Family Matters:
The Life-Cycle Transition and the Fertility Decline in Antebellum America

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University of California, Riverside
June 2003

Circulated for discussion at the DAE Summer Institute

National Bureau of Economic Research

Cambridge Massachusetts

July 15, 2003 11:00AM

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Early drafts of this paper were presented at the ‘History Matters’ Conference in Honor of Paul A. David held at Stanford University in June 2000, at the “Frontiers” conference of the All-UC Group in Economic History held at Scripps College in March 2001, and seminars in Japan at the International Research Center for Japanese Studies (Tokyo) and Osaka Gakuin University.

The authors acknowledge the helpful comments of Paul A. David, Akira Hayami, Shelia Johansson, Thomas Mroz, William Sundstrom, and Yasukichi Yasuba. Data assembled by and generously made available to us by Michael Haines and Thomas Weiss made our task easier.

Suggested Citation: Susan B. Carter, Roger L. Ransom, and Richard Sutch. "Family Matters: The Life-Cycle Transition and the Unparalleled Fertility Decline in Antebellum America." In Timothy W. Guinnane, William A. Sundstrom, and Warren Whatley, editors, *History Matters: Essays on Economic Growth, Technology, and Demographic Change*. Stanford: Stanford University Press.

JEL Classification Codes: J11, J13, N31, N41.

ABSTRACT

We explain the dramatic early decline in American fertility in terms of the life-cycle transition. Prior to the transition, grown children provided economic security for their parents' old age. As children reached adulthood, the workload of the family farm was gradually shifted to them, giving parents protection and support in the event of sickness or infirmity. After the transition, planned, self-financed retirement became the norm and grown children were freed from parental control. We show that this life-cycle transition was triggered by a multi-faceted public policy initiative aimed at opening new lands west of the Appalachian Mountains to American settlement. An unintended consequence of these policies was a rapid rise in the out-migration of young adults, the collapse of the patriarchal old-age security strategy, and a rapid shift to lifecycle behavior. We test this model using cross-sectional county-level data from 1840 and show that it outperforms both the target-bequest model of Easterlin and the labor market opportunities model of Sundstrom and David. We demonstrate that the lifecycle transition model is also consistent with a variety of patterns in the time trend data that are difficult to explain using the alternative models.

An enduring puzzle, which has occupied the attention of demographers and economic historians for decades, is the early and rapid decline in American fertility. From an extraordinarily high level around 1800, white female fertility plummeted by more than half over the course of the next hundred years [Coale and Zelnik 1963]. Figure 1 presents the long-run picture of American fertility decline as measured by the total fertility rate of white women. The total fertility rate is the standard measure of completed family size.[1] The data for 1800 through 1920 come from Warren Sanderson [1976, 1979]. They suggest that in 1800 the average American woman who survived to the end of her reproductive life would have given birth to 8.02 children! Because some women never marry and others are infertile or develop secondary infertility, eight children per woman is close to the biological maximum for a large, heterogeneous population such as that of the United States in 1800.[2] From this high level, the series shows a continuous and rather steady decline for the next 120 years. The figure also illustrates the dip during the Great Depression of the 1930s and World War II and the rebound in the late 1940s and early 1950s, commonly known as the Baby Boom.

[Figure 1]

In Figure 2 we compare Sanderson's figures with our own index of fertility, the child-woman ratio, for the period antedating the Civil War. The child-women ratio, variously defined, has become the standard used in studies of antebellum fertility patterns. For our purposes we define the child-woman ratio as the number of children aged zero to four per 1000 women aged 15 to 44.[3] This

1. The total fertility rate is calculated as the sum of the age-specific birth rates across the entire reproductive span. This rate specifies how many children each woman would bear if she lived to the end of her reproductive life and experienced the age-specific fertility rates for the year specified throughout her reproductive life. See Alan Bogue [1985].

2. Given what is known about the average age of marriage and the proportion of women ever married, marital fertility rates had to have been very close to the biological maximum to produce total fertility rates as high as these. Alfred Lotka's estimate of the total fertility rate for 1790 was 7.76 children per *mother* [1927]. Lotka went on to calculate that this rate implied an average interval between births for young mothers of 14.27 months [1927: Table VI, p. 167]. Nine months for gestation and three to five months of postpartum non-susceptibility places an *average* birth interval of 14.3 months at the extreme limit of reproductive frequency. Paul David and Warren Sanderson report an estimate for the average interval between a birth and the first subsequent menstruation of 5.17 months based on a sample of well-to-do American women who gave birth between 1892 and 1920 [1986: Table 7 following p. 63]. Post-partum non-susceptibility is likely to last a month or two beyond the resumption of menstruation. The length of the period that elapses before the first post-natal menstruation would depend upon nursing practices and the typical age at which infants are weaned. In the sample studied by David and Sanderson the average lactation period was between six and seven months. We are not prepared to say whether nursing periods were definitely shorter than this in the late-eighteenth century, but surely a three to five-month period of non-susceptibility would be low by any standards.

3. We have calculated the CRS fertility index using the revised U.S. Census data in [Haines 2001a].

measure, which we shall refer to as the CRS Fertility Index, is introduced because, unlike total fertility, it can be easily calculated from published age distributions based on the decennial U.S. censuses. The required detailed age distributions are available for individual states and counties from published census data. We require geographically disaggregated measures of fertility for the empirical analysis described in this chapter. The point of Figure 2 is to demonstrate that the two measures of fertility closely follow the same downward path.[4] Figure 2 suggests that the child-women ratio is a good proxy for the total fertility rate, a point that has been affirmed in more sophisticated tests [Bogue and Palmore 1964, Sundstrom and David 1986: Appendix II].

[Figure 2]

One of the interesting features of the American fertility decline is that it was a rural phenomenon. It is true that fertility was substantially lower in urban than in rural places in 1800 and throughout the following century and also that the urban population increased more rapidly than the rural population over that time. Figure 3 presents the fraction of the population living in cities and towns with populations greater than 2,500 for the first half of the century and Figure 4 presents the trend in our fertility index separately for the urban and the total populations of the country, illustrating the wide rural-urban difference in fertility rates. Yet even by 1860 the fraction of the total population living in towns and cities was still so small that the relative rise of the urban population had only a small impact on the national fertility rate. As Figure 4 clearly shows, the fertility decline in the United States was driven by rural fertility decline.

[Figures 3 and 4]

Although there have been important refinements to the underlying data in recent years, they have not fundamentally altered the overall picture of a sustained decline in white rural fertility beginning around 1800-1815. The basic pattern has long been known and has perplexed demographers for at least 70 years [for example, see Thompson and Whelpton 1933: 263]. There are three questions.

» Why was fertility so high in 1800? The crude birth rate (births per thousand population) around 1800, by both contemporary [Blodget 1806: 58] and modern estimates put the number for the

4. At some census dates interpolations are required to calculate the numerator or denominator of our index since the age categories used for the published data do not always break at 5, 15, and 44. McClelland and Zechhauser introduced the method of interpolation that we have employed [1982: 23-25].

white population in the range of 50 to 55.[5] By any standards and birth rate over 50 per thousand, is enormously high; as high, indeed, as the birth rate in any country in the world today and considerably higher than the birth rates in Western Europe at the outset of the nineteenth century.6

» Why did the decline begin circa 1800-1815? This date is well in advance of any measured decline in infant or childhood mortality and therefore departs from the stylized model of the "demographic transition" in which mortality decline precedes or occurs simultaneously with fertility decline [Haines 2000, 2001a]. Mortality did not begin to fall in the United States until sometime after 1880, at least two generations after the onset of the fertility decline. If anything, mortality rates were increasing in the eighteenth and early-nineteenth centuries.[7]

» Why was there any fertility decline at all before the late-nineteenth century? Throughout the nineteenth century America was primarily an agricultural economy and the continent's European settlers and their descendents enjoyed the continuous availability of new and productive agricultural land. The Malthusian argument for a fertility decline based on population growth bearing down on scarce resources cannot straightforwardly explain the American case.

