate the fertility rates of industrial townships prior to the arrival of textile mills are declining at a rate similar to townships that do not industrialize by 1900. This finding is consistent with the main assumption behind a difference-in-difference model.

The estimated impact of industrialization on fertility is represented by $\delta 1$ and $\delta 2$ in Equation 1:

$$F5_{jt} = c + \mu 1 I_{j,1895} + \mu 2 I_{j,1900} + \delta 1 I_{j,1895} * 1(t=1900) + \delta 2 I_{j,1900} * 1(t=1900) + \beta X_{jt} + \lambda_j + \theta 1(t=1900) + \varepsilon_{jt} \qquad (1)$$

where X_{jt} is a vector of township-year characteristics. c is a constant, λ_j is a township-specific fixed effect, $1(t = 1900)$ is an indicator for the second year of data, θ is the 1900-specific year effect, and ε_{jt} is a random error term. The estimation is performed over t=1880, 1900.

The first-difference estimating equation is:

$$\Delta F5_j = \delta 1 I_{j,1895} + \delta 2 I_{j,1900} + \beta \Delta X_{jt} + \theta + \varepsilon_j \qquad (2)$$

where $\varepsilon_j = \varepsilon_{j,1900} - \varepsilon_{j,1880}$.

Variable means and standard deviations are located in Table 1. Table 3 contains the estimates from Equation 2 under a variety of specifications. As anticipated, a more pronounced impact of I_{1895} on fertility rates than I_{1900} is observed in Table 3; $\delta 1$ is consistently more significant than $\delta 2$, both economically and statistically.

In column 1 of Table 3, I include all townships in the dataset, excepting only those that already

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[23] The regression is $F_t = \alpha + \sum \beta_j 1(TOWNSHIP = j)$ where the summation is taken over all townships. The residuals then represent deviations from the township average fertility rate for 1880-1899. I also smooth the results by averaging these residuals across two-year intervals. A chart without smoothing contains many more spikes in the residual, but generates the same conclusion.

contained a textile mill in 1880 (1.8 percent of all townships) and incorporating only the political designation of the township as a county seat in X_{jt}. In column 2, I add two indicators: one for whether the township is located in a county on South Carolina's Atlantic coast and one for whether the size of the town population in 1900 exceeds 2,500. Coastal counties were not as heavily dependent on agriculture prior to the arrival of the mills, did not participate in the textile industry, and were arguably different from the Piedmont counties in other ways as well. The town population measure is a recognition that, in larger towns, industrialization came in forms other than textile mills, and the industrialization proxies used herein are inappropriate.[24] For both columns 1 and 2, industrialization, as proxied by textile mills, was accompanied by more rapid fertility decline between 1880 and 1900. For a mill built between 1881 and 1895, the estimated additional reduction in fertility is between 6 and 8 percent.

Given these concerns about the adequacy of I_{1895} and I_{1900} to measure industrialization in coastal counties and in townships with larger town populations, I trim the sample in columns 3 - 8 to eliminate these counties. This is the baseline specification. The results in column 3 again indicate that textile mill locations exhibited an acceleration in fertility decline between 1880 and 1900 relative to non-industrial townships. Industrialization prior to 1895 is associated with a differential reduction in fertility of 6.9 percent in this trimmed sample, controlling only for county seat status. This 6.9 percent estimate represents the fertility reduction for the average township. In column 6 I weight the estimate by township population in 1900, which leads to a slightly larger reduction of 7.4 percent in the estimated impact of industrialization.

These results clearly indicate that the presence of a textile mill in a township is correlated with lower fertility rates in 1900. What changes in observable characteristics of textile locations might help

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[24] 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.

explain this correlation? I add controls for the change in the racial composition and density of the township's population in column 4. Industrialization may have induced the small-scale urbanization by $TOWNPOPPCT$ ("town" residents as a percentage of total population) and may have altered the ratio of the non-white to white population ($PCTNONWHITE$) as textile mills employed white workers almost exclusively. Incorporating those two covariates, the estimate for δ_1 is reduced by approximately 11 percent, indicating that changes in population density and racial composition accounted for a small proportion of the observed fertility reduction in textile locations.

The $F5$ fertility measure used in these regressions is a marital fertility rate, but it may still be the case that changes in the sex ratio or marriage rates altered fertility within marriage if, for instance, a changing marriage rate impacted the age at which women marry and their fertility window within marriage. I add measures of the change in both of these variables ($SEXRATIO$ and $FEMMARRATE$) for residents aged 18 to 42 in column 5. The estimated mill impact is reduced relative to column 3 by approximately 30 percent, indicating that changes in the sex ratio and marriage rates account for roughly one-third of the overall decline in fertility observed in textile locations.

In columns 7 and 8 of Table 3, I undertake two robustness checks. To determine the sensitivity of the results to the fertility measure used, I repeat the estimation on $F3$ measures of fertility. There is little change in coefficients as reported in column 7. In column 8, I limit the denominator to married females (excluding widowed and divorced females). Again, there is little change in the results.

The results from columns 3 - 6 of Table 3, show that textile mill establishment significantly reduced fertility rates in South Carolina between 1880 and 1900 and that changes in population density, racial composition, sex ratios, and marriage rates of these townships can explain less than half of the fertility reduction. Mill establishment prior to 1895 is associated with a 6.9 percent reduction in fertility rates in a specification with no demographic covariates and 4.3 percent after controlling for these changing aspects of the township population.

A remaining concern is whether differential migration not captured by changes in the racial composition, sex ratio, and marriage rate, is responsible for the observed decline. This concern motivates construction of a household-level dataset in the next section.

CONTROLLING FOR MIGRATION

The advantage of township data is that township boundaries are the same throughout the 20-year industrialization period, allowing us to measure a "pre-industrialization" and "post-industrialization" fertility metric and generate a difference-in-difference estimate of the impact of textile mill establishment on fertility. But townships are not composed of an immobile set of individuals, and the fertility pattern documented above could simply be a result of selective migration without changing the fertility outcomes of households *per se*. In this section, I generate a new sample of households that allows me to observe migration patterns.