This paper is an effort to answer all three puzzles. It also represents the continuation and elaboration of our long and always-interesting discussion of these issues with Paul David and his collaborators, most notably Warren Sanderson and William Sundstrom. This dialog had its origins in 1984 when David and Sundstrom circulated a formal cooperative game model that linked fertility decisions of couples to their life-cycle strategy to secure support for their old age. This was one of the first papers from David's highly important "Stanford Project of the History of Fertility Control"

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5. See McClelland and Zeckhauser 1982: Tables C-14, C-15, and C-19, pp. 156 and 158, and Haines 2000: Table 4.3, p. 158 144, and 2001b: Table 8.2, P. 308. Blodget's 1806 estimate of the crude birth rate for the period 1790 to 1803 ranged between 52 and 53 per thousand. See our discussion in Ransom and Sutch (1986a: pp. 16-22).

6. The only place in the world today with a comparably-high reported crude birth rate is sub-Saharan Africa: Mali (49.2), Niger (51.5), and Chad (48.8). Five other crude birth rates above 46 per 1,000 reported by the U.S. Census Bureau in its "International Data Base" as of May 10, 2000 (www.census.gov) were also in Africa (Uganda, Kinshasa [Congo], Angola, Liberia, and Somalia). The highest birth rates in Europe around 1800 were in Lombardy (40-45), Iceland (39.8), and Finland (38-40). See Cipolla (1965: 576), Jónsson and Magnússon (1997: 51), and Gille (1949: 63).

7. On early nineteenth century trends in mortality see J. Potter [1965: 646 and 683], Yasukichi Yasuba [1961: 86-96], Maris Vinovskis [1972], Ed Meeker [1972], McClelland and Zeckhauser [1982 : 54-68], Clayne Pope [1992], and Haines [2000, 2001b].

[David and Sundstrom 1984]. Influenced by this work, Ransom and Sutch presented two papers on the decline in antebellum fertility to the All-UC Group in Economic History Conference in Laguna Beach in May of 1986 [Ransom and Sutch 1986a, 1986c]. A few days later Susan Carter presented two papers connecting the fertility decline with the rise of school attendance at the 1986 Cliometrics Conference in Oxford, Ohio [Carter 1986a, 1986b]. At the same two conferences, Sundstrom and David presented an early version of a paper on farm-family fertility in the Antebellum Era that was subsequently published and has since enjoyed considerable attention [1986, 1988].

In this paper we return to these issues and offer a more general account of the antebellum fertility decline, one that embraces factors described in all three papers. Our story is a public policy story as well. In addition to explaining the otherwise anomalous behavior of the time trend in American antebellum fertility, it contains a message for today's policy-makers. That message is that family matters. Where the services of children are used to secure parents' old age provisioning, fertility will be high – perhaps too high to allow for economic development. Where physical and financial assets – perhaps together with credible governmental pledges – secure parents' old-age provisioning, fertility will be low and parents will invest in their children's education and other nurturing that enhances productivity.

Current State of the Discussion[8]

The Sundstrom-David 1988 article and the 1984 theoretical paper on which it was based were an ingenious effort to explain the early onset of the rural white fertility transition in America. They suggested that the high demand for children in the early years was motivated by parents' desire to provide for their own old-age security. By having a large number of children and by offering these children a portion of the farm family's wealth as a potential inheritance in exchange for their continuing support, parents could ensure for themselves a comfortable and secure flow of goods and services even after their own ability to support themselves was diminished by poor health or old age. More children were better than few for securing old age provisioning for two reasons. With many children, the parents' bargaining power would be enhanced and the threat of disinheritance made more salient. Moreover, the more children who cooperated in the support of their aged parents, the smaller would be the burden on any one of them. That factor, too, enhanced

8. In this chapter we focus on our discussion with Paul David; for a more extensive review of the literature see Lee A. Craig [1993: Chapter 1].

the security of the arrangement. The resulting bequests passed at death and were established out of strategic rather than altruistic considerations.

This model of intergenerational bargaining over old-age support and the distribution of the family wealth at the parent's death also helps Sundstrom and David explain the timing and motivation for an early rural fertility decline. According to their argument, the old-age security motive for having many children would have weakened substantially when opportunities outside of agriculture began to improve some time in the early nineteenth century. The bargaining position of parents would weaken with the growth of alternative employment opportunities outside of the parental farmstead. The importance of inheriting farmland would be diminished. Sundstrom and David focused on the growth of nonagricultural employment as the lever of change in antebellum America. Testing their model using state-level data for 1840, they concluded that nonagricultural labor market opportunities had a large, negative effect on rural white fertility.

An additional contribution of the Sundstrom-David article was to demonstrate that the inclusion of measured nonagricultural labor market opportunities in the statistical analysis eliminated the explanatory power of the most widely-cited alternative explanation for temporal and spatial variations in the fertility of the rural white population – the decreasing availability of cheap farmland with the progress of settlement. This competing hypothesis is associated with Richard Easterlin's proposal that American farmers had a strong target-bequest motive, which persisted throughout the nineteenth century.[9] The farmer's goal, according to this argument, was to leave each son and daughter a farm that was at least as productive as the one the farmer had received with his own inheritance. Despite the general availability of land in nineteenth-century America, Easterlin argued that land became "scarce" in any given agricultural community as its population grew and the number of suitable farm sites in the vicinity declined.

Cross-Section Evidence on the Target-Bequest Model

At the time that the Sundstrom-David [1988] paper appeared, the most widely accepted explanation for the anomalous pattern of American fertility decline focused on the role of change in local land availability. That focus was first inspired by an 1843 observation by George Tucker that fertility was lower in the relatively-densely-populated areas of southern New England, eastern New

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9. Easterlin [1971, 1976a, 1976b] and Easterlin, Alter, and Condran [1978]. Sundstrom and David's assault on the Easterlin hypothesis has relevance to the much larger debate in economics over the relative power of life-cycle versus target-bequest models to explain saving behavior.

York and Pennsylvania, New Jersey, Delaware, and Maryland than in the newly- and still-sparsely-settled regions to the west of the Appalachian Mountains [Tucker 1855]. Map 1 illustrates this geographic pattern by displaying county-level values of our fertility index in 1840 for each of the counties in existence at those times.[10] The map illustrates the strong regional character of fertility variation at that time. In 1840, only southern New England; southeastern New York; northern New Jersey; and the portions of Pennsylvania, Maryland, and Virginia east of the Appalachian Mountains exhibited low fertility, under 800 children per thousand women. Other counties, especially those in the western states, display relatively high fertility. Counties in the Southern States also exhibit a rising east-west fertility gradient, although the *level* of the white fertility index is generally higher in the South than in the North.[11] Detailed study of county-level census data – not shown here -- reveals that the geographic patterns of fertility variation seen in 1840 that are also evident across the entire period from 1800 to 1860. To illustrate this point, Map 2 provides the same information as Map 1, but this time for 1850.[12] The east-west fertility gradient as well as the North-South fertility differential is still evident, though the overall fertility level is lower across the board in 1850. Map 2 (studied in conjunction with Map 1) suggests an expansion of low fertility behavior out of the east and into the west. One way to view the national fertility decline, then, is to see it as the progressive adoption of northeastern low-fertility behaviors progressively westward and southward into the rest of the country.