In order to identify migrants, the location of the household at two points in time is needed. The 1900 Census contains information on an individual's state of birth, but not their 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 the genealogy tool Ancestry.com to link individuals between the 1900 Census and the 1880 Census and use their township location in both to infer migration. The 100 percent sample of the 1880 U.S. Census from the North American Population Project has information on 284,412 South Carolina resident males aged 0 to 20 in 1880.[25] Of those, 34,841 are uniquely matched to the 1900 U.S. Census using the search function of Ancestry.com and the individual's full name, race, and age ($\pm$1 year) to make a match.[26] Of those, 12,999 are married with their spouse present in the

[25] North Atlantic Population Project and Minnesota Population Center, *Complete Count Microdata*.; United States of America, Bureau of the Census, *Tenth Census.*

[26] United States of America, Bureau of the Census, *Twelfth Census.* Every individual in the 1900 U.S. Census has been digitized

household and reside in South Carolina townships with fewer than 2,500 town residents in 1900 and outside of the coastal counties. This subsample of married South Carolina males, aged 19 to 41 in 1900 with a spouse present in the household, is the basis for analysis. The 1900 Census return as transcribed by Ancestry.com contains a full list of household members, their name, relationship to the head of household, age, race, marital status, marital duration, and birthdate. The location of the male head at two points in time, 1880 and 1900, gives a measure of household migration.

A caveat is in order. Because the objects of interest are young, fertile households in 1900, I can only link the male head because 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 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 in the subsequent analysis.[27]

MIGRATION RESULTS

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

$$F5_{i,j}^{HH} = c + \delta 1 I_{j,1898} + \delta 2 I_{j,1900} + \theta Y_i + \beta X_j + \alpha MOVER_i + \varepsilon_{i,j} \qquad (3)$$

where $F5_{i,j}^{HH}$ is the (discrete) number of children less than age 5 in household i in township j, analogous to the F5 fertility rate from the township sample. The vector of township characteristics, X_j, was defined previously. Y_i contains the matched male's age, age squared, wife's age, age squared (all contained in $AGEVECTOR$), and an indicator for whether the matched male is black. $MOVER_i$ is an indicator for whether household i changed township locations between 1880 and 1900. The coefficient α measures

on Ancestry.com and is searchable by a subset of household characteristics, including name, race, and age. Failed matches result both from locating no matching individuals in 1900 (75% of failed matches) and from locating more than one matching individual in 1900 (25% of failed matches).

[27] The size or direction of this bias is unknowable.

differential fertility for township movers. Table 2 gives sample means for variables contained in the household sample. As a consistency check, $\bar{F5}$ from Table 1 and $\bar{F5}^{HH}$ from Table 2 are both equal to 1.22.

An ordered probit estimator is used for Equation 3 because values for $F5^{HH}$ are discrete.[28] Coefficients and standard errors for $\delta 1$, $\delta 2$, and α are reported in Table 4, but the coefficients no longer have a marginal effect interpretation. The marginal effect implied by $\delta 1$ is listed lower in the table. In column 1 of Table 4, the estimate of the impact of industrialization on fertility controlling only for variables available in the township sample indicates a negative correlation between $F5^{HH}$ and pre-1896 industrialization of about 4.1 percent in the household sample compared to 7.4 percent in the township data weighted by population. After adding race and age covariates in column 2, the implied reduction in fertility corresponding to pre-1896 industrialization is 4.1 percent. [29]

$MOVER_i$, the indicator for migration, is included in column 3 and the negative coefficient implies that migrants had lower fertility. Comparisons of coefficients for the the sample of movers in column 4 and non-movers in column 5 shows that migrants who resided in townships industrialized by 1895 had 6.9 percent lower fertility than migrants to non-industrial townships. On the other hand, non-movers in those same townships exhibited 1.1 percent higher fertility, although the coefficient is not statistically significant. This is a striking result as it indicates that households who remained in textile locations between census enumerations exhibited no change in fertility relative to those households who remained in a non-textile location. The industrialization process was correlated with lower fertility, as earlier results have indicated, but migrating households were responsible for the negative correlation.

[28] Poisson estimation does not remarkably alter the results.

[29] The analysis excludes households with a female spouse less than 15 years of age and greater than 50 years of age as these entries are more likely data errors than actual spousal matches.

There are at least three potential explanations for this result. First it is possible that migrants to textile townships were disproportionately from low-fertility native townships and brought these fertility patterns with them. But adding covariates for average fertility of the migrant's home township ($HOMETWPF_i$) and population of the migrant's home township ($HOMETWPPOP_i$), either in 1880 (Table 4 - column 6) or 1900 (column 7), does not reduce the estimated impact of industrialization.[30]

A second potential explanation is that movers to textile locations had lower initial fertility rates than their native township peers. Perhaps these low-fertility households were attracted to the labor markets in industrial locales and brought their low fertility with them. If so, we would expect migrants to townships where mills were built late in the 1881-1900 timeframe to exhibit low fertility as well, but that is not the case. In every specification of Table 4 involving mover households (columns 4, 6, and 7) the impact of being in an industrial township in 1895 ($\delta 1$) is large and negative while the impact of location in an industrial township where a new mill was added by 1900 ($\delta 2$) is less negative and statistically insignificant. Migrants exhibited lower fertility than non-migrants in textile locations, but only in locations where they had been exposed to a textile mill for five years or longer. Migrants to townships where mills were built between 1896 and 1900 did not have lower fertility rates than their peers. This points not to selective migration of households, but to a different fertility response to residence in a textile locale.

This gives rise to a third explanation. I document below that women in the households that migrated to textile townships disproportionately chose textile occupations and experienced higher rates of child mortality. In addition, the loss of proximity to extended family for migrants might have

[30] The variables $HOMETWPF_{1880}$ and $HOMETWPF_{1900}$ represent the $F5$ marital fertility of a household's home township measured in 1880 and 1900, respectively. The variables $HOMETWPPOP_{1880}$ and $HOMETWPPOP_{1900}$ represent the town population of a household's home township measured in 1880 and 1900, respectively.

contributed to higher costs of raising children.[31]

MIGRATION, OCCUPATIONAL CHOICE, AND CHILD MORTALITY

Occupational choice may have contributed to the differing impact of industrialization on movers and stayers. Since Ancestry.com did not report occupations for the sample used in Table 4, I transcribed the occupation of the male and female household heads for the 2,342 households residing in townships in 1900 that were industrialized between 1881 and 1900 from the original census enumerations. The occupation shares in Table 5 show that 11 percent of male heads of migrant households were employed in textile jobs, compared with only 4 percent of stayers; 7 percent of migrant women compared to 3 percent of stayers were in textile jobs. Movers also had a higher rate of employment in non-farm occupations in general.

Both nonagricultural employment categories were negatively correlated with fertility. When I estimate fertility for households with occupations listed in the industrial townships as a function only of migration in column 1 of Table 6, fertility is strongly negatively correlated with migrant status in industrial locales. After controlling for the occupations of the male and female household heads in the sample in column 2, households with males and females in the textile industry have lower fertility, while the relationship between fertility and migration is reduced by approximately 25 percent from -9.8 percent to -7.2 percent but remains significant.

The impact of occupations was strong not only for white residents who were likely to experience textile employment, but also for black migrants who very rarely were textile workers. Column 3 of Table 6 limits the sample to black households and the results are largely unchanged. The impact of textile

[31] It does not appear that migrants' fertility rates were mismeasured due to leaving children behind, the so-called "missing children" hypothesis. See Moehling, "Broken Homes". Comparing the ratio of children present in the household to surviving children for young migrant mothers and young stayers in industrial townships, there is minimal difference. The number of additional "missing" children for migrants relative to stayers is 3 out of 1,000, much smaller than the fertility differential observed in Table 4.

mills, it appears, extended beyond their own employees, perhaps because they altered the labor market for townships in general.

Occupational choice, then, can explain part of the difference in fertility between movers and stayers in textile locations, but a significant portion of the correlation remains unexplained. One further hypothesis is that migration influenced infant mortality which, in turn, affected fertility. Higher rates of infant and child mortality in industrial locations for migrating households in 1900 may be the cause of lower observed fertility in 1900 if replacement is not perfectly achieved.[32]

The 1900 Census asked married women how many children they had borne and how many were surviving.[33] Using the household sample, 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, industrial residence and migration.[34]

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:

$$S_{ij} = \tau D_i + \alpha MOVER_i + \beta X_i + \theta Y_j + \varepsilon_{i,j} \quad (4)$$

where S_{ij} is the observed child survival rate for household i in township j in 1900. Unlike $F5$, 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 and I_{1896}

[32] On the other hand, higher rates of infant mortality may lead to higher fertility by reducing birth intervals.

[33] Unfortunately, standardized infant and child mortality statistics for South Carolina townships in 1900 do not exist.

[34] 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.

and I_{1900} are no longer relevant. 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. The same set of control variables are used to estimate Equation 4 as for Equation 3, and the same sample restrictions apply.

Table 2 gives the mean and standard deviation of S_{ij} and D_{ij}. The results in column 1 of Table 7 indicate no discernible difference in infant and child mortality rates between residents of industrialized and non-industrialized townships.[35] These are small numbers; the τ coefficient in column 1 represents a reduction in survival rates of 0.9 percent.

Adding migration status to the regression (Table 7 – column 2) does not affect the results. But in column 3, I add an interaction between mover status and the textile exposure measure, D_{ij}, and the estimates indicate that survival rates were significantly lower among movers to industrial locations than among their peers. A mover to a township with a textile mill present for the entirety of their marriage duration experienced a reduction in child survival rates of 3.7 percent (0.031/0.84) relative to non-movers or movers to non-industrial locales. The coefficients when occupations dummies are added to the specification in column 4 indicate that the occupational choice of migrants largely explains the adverse child survival rates. Female employment in a textile mill had a large negative correlation with child survival rates, while employment of the male had a more muted correlation. When the occupation dummies are added the coefficient of the interaction between mover and location in an industrial household turns positive and is statistically insignificant. For black residents (column 5), migration was similarly inconsequential for determining infant and child mortality after controlling for occupation.

The results in Tables 6 and 7 indicate that occupational choice may explain part of the lower observed fertility rates among migrants in industrial locales. A lower child survival rate in migrant households is entirely attributable to occupational choice, lending futher support to this conclusion. If

[35] Restricting the sample to younger women or newly married couples does not change the result, and replacing D_{ij} with the industrialization proxies employed previously generates the same conclusion.

differential fertility among movers to industrial locations was driven by reductions in survival rates, it appears to have been the result of occupational choice. But a significant portion of the mover-stayer fertility differential remains unexplained, even after controlling for occupation in Table 6.

EVALUATING POTENTIAL MECHANISMS

The introduction to his paper listed several ways in which economic growth may have affected fertility rates, and I evaluate those potential mechanisms in turn.

First, the available evidence indicates that increases in the costs of raising children contributed to reduced fertility in textile locations. Female occupation is a strong predictor of household fertility in the sample (Table 6), and low migrant fertility can be explained in part by higher rates of female employment in textile and service industries. Fertility is most strongly associated with textile employment where employment would have prevented active childrearing. But there is a significant impact among service workers as well. The arrival of textile mills increased demand for female-provided services such as cooking, laundering, growing small amounts of crop and livestock, and boarding. These occupations were dominated by African American females and this indirect effect can explain the reduction in fertility among this population.

In addition, the observed difference in fertility for migrants relative to natives is consistent with a different cost of children explanation: the costs of child care. For natives in industrialized locales, extended family could have served as a backstop for childcare. But for migrants this option was not available. Childcare in the mills was sporadically supplied, and most families would have relied on household members for this service. The lack of extended family members to perform this task would have resulted in an increase in the cost of raising children for migrants relative to natives and may have been another cause of the observed fertility differential.[36]

[36] This hypothesis is further supported by the fact that all migrants, in industrial locales and otherwise, exhibited lower fertility rates than their peers, and the absence of an extended family would have affected migrants no matter their final destination.