[Maps 1 and 2]

10. The CRS fertility index is the child (0-4) to women (15-44) ratio described earlier. The quartile ranges plotted on Map 1 are quoted as the number of children per *thousand* women. It should be noted that in 1840 Wisconsin Territory (spelled at that time "Wiskonsin") included what is now eastern Minnesota. The blank areas on the maps in northern Michigan and southern Florida were largely unpopulated in 1840.

11. Maine fits the general pattern since it was sparsely settled when it became a state in 1820 and it attracted migrants throughout the next thirty years. Eastern Louisiana (the Parishes around New Orleans and north along the Mississippi River) was settled territory by 1840 and might be properly regarded as similar in this respect to the seaboard east of the Appalachians.

12. To facilitate comparison between the two maps, the CRS Index is plotted using the 1840 county boundaries for both years.

Maps 1 and 2 use shading based on the same quartile ranges based on the 1840 fertility index to aid comparison. However, fertility had fallen so much between 1840 and 1850 that most of the country had CRS fertility of less than 950 per thousand in 1850. Map 3 redisplays the 1850 data with shading ranges more appropriate for that year. The regional patterns clearly visible in 1840 remain intact ten years later.

[Map 3]

Yasukichi Yasuba was the first to suggest, in 1962, that the availability of easily accessible land might provide an explanation for the robust East-West fertility gradient that drew the comment of so many observers. Yasuba proposed that East-West differences in population density could account for the geographical pattern to fertility. Here is his explanation.

> (A)s time passed, the acquisition of new land in the settled areas became increasingly difficult and costlier and the average distance from the settled to the new areas where land was plentiful became farther. Consequently, fertility in the older communities may have been reduced directly in response to the decreased demand for children or indirectly as a result of the rise in the age at marriage and the fall in the incidence of marriage. [Yasuba 1962: 159].

Richard Easterlin recast this argument in a compelling format that was an ingenious attempt to salvage the Malthusian relationship between resource abundance and fertility from the dilemma posed by the declining American fertility rate. Easterlin and his students suggested that parents had an altruistic motive to preserve and augment the family's wealth – primarily the land and capital required for farming – and to pass those assets on to their children when they died.[13] Young couples, with target bequests for their future children in mind, would anticipate difficulty in providing an inheritance of land for their offspring and would take steps to limit their family size accordingly. Over time fertility would decline because, in any given community, land would become increasingly scarce, more expensive, and more difficult to acquire. In Easterlin's model there is no period of Malthusian stress or economic hardship because parents would foresee the developing problem of land scarcity and take effective birth control measures to protect the living standards of their children.

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13. See Easterlin [1976a and 1976b], Easterlin, George Alter, and Gretchen Condran [1978], Donald Leet [1976, 1977] and Morton Schapiro [1982]. In addition to the contributions of Tucker and Yasuba mentioned in the text, the Easterlin hypothesis had antecedents in the work of Forster, Tucker, and Bridge [1972] and Leet [1975], but none of these authors attributed the relationship between fertility and land scarcity to target-bequest behavior.

Rather than test this hypothesis about the link between declining local-land-availability and the decline in rural fertility by following developments in a given community, Easterlin and his followers viewed the cross-sectional variation in fertility displayed in Map 1 as a synthetic time trend. Regions of high fertility in 1840 were at an early stage of a transition process, while those with low fertility had advanced further along. Thus cross-section analysis of the geographical patterns of fertility could reveal the forces that would act through time to reduce fertility in any given region. Because the 1840 Census was the first to include agricultural variables, and because that date seems to capture the fertility decline in mid-transition when the cross-sectional variation was high, empirical work has focused almost exclusively on state level data for 1840 (and to some extent for 1850).[14]

Scholars have proposed a variety of measures of fertility and of local-land availability. The most important finding within this literature is the robust positive correlation between local-land availability and female fertility, regardless of the way in which either variable is measured. This would appear to give strong support to the local-land-availability model. However, an important result of the Sundstrom-David paper is their finding that when measures of nonagricultural employment opportunities are added to the standard local-land-availability model, land availability exhibits a *negative* rather than the expected positive effect on fertility. This suggests that the anomalous behavior of nineteenth-century American fertility may not have been due to declining local-land availability at all, but rather to some other force positively (and perhaps spuriously) correlated with it.

At the same time, other empirical work was also undermining the credibility of local-land-availability as the proximate cause of the early American fertility decline. In Table 1 we display the results of ten ordinary least-squares regressions that we ran in 1986 using 1840 state-level data [Ransom and Sutch 1986a]. These regressions were designed to explore the robustness of the land-availability/fertility connection when measured in the variety of ways that appear in the literature. We constructed five different proxies for local-land availability and two different indexes of rural fertility. The ten equations result from pairing each of the fertility measures with each of the land-availability measures. All ten equations were estimated using the same data set so that

14. There was a serious cholera epidemic in 1849, which would distort the fertility indexes calculated for some states from the 1850 census [Vinovskis 1978, Rosenberg 1987: Part 2]. Other variables to be introduced below are not available before 1840.

differences in the outcomes are due entirely to differences in the definitions.[15] We take the R^2 values from the regressions as our measure of the success of each linear model – the higher the R^2 the more successful we judge the model.

[Table 1]

What we find is that the more conceptually appropriate the proxy for local land availability, the poorer its performance. This is not what a proponent of the target-bequest hypothesis would have expected and this finding suggests that the correlation between land-scarcity and fertility may be spurious. To reach this conclusion, first compare the results of measuring rural fertility according to the fertility index for the state as a whole versus defining it to apply to the rural population only. Clearly the latter is a more appropriate measure of rural fertility. Nonetheless, each and every one of the five measures of local land availability does a better job of explaining total fertility than it does rural fertility. This is not encouraging for advocates of the target-bequest model. Table 1 supports our suspicion that the correlation between land availability and fertility is spurious.[16]

Next consider the five measures of local land availability. The first, persons per square mile, is the measure that caught the eye of George Tucker in the 1840s and motivated him to propose a negative relationship between land availability and fertility. Yasuba [1962] developed a more refined measure of "land availability" by limiting the numerator to potentially arable cropland, which he defined as cropland in 1949. Schapiro [1982] developed a "potential farmland" measure that was more robust in the face of rural population decline by defining the potential in terms of the first "clear peak" in rural population. Vinovskis [1976] sought to incorporate the productivity of the farm by measuring "land availability" in terms of average farm value. In all three cases, these conceptually superior measures of land availability perform more poorly than the crude index employed by Tucker. The only measure whose performance is superior to that of Tucker's is the one developed by Forster, Tucker, and Bridge, who calculated the "adult-farm ratio," which they defined as the ratio of the adult white population to the number of farms existing at a future date arbitrarily chosen to

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15. The dependent variable of these regressions is the version of the child-women ratio introduced by Yasuba. It employs a different definition and interpolation technique than the CRS index we use below in our analysis, but we employ it here since the Yasuba Index is the variant used by those researchers referred to in the table.

16. One distinct possibility is that density reflects the extent of the urbanization of a population. Since urban fertility was lower than rural fertility throughout the country in 1840, this may produce a strong correlation between density and fertility. Sometime before Yasuba and Easterlin developed the land-scarcity hypothesis, Wendell Bash [1963] used population density as an index of the degree of urbanization in his study of the fertility decline in New York State. The urbanization effect would, of course, be weaker with the rural population data because towns and cities with more than 2,500 people have been excluded.

reflect "full settlement." They experimented with both 1860 and 1880 as the target; the 1860 measure proved to be the superior predictor of rural fertility in 1840 [Forster, Tucker, and Bridge 1972: 19-21 and 41]. Maris Vinovskis was critical of the adult-farm ratio and proposed, we think correctly, that the average value of a farm is a more direct and conceptually superior measure of the cost of assisting one's children in establishing a household of their own [Vinovskis 1976]. In other words, the better the proxy for local-land availability, the poorer is the performance of the measure.