The available data also suggests an increase in population density as an important factor in inducing lower fertility. In the township results of Table 3, controlling for the town population of a township reduces the coefficient on the industrialization proxy in column 5 by 29 percent for townships industrialized after 1895 and by 18 percent for those industrialized before that date.

On the other hand, there is little evidence that child human capital or quality/quantity tradeoff concerns drove fertility reduction. Textile mills relied on low-skilled operatives, and there is no indication that textile manufacturing increased the return to human capital or incentivized parents to invest in child quality over quantity.[37] A variant of the original quality/quantity hypothesis focuses on the potential impact of an increase in income on parental preference for quality over quantity. But this also has little support in the data as indicators for male occupational status (a proxy for household income) have a muted correlation with fertility in comparison to those for female occupational status (a proxy for both household income and the opportunity cost of female time). (See Table 6.)

Finally, a decrease in the labor opportunities of children is an improbable mechanism in this context. Available sources indicate that children represented a large proportion of workers in Southern mills, even when mills self-reported their employment numbers. Further, 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 mill employment, extensive as it was, was less well renumerated than their previous employment, generally as farm laborers. This is a questionable assumption, in part because children, with their smaller and more dextrous hands, were

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But migrants to textile locations exhibited even lower fertility rates and may also have been differentially affected by the loss of extended family. Their increased likelihood of being engaged in occupations which were incompatible with child-rearing (for example, non-agricultural occupations outside of their own home) would have increased their reliance on child care relative to migrants to other locations.

[37] See Becker, Hornung, Woessman, "Education", for evidence that the textile industry in Prussia exhibited low returns to education relative to metal, rubber, and other industries.

actually better suited for some mill tasks than were adults.

I conclude that increases in child mortality, the opportunity cost of female time, and in other costs of raising children, including those resulting from increased population density, are the most likely explanations for lower fertility in South Carolina textile locations.

CONCLUSION

Fertility decline in the 19th century United States has often been attributed to an quickening pace of industrial activity. I exploit the fact that South Carolina's industrial experience between 1881 and 1900 can be proxied by the textile industry in particular and evaluate the impact of the establishment of a textile mill on rural, marital fertility rates in South Carolina. Using a difference-in-difference approach, I estimate a 6 to 10% reduction in fertility following textile mill establishment.

In order to evaluate potential mechanisms to explain this result, I build a household data sample. I use the location of male heads of household at two points in time to measure migration and show that migrants exhibited substantially lower fertility than natives in industrial townships. Observing that migrating households were also more likely to be employed in the textile industry, I argue that an increase in the costs of raising children, including a heightened opportunity cost of female time, led to lower household fertility in mill locations. I hypothesize that the separation of migrating households from their extended families may also have raised the costs of childrearing and resulted in lower migrant fertility in industrial locales. Finally, the results indicate that reductions in child survival rates among migrating industrial workers and increases in population density also contributed to the observed fertility reduction.

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TABLES

TABLE 1

Township Data Variable Summary

	All Townships	*Standard Deviation*	No Textile Mill By 1900	First Mill Built 1881-1890	First Mill Built 1891-1895	First Mill Built 1896-1900
$F5_{1880}$	1.42	*0.14*	1.43	1.39	1.36	1.40
$CTYSEAT_{1880}$	0.05	*0.22*	0.03	0.13	0.36	0.27
$TOWNPOPPCT_{1880}$	0.03	*0.11*	0.02	0.07	0.10	0.16
$MARRATE_{1880}$	0.68	*0.05*	0.68	0.64	0.63	0.65
$SEXRATIO_{1880}$	1.08	*0.09*	1.07	1.08	1.08	1.11
$PCTNONWHITE_{1880}$	0.57	*0.20*	0.58	0.44	0.47	0.50
$F5_{1900}$	1.22	*0.18*	1.24	1.08	1.10	1.12
$CTYSEAT_{1900}$	0.06	*0.24*	0.03	0.13	0.43	0.27
$TOWNPOPPCT_{1900}$	0.07	*0.12*	0.05	0.18	0.18	0.26
$MARRATE_{1900}$	0.65	*0.05*	0.65	0.65	0.61	0.62
$SEXRATIO_{1900}$	1.03	*0.13*	1.03	1.00	1.04	1.05
$PCTNONWHITE_{1900}$	0.58	*0.20*	0.60	0.39	0.45	0.46
N	341		301	8	14	11

Notes: Sample includes all Non-Coastal Townships, with no textile mill by 1880 and 1900 Town Population $< 2{,}500$. Corresponds to results in Tables 3 and 9.
Source: See the text.

TABLE 2

1900 Variable Summary for Household Data

	Sample Mean	*Standard Deviation*
FE_i = Number own children <5 in 1900 household i	1.22	1.00
$I_{j,1896}$	0.11	0.31
$I_{j,1900}$	0.07	0.26
$CTYSEAT_{j,1900}$	0.10	0.29
$BLACK_i$	0.49	0.50
$MALEAGE_i$	30.49	5.7
$FEMALEAGE_i$	26.94	6.1
$MOVER_i^a$	0.57	0.49
$S_{i,j}$ = Survival rate of children ever born	0.84	0.25
D_i = Percent of marriage duration for which textile mill is present	0.11	0.30

a) Conditional on remaining in South Carolina
Notes: Corresponds to results in Tables 4, 6, and 7
Source: See the text.