Time-Series Evidence on the Target Bequest Model

In addition to the somewhat technical objections to the local-land availability model, we have at least three *a priori* problems with the Easterlin target-bequest model's time-trend predictions:

» First, acceptance of the land-scarcity argument as an explanation of the fertility decline requires the view that families found it increasingly difficult to provide farms for their children throughout the nineteenth century. In fact, improvements in transportation and communication, the continuing release of the public domain at land auctions, and rising agricultural incomes should have made it easier, at the margin, to purchase a farm. Throughout the nineteenth century, moreover, settled farm communities experienced a continually decreasing cost and rising attractiveness of out-migration. As Dov Friedlander [1969] argued, this should have reduced the necessity of an adjustment in reproductive behavior.[17]

» Second, the land-scarcity model has difficulty explaining why fertility was so high in the late eighteenth century and why the onset of the fertility decline occurred at the time it did. Fertility began to fall at precisely the time American land policy changed, opening up vast expanses of public domain to settlement. Relatively speaking, the threat of land scarcity must have appeared much greater in 1800 than at any time during the period between 1815 and 1840. The land-scarcity model would also predict that the fertility decline should halt shortly after a community had reached its peak population density, yet states like Vermont and Delaware continued to show fertility declines long after their rural population had ceased to grow.

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17. Easterlin addressed this point by suggesting that the American case "raises doubts" about the demographic escape valve of out-migration [Easterlin 1976a: 46]. Perhaps so, but since the escape-valve mechanism is, like the land-scarcity model, founded in the Malthusian tradition, it seems to us that the theoretical inconsistency between Easterlin and Friedlander has not yet been adequately addressed.

» Third, the land-scarcity model does not easily provide an explanation for the case of the Deep South. That region began its fertility decline later than was the case in the North and exhibited a more gradual decline in white fertility despite a settlement history not unlike that of the states of the Old Northwest. Despite this challenge to his model, Easterlin concentrated his attention upon the northern farm areas in his empirical work "because of the more plentiful supply of data for this region, and the fairly homogeneous structure of agricultural organization." However, he suggested the land-scarcity model ought to fit the American South and called for research on the subject [Easterlin 1976b: 46 and 73].[18]

Cross-Section Evidence on the Intergenerational Bargaining Model

In their 1988 paper, Sundstrom and David demonstrated that interstate differences in nonagricultural employment opportunities could account for interstate differences in rural white fertility in 1840.[19] The Sundstrom-David findings based on their ordinary-least-squares regression analysis are summarized in Table 2. Their dependent variable was the child-woman ratio for whites (the ratio of children under 10 to women 16 to 45). Their independent variables included two different measures of the relative attractiveness of non-farm employment: the relative employment share of nonagricultural to agricultural labor in 1840 (RES40) and the relative wage, measured as the ratio of the daily common labor wage to the monthly farm labor wage, both with board (RW50). These wage data are available for 1850, but not 1840. Sundstrom and David point out that the anticipated wage a decade later "might be more appropriate on expectational grounds" [p. 187]. The Sundstrom-David empirical model was formulated to test the David-Sundstrom [1984] model of intergenerational bargaining and strategic bequests. The greater the nonagricultural employment opportunities relative to the total employment in the state and the higher were common laborers'

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18. The Southern case seems not to have been pursued by the other supporters of the target-bequest hypothesis. Don Leet [1975, 1976, and 1977] confined his examination to Ohio and Morton Schapiro specifically excluded the Southern States from his analysis because of their "idiosyncratic economic and social structures." As he put it, "slavery played an important role" in the South [Schapiro 1982: 585-586]. Schapiro did not, however, offer a comment on how or why slavery should affect white fertility rates. Richard Steckel [1977] took up Easterlin's challenge to test his model with Southern data but reported that in his regression analysis the "measure of population pressure [was] statistically insignificant or [had] a sign unfavorable to the population pressure hypothesis" [pp. 15 and 170-176].

19. Their dependent variable was a variant of the child-woman ratio they call the "rural white refined birth ratio," defined for the rural white population as the number of children less than 10 years of age divided by the number of women ages 16 to 44.

wages relative to wages for agricultural labor, the stronger would be children's bargaining power and the weaker would be that of their parents.

To capture cross-state differences in the marital status of the female population, Sundstrom and David include a measure of the relative share of males in the rural white population aged 10 and over (MFR40). Where this ratio was unusually low, marriage opportunities for adult females would be limited and thus the child-woman ratio would be depressed. Finally, to measure the power of the alternative, target-bequest hypothesis, Sundstrom and David included a measure of the density of rural settlement (DSR), defined in the spirit of Schapiro [1982] as the ratio of the state's rural population in 1840 divided by the state's maximum rural population over the period 1790 through 1940. All of the variables were log-transformed.

[Table 2]

Sundstrom-David's OLS coefficients for the country as a whole and for the North and South separately are shown in Table 2. Note that in the presence of the variables measuring the nonagricultural employment opportunities, the scarcity of local-land (DRS40) no longer appeared to reduce fertility. In fact, the opposite was the case. Rural fertility was highest where rural settlement was most dense, though the magnitude of this relationship was not large and the effect was not measured with precision. A second striking finding was that nonagricultural employment opportunities explain rural fertility differentials not only in the North, but also in the South as well as in the regression for the country as a whole. This finding led Sundstrom and David to speculate on the demographic implications of the institution of Southern slavery. "If only Emancipation had occurred in 1789 or before," they write,

> [R]ural white fertility in the South might well have followed a course during the first half of the 19th century which hewed more closely to that taken by the northern section of the country. … [W]e would say that a more precipitate decline in Southern fertility levels would have ensued, not as a consequence of intensified agricultural settlement in the absence of slavery, but rather, as a result of a difference in the path of development both with regard to the growth of commerce and industry, and the penetration of those activities into the economic life of the region's rural population [pp. 192-193].

Sundstrom and David relied on state-level data to test their model. Given the heterogeneity of economic opportunities for young people within states in 1840, this is really too high a level of aggregation. For example, we would expect that the nonagricultural employment opportunities of young adults in upstate New York were quite different from those who lived in or near New York City. The state-level aggregation also meant only 29 observations for their country-wide estimating equation and only 16 and 13 observations, respectively, for their Northern and Southern state equations. Because of the small number of observations their coefficient estimates are, of necessity, imprecise. Recognizing these shortcomings, Sundstrom and David conclude by advocating, "further empirical studies based upon disaggregated data" [p. 193].

In this section we respond to their call by developing a data set based on county-level aggregates and estimating a regression model designed to explain cross-county fertility differences with a specification designed to embrace the spirit of their model and to extend its implications. Table 3 presents summary statistics from our tests of the Sundstrom-David model using county-level data for the 1840s. All of the county-level variables are defined and described in the Appendix in Table 5A-B. Our findings confirm the robustness and predictions of their cross-section estimating model. They are also consistent with important implications of the model that they, themselves, were not able to test with the state-level data available to them.