TABLE 3
Impact of Industrialization on Fertility
Difference-in-Difference Estimation Results for Township Sample (Equation 2)

	Full Sample		Trimmed Sample - Baseline				Robustness Checks	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]	(8)
Dependent variable	ΔF_B	ΔF_B	ΔF_B	ΔF_B	ΔF_B	ΔF_B	$\Delta F_{B,1900}$	$\Delta F^{MARR}_{B,1900}$
Townships	ALL	ALL	Eliminate Coastal and Town Pop. $> 2,500$ Counties	See (3)	See (3)	See (3) Weighted by $Pop'n_{1900}$	See (3)	See (3)
$\delta 1$, the coefficient on I_{1895} (Townships industrialized by 1895)	-0.093*** (0.035)	-0.075** (0.037)	-0.084** (0.041)	-0.074* (0.042)	-0.052 (0.042)	-0.088*** (0.029)	-0.074** (0.033)	-0.097** (0.044)
$\delta 2$, the coefficient on I_{1900} (Townships industrialized after 1895)	-0.0867** (0.041)	-0.074* (0.042)	-0.074 (0.045)	-0.058 (0.046)	-0.052 (0.045)	-0.084* (0.037)	-0.047* (0.043)	-0.079 (0.048)
Percent reduction in fertility implied by $\delta 1$	7.8%	6.3%	6.9%	6.0%	4.3%	7.4%	10.0%	7.3%
Other control variables								
$\Delta COASTALCOUNTY$		Y						
$1(TOWNPOP1900 > 2500)$		Y						
$\Delta CTYSEAT$	Y	Y	Y	Y	Y	Y	Y	Y
$\Delta PCTNONWHITE$				Y	Y			
$\Delta TOWNPOPPCT$				Y	Y			
$\Delta SEXRATIO$					Y			
$\Delta FEMMARRATE$					Y			
F-statistic	3.82	3.32	2.25	2.35	4.12	851.21	2.48	2.40
Number of observations	391	391	341	341	341	341	341	341

* indicates significance at 10% level
** indicates significance at 5% level
*** indicates significance at 1% level
(a) In Column (7) I_{1895} becomes I_{1897} and I_{1900} represents only those mills built between 1898 and 1900.

Notes: Point estimates of coefficients. Standard errors in parentheses.
Source: See the text.

TABLE 4
Impact of Industrialization on Fertility
Ordered Probit Results for Household Sample (Equation 3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	$F5^{HH}$	$F5^{HH}$	$F5^{HH}$	$F5^{HH}$	$F5^{HH}$	$F5^{HH}$	$F5^{HH}$
Households	ALL	ALL	ALL	$MOVER = 1$	$MOVER = 0$	$MOVER = 1$	$MOVER = 1$
$\delta 1$, the coefficient on I_{1895}	-0.050	-0.055*	-0.050	-0.094**	0.014	-0.097**	-0.094**
(Townships industrialized by 1895)	(0.032)	(0.033)	(0.033)	(0.042)	(0.054)	(0.042)	(0.042)
$\delta 2$, the coefficient on I_{1900}	-0.003	-0.004	0.001	-0.033	0.051	-0.036	-0.035
(Townships industrialized after 1895)	(0.038)	(0.038)	(0.038)	(0.048)	(0.063)	(0.048)	(0.048)
α, the coefficient on $MOVER_i$			-0.061***				
			(0.019)				
Marginal effect of I_{1895} on $E(F5^{HH})$ implied by $\delta 1$ (as a percent of $\bar{F5}^{HH}$)	-3.7%	-4.1%	-3.7%	-6.9%	+1.1%	-7.7%	-7.3%
Other control variables							
$CTYSEAT_{1900}$	Y	Y	Y	Y	Y	Y	Y
RR_{1890}	Y	Y	Y	Y	Y	Y	Y
BLACK		Y	Y	Y	Y	Y	Y
$AGEVECTOR$		Y	Y	Y	Y	Y	Y
$HOMETWPF_{1880}$						Y	
$HOMETWPF_{1900}$							Y
$HOMETWPPOP_{1880}$						Y	
$HOMETWPPOP_{1900}$							Y
Pseudo R-squared	0.00	0.03	0.03	0.03	0.03	0.03	0.03
Number of observations	12,999	12,999	12,999	7,452	5,547	7,452	7,452

* indicates significance at 10% level

** indicates significance at 5% level
*** indicates significance at 1% level
Notes: Point estimates of coefficients. Standard errors in parentheses.
Source: See the text.

TABLE 5
Male and Female Occupation, Tabulated by Mover/Stayer status

	Male				Female			
	Farmers and Farm Laborers	Textile Workers	Other	Unemployed	Farmers and Farm Laborers	Textile Workers	Other	Unemployed
Proportion of all stayers	0.73	0.04	0.22	0.01	0.14	0.01	0.08	0.77
Proportion of all employed stayers	0.74	0.04	0.22	---	0.62	0.03	0.35	---
Proportion of all movers	0.60	0.11	0.29	0.01	0.12	0.02	0.07	0.79
Proportion of all employed movers	0.60	0.11	0.29	---	0.58	0.07	0.35	---
Total	0.65	0.08	0.26	0.01	0.13	0.01	0.07	0.79

Source and notes: See the text. The Other category is comprised mostly of service occupations.

TABLE 6
Impact of Mover/Stayer status and Occupational Choice on Household Fertility (Equation 3)

	(1)	(2)	(3)
Dependent variable	$F5^{HH}$	$F5^{HH}$	$F5^{HH}$
Households	I_{1895}=1 or I_{1900}=1	I_{1895}=1 or I_{1900}=1	(I_{1895}=1 or I_{1900}=1) and $BLACK = 1$
α, the coefficient on $MOVER_i$	-0.127***	-0.095**	-0.129*
	(0.047)	(0.047)	(0.075)
Marginal effect of $MOVER_i$ on $E(F5^{HH})$ implied by α (as a percent of $F5^{HH}$)	-9.8%	-7.2%	-10.9%
Occupation variables			
1(wife=farmer or farm laborer)		0.048	0.004
		(0.073)	(0.086)
1(wife=textile worker)		-1.639***	
		(0.316)	
1(wife=other worker)		-0.100	-0.182
		(0.092)	(0.116)
1(husband=textile worker)		-0.323***	-0.608*
		(0.056)	(0.355)
1(husband=other worker)		-0.047	-0.310***
		(0.092)	(0.095)
Other control variables			
$CTYSEAT_{1900}$	Y	Y	Y
RR_{1880}	Y	Y	Y
$BLACK$	Y	Y	
$AGEVECTOR$	Y	Y	Y
I_{1900}	Y	Y	Y
Pseudo R-squared	0.03	0.04	0.02
Number of observations	2,349	2,349	958

* indicates significance at 10% level
** indicates significance at 5% level
*** indicates significance at 1% level
Notes: Point estimates of coefficients. Standard errors in parentheses.
Source: See the text.