Table 3 reports the results of seven separate cross-sectional regressions designed to explain cross-county variations in white fertility in 1840. We use as our index of fertility the white child-woman ratio, which we call the CRS index. It is defined as the number of children under five divided by the number of women 15 to 44. Using the number of children 0 to 4 rather the number 0 to 9 is, we believe, a better index of local fertility – one less distorted by the interstate migration of women. The dependent variable in these regressions is the natural logarithm of the CRS index since, as Sundstrom and David pointed out, the relationship between the fertility and its economic and social determinants cannot be strictly linear [1988: 54-55]. Fertility is bounded by a minimum value of zero, yet an inverse linear relationship between fertility and land availability or nonagricultural employment opportunities would predict negative values of fertility when land became sufficiently scarce or when opportunities off the farm became sufficiently attractive.

[Table 3]

Before proceeding with a test of the Sundstrom-David strategic bequest model, we make a final test of the Easterlin target-bequest model to test its predictive powers at the county level using variables that are available to us. For that we need some measure of local-land availability. The Sundstrom-David measure – the ratio of the 1840 rural population to the maximum rural population of the state during the period 1790-1940 – is not practical to calculate on the county level given the many county boundary changes that occurred over this long time span. As an alternative we use the natural logarithm of improved acres of farmland per rural white resident in 1850 (LAND

ABUNDANCE).[20] It is not unlike the measure constructed by Yasuba [1962] and Forester et al. [1972] and has the advantage of being easy to calculate with the data at hand. The target-bequest hypothesis would predict that this variable should appear with a positive coefficient. The more acreage available in the county per capita, the larger would be the number of children parents could safely provide for. Equation zero, listed in the first column of data, is a regression with the logarithm of the CRS Index as the dependent variable and the logarithm of the acreage per capita as the independent variable.[21] It is comparable to the regressions reported in Table 1, but with over one thousand county-level observations rather than 27 state-level observations. Interestingly, the coefficient on LAND ABUNDANCE at the county level turns out to be quantitatively insignificant. Here again an attempt to improve the specification of the target bequest model, in this instance by disaggregating to the county level, makes the fit worse rather than better. The R-squared value is reduced to zero.

Equations 1 through 7 in Table 3 are our attempt to replicate with county-level data the intergenerational bargaining model specified in the spirit of Sundstrom and David. We are able to measure nonagricultural employment opportunities at the county level in a way that is similar to the measure that Sundstrom and David used. As we pointed out, use of county-level data should sharpen the measure of nonagricultural opportunities by reducing the heterogeneity observed across a large and economically-diverse state such as New York. On the other hand, the draw of non-farm jobs might in some cases have extended across county boundaries. We explore this possibility later in the chapter by introducing measures of transportation links among counties. For 1840, we have total county employment by sector. We used these data to construct an index of opportunities outside of agriculture (NON-AG JOBS) by dividing nonagricultural by total employment.[22] Because employment in some counties is *only* in agriculture, nonagricultural

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20. To move the data from 1850 back to 1840, we made several adjustments to reflect county boundary changes between those two dates. To do so we combined counties into "super counties" which represented the smallest contiguous geographical region whose 1840 and 1850 boundaries remained substantially unchanged. Because of the not-infrequent subdivisions of large counties or unorganized regions between 1840 and 1850, most of these super counties were aggregations of contiguous 1850 counties to match the 1840 boundaries. We then calculated the per capita acreage figure for 1850 for each of these super counties and applied that figure to each of the counties in 1840 that coincided with the super county. Our guide to this process was the invaluable *Map Guide* of William Thorndale and William Dollarhide [1987].

21. For the regression experiments the CRS Fertility Index is entered as a child-woman ratio and is not converted to children per thousand women. This keeps the dependent variable scaled to the same order of magnitude as the various independent variables.

22. For each county the census reported the industry of employment in seven categories: mining, agriculture, commerce, manufactures and [hand] trades, navigation of the ocean, navigation of canals, lakes, and

employment ratios in those cases are zero. Since the natural logarithm is not defined for zero, the purely agricultural counties would drop out of the analysis if we followed Sundstrom and David precisely and took a logarithmic transformation. Because fertility behavior in purely agricultural counties is an important part of the overall story, we don't want to exclude them from the analysis. For this reason, we entered this variable as a proportion. The other Sundstrom-David measure of the attractiveness of nonagricultural employment – the relative wage in nonagricultural verses agricultural employment – is not available at the county level and we cannot incorporate it into our analysis.

Sundstrom and David included a measure of the male-female ratio for the rural population 10 years of age and older in the state as another independent variable. They argued for its inclusion by noting that a high ratio of men to women raises the proportion of women at every age who are married and at risk of pregnancy. This would be the case in frontier settlements. We feel that it is at least equally important to put the argument the other way around: where women of marriageable ages outnumber men, the chance of marriage is reduced. This would be the typical case in regions experiencing extensive out-migration of their young-male populations. We calculate the male-female ratio as the number of men 15 to 49 relative to the number of women 15 to 44. We suspect, however, that there is a limit to the extent to which very high male-female ratios could increase fertility, once all or most marriageable women have a spouse, further increases the male-female ratio would have little effect. Since the weighted mean across counties and the median county value of the male-female ratio defined in this way are both close to 1.1 (1.11 and 1.09 respectively), we have introduced the male-female ratio in such a way to have an influence only at values below 1.1.[23] For reasons discussed below, we are concerned about introducing a spurious correlation through the introduction of the male-female ratio, but we retain it here to keep our county-level replication of the intergenerational bargaining model as faithful to Sundstrom and David as possible.

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rivers, and learned professions and engineers. Sundstrom and David used the figures on nonagricultural employment from Easterlin [1960:126-132], which are based on the same 1840 census figures that we use. Easterlin, however, made two adjustments that we have not made. First, he excluded the learned professions and engineers. Second he made estimates for counties that reported no labor force statistics and revised the data for several counties with very low labor force estimates. In our regressions 33 counties without occupational data were simply dropped from the analysis.

23. We define two variables. One is equal to the male-female ratio for the county, if and only if, that ratio is less than 1.1. This we call MEN SCARCE in the table. For all counties with a calculated male-female ratio of 1.1 or greater this first variable is set equal to 1.1. The second variable is a dichotomous dummy variable equal to zero for counties with below median male-female ratios and equal to one for those with a ratio of 1.1 or higher. This variable we label as WOMEN SCARCE.

Our data set includes one observation per county in 1840. However, we excluded some areas that were newly and very thinly settled in 1840.[24] Altogether this left a data set with 1,112 counties. In addition, we had to omit 33 counties because they failed to report data on employment, a key variable in the Sundstrom-David analysis. Thus the regressions were limited to 1079 observations. Of those 984 were strictly rural counties. Because the counties varied greatly in size, we weighted the observations by the number of women 15 to 44 (CRS MOMS). This gives each woman of childbearing age an equal weight in the final result.

Because of the possibility of errors and other discrepancies in the underlying census data, we used the median regression technique rather than ordinary least squares (OLS). Median regression is more robust to the presence of anomalous outliers in the data.[25] This procedure estimates the median of the dependent variable by minimizing the sum of absolute residuals (MAR) rather than estimating the mean of the dependent variable by minimizing the sum of the squared residuals as in ordinary regression. By definition, MAR will produce a lower R^2 measure of fit than would OLS. In the table we present the coefficients as estimated by MAR which we believe are more accurately measured and we present both the "pseudo" R^2 from MAR and the R^2 from an OLS estimate of the same model. In no case did the OLS coefficients deviate in a disturbing way from their MAR counterparts. This gives us confidence that the results are not a spurious product of poor or corrupt data.

Equations 1, 2, and 3 in Table 3 are our effort to re-estimate the Sundstrom-David equations displayed in Table 2. Following Sundstrom and David, we first estimate the equation for the country as a whole (Equation 1) and conduct separate estimates for the North and the South (Equations 2 and 3). We also report Equation 4 which pertains to the country as a whole but includes a dichotomous variable that takes the value of "1" for counties in Southern states. Taken as a whole, the results of our Equations 1 through 4 are testimony to the robustness of the Sundstrom-David findings. The overall goodness-of-fit measures reported in the bottom row seem excellent for cross-section regressions with hundreds of observations. The variable standing in for the intergenerational bequest hypothesis, NON-AG JOBS, has the appropriate negative sign. The natural logarithm of MEN SCARCE enters with a positive coefficient, as Sundstrom and David would

24. Excluded were the territories of Florida, Wisconsin, and Iowa (regions that were not states in that year). In addition we excluded most of northern Michigan, northern Illinois and Indiana, and one adjoining county in Ohio (Van Wert) and portions of southwest and far western Arkansas.

25. The regressions were performed with the software package Stata 7.0. In Stata median regressions are run with the command "qreg."

predict based on the argument that low male-female ratios would put fewer women at risk of pregnancy. Also of significance is the fact that our measure of land availability, the natural logarithm of LAND ABUNDANCE, displays a negative sign, just as it did in Sundstrom and David's regression. This is the opposite of the positive sign predicted by the target-bequest model.

One difference between our findings and Sundstrom-David's is a much larger negative response of rural fertility to nonagricultural employment opportunities in the North than in the South. This North-South difference shows up in another way in Equation 4. There the coefficient on the dichotomous variable for counties in Southern states, SOUTH, is large and positive suggesting that the relative paucity of nonagricultural opportunities employment opportunities, ceteris paribus, is not enough to account for the higher level of rural white fertility in the South. North-South labor market conditions leave a substantial share of North-South fertility differences unexplained. We return to this point later in the chapter.

Our county-level data provide us with opportunities to test several logical extensions of the Sundstrom-David model that they, themselves, could not test with state-level data. One intriguing extension has to do with the implications of "internal improvements," that is, the building of canals and railroads that reduced the cost of the movement of goods and people among regions. Presumably the new facilities opened up nonagricultural employment opportunities. There would be both a direct effect as workers were hired onto railroad and canal construction projects and an indirect effect from improved information and reduced travel costs to employment opportunities in other counties. We expect that variables indicating access to transportation would indicate counties served by the transportation network and would therefore indicate the impact of those internal improvements on rural fertility. In Equation 5 we include all of the independent variables included in earlier equations together with two dichotomous variables, one indicating the presence of a railroad (RAIL) and the other indicating access to either the seacoast or to an inland waterway (WATER). Because many coastal areas did not have seaports and many rivers and lakes were not navigable year around, we expect that the average impact of water access to be smaller than that of railroads. Both the railroad and waterway variables were measured in 1850, rather than 1840 to crudely capture both the impact of railroad construction and the anticipation of railroad and canal services on the fertility decisions of couples in the period 1836 to 1840.[26] Map 4 shows those counties that

26. These variables were constructed and first used by Craig, Palmquist, and Weiss [1998] and were included in the data set assembled by Haines [2001a].

were served by rail and/or water transportation in 1850. Both variables have a powerful impact and work in the expected direction of reducing fertility. Railroads display a more powerful impact that the water variable.

[MAP 4]

Finally, our county-level data allows us to explore the generalizability of the Sundstrom-David hypothesis for urban as well as rural regions. Sundstrom and David estimated their state-level regressions using the rural population of each state. Because we did not have the age distributions for each and every town with a population of 2,500 or more, we restricted our Equations 0 through 5 to counties that had no towns of that size or larger. In Equation 6 we re-estimate Equation 5 by expanding the universe to all counties. It is interesting that the predictive power of the model is actually improved when the urban counties are added. It is improved again by adding a categorical variable to indicate that the county has a town (TOWN in equation 7). That dichotomous variable has an estimated coefficient that is both large and negative. It would seem that the appearance of nonagricultural employment opportunities had an even more geographically-widespread impact on fertility than Sundstrom and David had proposed.

Time Series Evidence on the Intergenerational Bargaining Model

While Sundstrom and David confine their empirical analysis to a cross-section of states in 1840, their objective is to shed light on the change in fertility across time. We have three reservations about the applicability of their intergenerational bargaining model to explain the decline of fertility in the United States during the nineteenth century.

» First, the fertility decline began as early as 1800 and although the change was modest between 1800 and 1810, it was well underway by 1820 (See Figure 2). Yet the rise of manufactures is traditionally dated several decades later, not beginning in earnest until 1832. Most historians of the period suggest there was a severe contraction of manufacturing and other nonagricultural employment opportunities following the end of war in 1815 and that the recovery from the post-war setback was slow [Engerman and Sokoloff 2000]. This account is consistent with Thomas Weiss's [1992] estimates of the growth of nonagricultural employment as a share of the total between 1800 and 1860. In Figure 5 we plot the national trend in fertility against the trend in nonagricultural employment. Even in southern New

England, which by all accounts was the locus of manufacturing and commercial development in the early decades of the century, it is difficult to relate the decline in rural fertility to the expansion of nonagricultural opportunities for young adults. This pattern is clear in Figure 6. The failure of the county-level data on non-farm employment to fully explain higher fertility in the south, also suggests that a richer model is required to explain both the cross-section pattern in 1840 and the decline in fertility between 1800 and 1860.

[Figures 5 and 6]

» Second, a powerful explanatory variable in the Sundstrom-David regression analysis was the adult male-female ratio. Sundstrom and David justified their inclusion of this variable as a measure of the marital status of women. In our county-level replications we used a refined version of this variable, MEN SCARCE that ought to make the variable an even better measure of women's marital status. Despite these improvements, we are concerned about this variable's interpretation. We know that inter-county migrants tended to be young adult males and there is a substantial correlation between the male-female ratio in 1840 and the rate of in-migration between 1830 and 1840. Counties with a male-female ratio substantially below 1.1 were counties that had experienced out-migration. If out-migration itself exerted an independent, negative influence on fertility, that effect would be confounded with that of marriage-rates. For reasons described below, we think that out-migration should have a negative impact on fertility. To test for this possibility we require an independent measure of out-migration.

» Finally, the Sundstrom-David model is a static one in which the impact of nonagricultural employment opportunities is potentially reversible. While Sundstrom and David discussed their model in terms of the growth in opportunities off the farm, the logic of the model also predicted that a setback that reduced nonfarm opportunities should lead to an increase in fertility. We find this implausible. We suspect that the shift in rural "mentality" was irreversible and cannot be captured with a static model. In other words, the historical process was path dependent.

Our point can be demonstrated by comparing the cross-sectional relationship between fertility and employment opportunities with the time series evidence. In Figure 7 we plot our measure of fertility (CRS Fertility Index) on the vertical axis against the proportion of the labor force in non-farm occupations (NON_AG JOBS) on the horizontal axis. There is a point on the scatter diagram for every rural county in 1840. On the same graph we have traced out the time trends of these two, paired variables for the United States and southern New England (Massachusetts, Rhode Island, and Connecticut) separately.[27] The black line traces the U.S. data as it moves down and to the right from 1800 to 1860. The blue line traces the path downward followed by the three New England States. In 1840 most rural counties with high levels of nonagricultural occupations experienced lower fertility than would be predicted using US or New England time series data. Consider a young couple that left their parents in southern New England and moved to the frontier. They would face *fewer* nonagricultural opportunities in their new home than they would have had they stayed back. While fertility on the frontier was higher than in New England, it was not as high as we would predict from the static model and the time series data. That suggests that the generation who moved to the frontier did not replicate the fertility patterns of their parents' generation when they faced roughly comparable non-farm opportunities. Instead, they reduced their own fertility below that of their parents.