TABLE 7
Regression Results for Child Survival Rates in the Household Sample (Equation 4)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	$S_{t,j}$	$S_{t,j}$	$S_{t,j}$	$S_{t,j}$	$S_{t,j}$
Households	ALL	ALL	ALL	I_{1898}=1 or I_{1900}=1	(I_{1898}=1 or I_{1900}=1) and $BLACK = 1$
τ - coefficient on $D_{t,j}$	-0.0085	-0.0079	0.013	-0.011	-0.008
	(0.0078)	(0.0078)	(0.013)	(0.023)	(0.041)
α, the coefficient on MOVER		-0.0049	-0.0010	-0.024	-0.001
		(0.005)	(0.005)	(0.021)	(0.035)
MOVER x $D_{t,j}$			-0.031**	0.0045	0.000
			(0.016)	(0.027)	(0.047)
Percent change in survival rate implied by τ	1.0%	0.9%	1.5%	0.8%	1.0%
Occupation variables					
1(wife=farmer or farm laborer)				-0.021	-0.006
				(0.017)	(0.021)
1(wife=textile worker)				-0.140**	
				(0.058)	
1(wife=other worker)				-0.015	-0.006
				(0.021)	(0.021)
1(husband=textile worker)				-0.076***	-0.05
				(0.018)	(0.09)
1(husband=other worker)				-0.037	-0.058**
				(0.013)	(0.022)
Other control variables					
$CTYSEAT_{1900}$	Y	Y	Y	Y	Y
RR_{1880}	Y	Y	Y	Y	Y
$BLACK$	Y	Y	Y	Y	
$AGEVECTOR$	Y	Y	Y	Y	Y
Adjusted R-squared	0.02	0.02	0.02	0.03	0.02
Number of observations	11,188	11,188	11,188	2,284	890

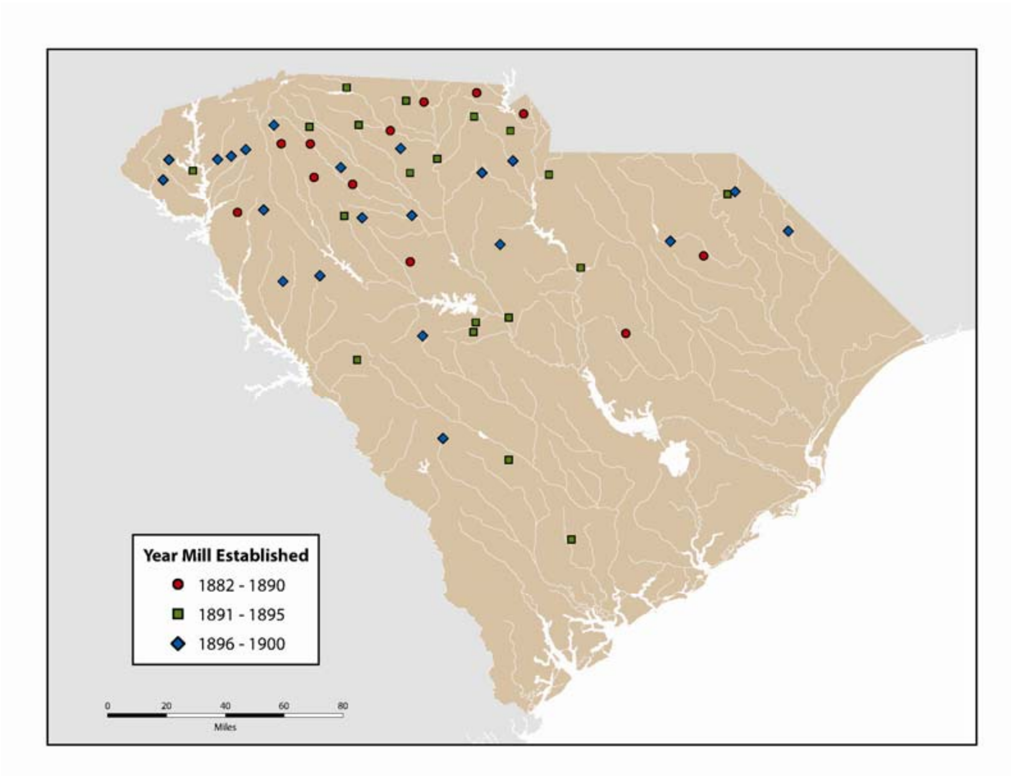
* indicates significance at 10% level
** indicates significance at 5% level
*** indicates significance at 1% level
Notes: Point estimates of coefficients. Standard errors in parentheses.

Source: See the text.

FIGURES

FIGURE 1

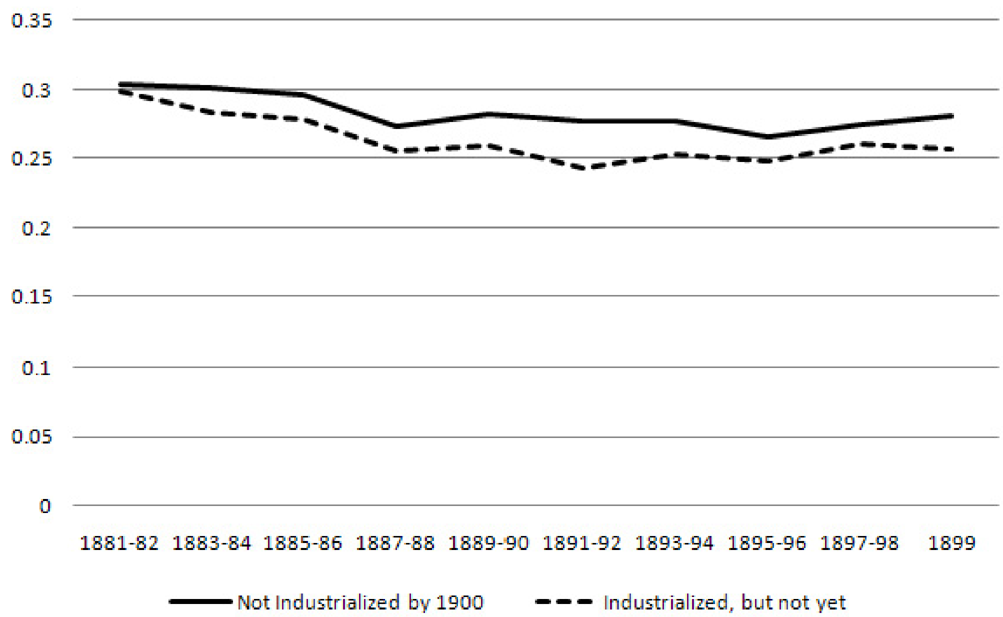
South Carolina Mill Establishment: 1881-1900



Source: Davison Publishing Company, *Davison's Blue Book.*

FIGURE 2

Residual Fertility (1880-1899) in Non-Industrial Townships, by future industrial status



Notes: Plotted residuals from a regression of annual fertility rates from 1881 to 1899 in townships that do not contain a textile mill *in that year* on a township fixed effect and a constant. Mean residuals are plotted for two types of townships: those that do not industrialize in the 20-year window ("Not industrialized by 1900") and those that industrialize at some point before 1900 but have not done so by year t ("Industrialized, but not yet"). See "Difference-in-Difference Results" for more details.
Source: See the text.

FIGURE 3

F5 Fertility Rates for Industrialized and Non-Industrialized South Carolina Townships (Left Panel) and for all South Carolina, the South, U.S. (Right Panel)

Notes: Left-hand panel includes only townships in the baseline sample (non-coastal, town population <2500) from Table 3, Column 3. Right-hand panel, All South Carolina includes all S.C. townships while Paper Sample is the baseline sample from Table 3. "All South" includes all former Confederate states.
Source: Left-hand panel: see the text. Right-hand panel: United States of America, Bureau of the Census, *Tenth Census, Twelfth Census.*

APPENDIX 1: THE OCCUPATION OF SOUTH CAROLINIANS IN 1900

The 1900 employment of the population by industry is given in Table 8, tabulated by gender. The data source is the IPUMS 1% sample of the 1900 U.S. Census. For South Carolinians between the ages of 15 and 40, 91.4% of males were labor force participants while 40.5% of females were. Among the *married* population in this age range, the figures are 97.8% and 22.7%, respecively.[38] The vast majority of both male and female workers were employed in agriculture (66% of males and 61% of females). Outside of agriculture, manufacturing and services held employment for roughly 25% of the male population and 39% of females. Trade and transport sectors employed the remaining 9% of men and almost no women.

Within manufacturing, the blossoming textile industry in 1900 was the employment leader. More than 30% of males employed in manufacturing were in the textile industry. Carpentry (7.5%) and sawmills (6.8%) came in a distant second and third. For females, the proportion of manufacturing jobs in textiles was even higher at 57%. Most of the remaining women in manufacturing were employed in dressmaking and as seamstresses (32.3%), occupations likely centered in the operative's home rather than in an central locale.

Table 8
1900 Industry Occupation Statistics, by Gender, South Carolina

Occupation Category	Percentage of Employed Males	Percentage of Employed Females
Farming and agriculture	66.3%	60.5%
Services	11.7%	29.8%
Trade and transport	9.0%	0.6%
Manufacturing	12.9%	9.1%
Percent of manufacturing in:	---	---
Textiles	30.5%	57.0%
Dressmaking	0%	32.3%
Carpentry	7.5%	0%
Saw and planing mills	6.8%	0%

Source: Author's Analysis of 1900 IPUMS Sample. Ruggles *et al*, *Integrated Public Use Microdata Series.*

It is clear from Table 8 that industrial employment (production at a centralized location) in South Carolina in this time period was limited almost exclusively to textile mills. All other employment was either agricultural or decentralized (dress-making, carpentry, etc.). The sole exception is the small level of employment among men in the region's saw mills. But as only 0.8% of males were so-employed, the contribution of saw milling to industrial employment will be ignored.

APPENDIX 2: OLS RESULTS FOR TOWNSHIP DATA

The OLS estimating equation for fertility in township j in 1900 is

$$F5_{j,1900} = \alpha + \delta 1 I_{j,1895} + \delta 2 I_{j,1900} + \beta X_{j,1900} + \varepsilon_{j,1900} \quad (4)$$

Table 9 contains the results of estimating Equation (4) under a variety of specifications. Variable means and standard deviations are located in Table 1 and the same sample trimming applies in this analysis as for the baseline results of Table 3.

Table 9
OLS Estimation Results for Township Sample (Equation 4)

	1900 Fertility OLS Baseline				1880 Fertility: Falsification Test
	(1)	(2)	(3)	(4)	(5)
Dependent variable	$F_{5,1900}$	$F_{5,1900}$	$F_{5,1900}$	$F_{5,1900}$	$F_{5,1880}$
Townships	Eliminate Coastal and Town Pop. $> 2{,}500$ Counties	See (1)	See (1)	See (1)	See (1)
$\delta 1$, the coefficient on I_{1895} (Townships industrialized by 1895)	-0.130*** (0.040)	-0.127*** (0.040)	-0.134*** (0.040)	-0.135*** (0.040)	-0.047 (0.033)
$\delta 2$, the coefficient on I_{1900} (Townships industrialized after 1895)	-0.101** (0.043)	-0.047 (0.044)	-0.050 (0.044)	-0.051 (0.044)	-0.029 (0.035)
Percent reduction in fertility implied by $\delta 1$	10.7%	10.4%	11.0%	11.0%	3.3%

	(1)	(2)	(3)	(4)	(5)
Other control variables					
$CTYSEAT_{1900}$	Y	Y	Y	Y	Y
$TOWNPOPPCT_{1900}$		Y	Y	Y	
$PCTNONWHITE_{1900}$		Y	Y	Y	
$MARRATE_{1900}$			Y	Y	
$SEXRATIO_{1900}$			Y	Y	
RR_{1890}				Y	
Adjusted R-squared	0.05	0.13	0.14	0.14	0.01
Number of observations	341	341	341	341	341

* indicates significance at 10% level
** indicates significance at 5% level
*** indicates significance at 1% level
Notes: Point estimates of coefficients. Standard errors in parentheses.
Source: See the text.