We address these concerns about the intergenerational bargaining model by offering three contributions.

» First, we provide an historical framework that ties the development of nonagricultural opportunities to the same set of forces that explain the fertility decline. In our dynamic model we connect fertility decline, the rise of manufacturing, and the forces that led to the rise of manufacturing to a public policy initiative – the opening of western lands. We argue that the subsequent westward migration triggered *both* the fertility decline and the rise of manufacturing. Our historical model not only accounts for inter-county differences in fertility at some point in time, but also allows us to explain why the fertility transition took place when it did – something that the intergenerational bargaining model cannot. Moreover, it allows us to explain why fertility continued to decline even after the rural population ceased growing – something that the target bequest hypothesis cannot.

» Second, we further develop our 1840 county-level data by linking it to values in 1830. The 1830-40 linkages allow us to measure the magnitude of out-migration and to take account of its impact on fertility.

» Third, we bring slavery into the story of white fertility change.

27. The time series data on the labor force come from Weiss [1992: 37 and 51].

The Life-Cycle Model of the Fertility Transition

Our story begins in much the same way as that of Sundstrom and David's, with the eighteenth-century American family-owned, family-operated, self-sufficient farm economy. The fertility of the population inhabiting those farms was extremely high, close to a biological maximum. The high level of fertility and the large families it produced were desirable to parents for at least three reasons.

» First, grown children provided economic security for their parents' old age. As the children grew up, the workload of the family farm could be gradually shifted from the older to the younger generation, and parents could rely upon their children to care for them in the case of sickness or infirmity. Thus children were economic assets in this family-based system. At a time when markets for financial and liquid physical assets either did not exist or were unreliable, inter-temporal reallocations of income were accomplished by relying upon reciprocity and implicit contracting with family members.

» Second, land abundance created opportunities for economies of scale in farming. Hired, non-family labor was scarce and expensive. Outside of the Slave South, the number of family workers limited the effective size of a farm [Wright 1978: 44-55]. For this reason, children were assets [Craig 1993: 74-75]. Large families permitted an expansion of the scale of the farm and perhaps led to an increase in per capita output.

» Third, a large family with many sons vying for the inheritance was easier to control. The glue that held this system together was patriarchy. A large family was like money in the bank – provided the children remained nearby and could be relied upon or coerced to live up to their family responsibilities. In an environment where land was abundant, it was possible for parents to acquire and improve sufficient land to promise that each son might eventually inherit a farm of his own. The multi-geniture inheritance system was the father's club. Children who abrogated their responsibilities to the family could be disowned and deprived of the inheritance of land necessary to maintain their economic well-being and their social position within the community.

Thus, self-sufficient farming and large patriarchal families were mutually reinforcing institutions. Self-sufficiency meant an absence of well-developed markets that, in turn, required reliance upon family-based mechanisms of reciprocity to provide farm labor and old-age security. Large families supplied the needed labor during the seasonal peaks of agricultural work but they also offered a surplus of labor in the off-season. This energy was employed in the home manufacturing of textiles, tools, and the like. The low opportunity cost of off-peak labor, in turn, inhibited the rise of urban manufacturing and retarded the development of markets [Clark 1979 and Hymer and Resnick 1969]. The absence of an urban alternative to agriculture assured that the primary emphasis of parents would be to raise their children to continue the tradition of family farming. With a tradition of self-sufficient farming there was little demand for education beyond the rudiments of literacy, and that primarily for religious reasons. This lack of more advanced schooling in the population at large inhibited entrepreneurship, long-distance commerce, and the spread of new technologies.

Given the self-reinforcing nature of the self-sufficient farming – high fertility nexus, it might seem that a regime of high fertility and self-sufficient family farming should have continued in America far into the nineteenth century. After all, the entire century was characterized by the continuous availability and gradual exploitation of large tracts of under-populated land. Many eighteenth-century observers predicted just that. Thomas Jefferson, for example, foresaw an agrarian democracy populated by independent yeoman. With equal foresight he predicted a continuing high rate of natural increase.[28] In a letter dated July 1787, he wrote:

> A century's experience has shewn that we double our numbers every twenty or twenty-five years. No circumstance can be foreseen at this moment which will lessen our rate of multiplication for centuries to come [Jefferson 1787].

As we have seen, Jefferson was wrong. At about the beginning of the nineteenth century, a long-sustained decline in fertility began. Fertility fell from the biological maximum of about eight children per woman to less than four children in about two generations This dramatic demographic development coincided with an equally dramatic transition to commercial farming, the development of cities, and the appearance of banks, schools, manufacturing, and a transportation infrastructure.

28. Benjamin Franklin and Adam Smith also explained the high American birth rate by the abundance of land and on that basis predicted the continuation of high birth rates for many generations [Franklin 1961, Smith 1776: 70, 392]. Had they foreseen the American acquisition of the trans-Mississippi territory or the coming transportation revolution, it would have only strengthened their confidence in the argument.

What we see in the Early National Period of American history is a population fundamentally and irreversibly altering its approach to life. Young adults freed themselves from patriarchal control and began to choose their own marriage partners and time their marriages to suit themselves [Smith 1973, Folbre 1985]. Children were sent to school and less work was expected of them on the farm [Fishlow 1966, Lindert 1978, and Kaestle and Vinovskis 1980]. Prohibitions against the distribution of birth control information were relaxed [Reed 1978, Folbre 1983]. Inheritance patterns changed toward more equality and less sexism [Morris 1927, Alston and Schapiro 1984]. Savings banks arose to collect the assets of savers, saving rates rose over the course of the nineteenth century until they stood at over 25 percent by the century's end [Ransom and Sutch 1995, 2001]. Planned, self-financed retirement came to be a common phenomenon [Ransom and Sutch 1986b; Ransom, Sutch and Williamson 1993; Carter and Sutch 1996]. Geographical and social mobility increased [McClelland and Zeckhauser 1982, Wells 1982]. The dramatic decline in fertility coincided with a shift from family to individual attitudes and values.[29]

Ransom and Sutch [1986] and Sutch [1991] suggest that the decline in fertility, the appearance of individualism, and the revolution in the American family values were a response to a public policy initiative that inadvertently led to a failure of the family-based income-transfer mechanism. That public policy initiative was the opening of new lands west of the Appalachian Mountains.

Trans-Appalachian settlement had long been a goal of the American revolutionaries and was viewed as essential to securing American claims to western lands against the counter claims of the Indian Confederacy (established by the Fort Stanwix agreement with the British in 1768), the Spanish (who at the time held both the Louisiana Territory and the Floridas), and the Canadians (who were in occupation of some lands south of the Great Lakes). Settlement had been held back first by the ineffectiveness of the land acts passed during the period of the Confederacy and then by the land policies of Alexander Hamilton implemented by the Federalists. It was the triumph of Jefferson which set in process a sequence of events that eventually triggered the western migration: the Land Ordinance of 1787 (based on Jefferson's plan), the suppression of Indian resistance at Fallen Timbers (1794) and the Treaty of Fort Greenville (1795), the Louisiana Purchase (1803), the treaty with the Sauks and the Foxes (1804), military incursions against hostile Indian communities

29. Maris Vinovskis (1981: Chapter 8) and Robert Wells (1982) both discuss the connection between the changes in values and the fertility decline. A term sometimes used to describe this shift in values is "modernization." For general treatments also see Carl Degler [1980] and Bellah, Madsen, Sullivan, Swidler, and Tipton [1985].

during the War of 1812 (the defeat and death of Tecumseh, 1813, and the Creek War, 1813-14), and the implementation of land acts which provided for the sale of land in family-farm-sized lots (1817 and 1820).[30] The construction of the Erie Canal (begun in 1816, completed in 1823) added considerable impetus to the westward movement of the population.