Analogous to the structure of Table 3, Column (1) of Table 9 includes only $CTYSEAT_{1900}$ as a component of $X_{j,1900}$. Subsequent columns include additional controls for town population and the non-white population ratio in 1900 (Column (2)), and the marriage rate and sex ratio for age 18-42 (Column (3)). In each case, the impact of industrialization on fertility as measured by $\delta 1$ remains large and significant.

As discussed previously, railroad presence may have been a driver for textile mill location in the late 1890s and could also have affected fertility. Including a measure for railroad presence (Column (4)) does not significantly alter the estimated impact of industrialization and the impact of the railroad itself is neither economically nor statistically significant.[39]

Table 1 indicates that fertility rates in townships that would eventually house textile mills were lower in 1880, before mill establishment. In Column (5), I undertake a falsification test to determine whether this difference is significant. I estimate the impact of a textile mill built between 1881 and 1900 on fertility *in 1880*. Control variables are the same as those in Column (1).[40] The difference in *ex ante*

Including this variable in the estimation does not affect the conclusions in this section, was not recreated for 1880 and 1900, and thus is not included in the difference-in-difference specifications.

(all measured in 1900) as control variables generates similar conclusions.

fertility is not significantly different from zero, but the point estimate still indicates a 3.3% difference in fertility in 1880. For this reason, I utilize a difference-in-difference estimator in the text and in Table 3 and a matching estimator in Appendix 3.

APPENDIX 3: A PROPENSITY SCORE ESTIMATOR

The difference-in-difference estimator employed in the text is one way of dealing with potential differences in *ex ante* characteristics of industrializing townships. A matching estimator is another.

Table 10
Propensity Score Matching Estimates - Township Sample

Model	LLM	KM
Dependent variable	ΔF_B	ΔF_B
Townships	Baseline Sample (From Table 3)	Baseline Sample (From Table 3)
$\delta 1$, the coefficient on I_{1895} (Townships industrialized by 1895)	-0.135*** (0.068)	-0.137** (0.049)
$\delta 2$, the coefficient on I_{1900} (Townships industrialized after 1895)	-0.046 (0.037)	-0.039 (0.032)
Percent reduction in fertility implied by $\delta 1$	11.1%	11.2%

* indicates significance at 10% level
** indicates significance at 5% level
*** indicates significance at 1% level
Notes: Point estimates of coefficients. Standard errors in parentheses.
Source: See the text.

The estimate is performed in two steps. First, I generate a propensity score for textile mill establishment based on observables of a township in 1880: its population, county seat status, "town" population percentage, marriage rate among fertile females (age 18 to 42), sex ratio for ages 18 to 42 and the percentage of the population that is non-white. I run a probit for I_{1895} and I_{1900} on these variables and generate, for each township, the predicted probability of receiving a textile mill in these two time periods.

Next, I use a local linear matching (LLM) and a kernel matching (KM) estimator, both with bootstrapped standard errors, to generate an estimated effect of industrialization on the treated townships. For each township j that industrializes between 1881 and 1900, the matching estimator compares the value of $FS_{j,1900}$ to the weighted average of FS_{1900} for non-industrializing townships where the weights are inversely proportional to the difference between the propensity score for j and that for the other townships.[41] A matching estimator, then, calculates the difference in fertility between locations with similar probabilities of industrializing, given 1880 characteristics. This process prevents estimates for the fertility impact that are driven by non-industrial townships that are entirely dissimilar to the industrial set.[42] Results are located in Table 10. Both a kernel match and a local linear match generate results consistent with those detailed in Table 3, although the point estimates are larger.

APPENDIX 4: LOOKING FOR "MISSING CHILDREN"

One possibility to explain the lower fertility rates of migrants in industrial locales (and elsewhere) relative to stayers is that they left children behind in their home location, with extended family or otherwise. The 1900 U.S. Census asks women for the number of children ever born to them and the number of those surviving. I calculate a ratio of the number of currently-residing children to the number of surviving children in a household. For younger women, those with younger children, this ratio should be an accurate measure of "missing" children.[43]

Table 11
Evidence of "Missing Children" in 1900

	Females aged 15 to 25		Females aged 26 to 35	
	No Textile Mill by 1900	Textile Mill by 1900	No Textile Mill by 1900	Textile Mill by 1900

Township stayers	0.968	0.950	0.958	0.980
Township migrants	0.956	0.953	0.946	0.951
	N=4,283		*N=4,728*	

Notes: Cells contain the average ratio of children present to surviving children reported.
Source: See the text.

Table 11 displays the average ratio of children present to children surviving, by migrating status and township industrialization status, for two different age brackets. The first line of the table shows the average percentage of surviving children present in the household of township "stayers" in 1900, divided between townships with and without a textile mill. The second line shows the same for migrants.

From these results, I detect no notable increase in the number of "missing" children for migrants relative to natives in either non-textile or textile locales. The first panel, females aged 15 to 25, can be reasonably assumed to contain females whose children are too young to have left the family to seek separate residence. The difference between the ratio for township migrants in mill and non-mill townships amounts to 3 "missing" children out of 1,000, much smaller than the fertility difference observed in Table 4. Panel two, females aged 26 to 35, is more likely to include the effects of adult children striking out on their own and is therefore less preferable for answering the question at hand. Nonetheless, the second panel of results indicates a higher ratio of children present in the household in industrialized townships relatve to non-mill locales and there does not seem to be a difference by migration status. I conclude that the fertility difference between natives and migrants is not attributable to "missing" children.