> Each of these developments provided additional impetus to westward migration into the lands of western New York, western Pennsylvania, and the Ohio Valley. Although halted temporarily by the 1812-1815 War with England, the migration quickly resumed once peace was restored and was greatly stimulated by the fact that many who fought had been paid in part with script redeemable for western land. This bounty script was transferable, so those who did not wish to move could sell their rights to others [Oberly 1990].

While the aggregate data is far from perfect, estimates of interregional migration based on calculations by Peter McClelland and Richard Zeckhauser [1982] suggest that, overall, five to six percent of the population departed the region between 1800 and 1810 and another seven to eight percent left in the second decade of the century.[31] Since this migration was highly selective of those in the 15-to-34-year age group, the clear implication is that many young adults left their parents behind when they left New England.[32]

The massive impending departure of this young cohort provoked considerable tension and anxiety within their parents' families. The increasing incidence and constant threat of "child default" put such stress on the traditional familial system that it initiated a search for a more reliable strategy

30. For a detailed discussion of Jefferson's land policy see Bernard Sheehan [1973] and drew McCoy [1980].

31. There is no comparable data for the colonial period, though what evidence we have suggests a much lower rate of geographical mobility. A contrary view has been offered by Georgia Villaflor and Kenneth Sokoloff based on a study of the place of birth of men who enlisted in the Colonial militia during the Revolutionary War. In the words of the authors, they discovered a "high level of mobility" [1982: 560]. If this finding could be generalized to the entire rural population of colonial America, it would cast doubt on our suggestion that child default was not a common problem in the eighteenth century. However, the persistence and migration rates reported in Villaflor and Sokoloff's tabular presentations lead us to the exact opposite of their conclusion. Over 82 percent of the militiamen who were born in New England or New York enlisted in their state of birth and only one-half of one percent were residing in a colony outside of the region [calculated from data presented in Villaflor and Sokoloff 1982: Tables 1 and 2: pp. 541-542, also see p. 549]. Residential persistence rates were somewhat lower in the slave states as would be expected given their laws of primogeniture and the slave-based alternative to the family old-age security system. It is also relevant to note that the sample of militiamen examined by Villaflor and Sokoloff seriously under represents farmers. Only 37 percent listed themselves as such [Table 8, p. 553]. We can confidently assume that eighteenth century farmers were less mobile than the artisans, seaman, and laborers who made up the majority of the Revolutionary Militia. Our contradictory interpretation of Villaflor and Sokoloff is supported by Daniel Scott Smith [1983].

32. A good discussion of the out-migration from New England and the seaboard states during this period can be found in Malcolm Rohrbough [1978]. In particular see pp. 81-87 and 157-161. Stilwell [1948] provides a fascinating and detailed portrayal of the migration from Vermont.

of securing old age.[33] The new strategy that emerged was based on saving. Henceforth, parents would attempt to save from current income during the peak earning years of their lives. They would invest these savings by accumulating assets (bank accounts, insurance policies, and stock shares, as well as farms, houses, and furnishings) and then, late in life, as their productivity declined, they would draw upon those assets for support. Grown children would no longer be needed or expected to support their aging parents.

If the parents happened to live to an old age, they might in this way exhaust the entire stock of wealth they had accumulated. In that case, there would be no inheritance left for the children. However, in the new scheme of things, this was not a crippling blow. Parents provided for their children, not an inheritance, but by preparing them for independence. Growing children were relieved from much of the on-farm labor extracted in the old system thus freeing their time for schooling and skill-acquisition. The parents gave up other income from unpaid child labor and "invested" it in their education. Education equipped the next generation for the richer set of opportunities that was beginning to appear in the towns and cities. The new strategy required a new ethic: avoiding the "shame of being a burden to one's children." The old ethic of avoiding the "shame of squandering the family estate" gave way. In the process, the modernization of values was accelerated.

Because large families were no longer needed to secure old age or to labor on the family farm and because large families impeded the ability of the parents to save, fertility fell. Because families were smaller, the rate of population growth was reduced and the need for extensive land clearing and farm building was correspondingly diminished. This freed resources to be used in the creation of capital for manufacturing. With small families, less home production was possible and the demand for manufactures increased. Because parents were saving and depositing money in banks, a pool of loanable funds was created from which manufacturing development could be financed. The transition to a manufacturing-based economy was propelled and accelerated as new institutions, asset markets, common schools, savings banks, life insurance companies, and factories took hold.

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33. The term "child default" is used by Jeffrey Williamson to suggest that children were previously viewed as a type of "asset" by their parents [1985]. Because the departing young rarely, almost never, returned and because remittances of money to family members who remained behind were also rare, these departures of the young were tantamount to a default on the parents' investment in their children. "If children were viewed as assets by their parents, and if the returns to those assets dropped as children fled …," Williamson asks, "wouldn't parents have had fewer children, seeking alternative ways to accumulate for old age?" [1985].

The post-transition household had a demand for fewer children. Three reasons parallel, but reverse, those we suggested explained the high fertility of the Colonial era:

» First, parents could no longer rely upon their children during old age; they might move away. The promise of an inheritance of land was, in any event, becoming a less important and a less-credible reward. The household's accumulated assets became its new source of security. Once parents were no longer obligated by family conventions and expectations to pass the family farm intact to their heirs, even land could serve as a life-cycle asset. In this context a large family with its consequent consumption requirements actually became a threat to old-age security.

» Second, parents could no longer rely upon their grown children to provide faithful labor on the family farm. At one time, parents had used the promise of an inheritance as an incentive to hard work and obedience. The loss of this bargaining chip undermined patriarchal authority. Contributing to the reduced value of child labor on the farm was a reduction in their relative productivity. New crops, the rise of animal husbandry, and agricultural developments such as the introduction of crop rotations evened out the farm's seasonal labor requirements. At about the same time, the rise of urban manufacturing provided commercial substitutes for home manufactures.

» Third, the spirit of individualism and independence favored quality rather than quantity when it came to establishing posterity of descendants. The new ethic placed the children in school rather than in the field.

An Empirical Model of Life-Cycle Fertility

Our argument postulates a diffusion of "modern" values governing intergenerational responsibilities and behavior with respect to saving, labor force participation, and fertility. Further we have suggested that it was a policy decision to open the trans-Appalachian west to settlement that triggered the revolution in family values. At the empirical level, we follow the lead of other researchers by presuming that this transition was at a different stage of completion at different geographical locations in 1840.

“Family values” are not tangible items subject to measurement or enumeration. The challenge at this point is to find indicators or “proxy variables” that would signal the appearance of modern views and that can plausibly be associated with the life-cycle transition in the cross section data. Models that rely upon proxy variables begin with an inherent disadvantage. Any empirical test that can be designed will necessarily be a simultaneous test of two hypotheses: in our case, the hypothesis about the fertility decline *and* the hypothesis that the proxies chosen are adequate measures of the extent to which life-cycle behavior has been adopted by the child-bearing population. If the joint hypothesis fails the test designed, it is impossible to know whether the outcome was caused by the failure of the primary hypothesis, the secondary hypothesis introduced to quantify the first, or both. On the other hand, if its proponents deem the joint hypothesis an empirical success, it may still fail to convince a skeptic who finds the proxy inappropriate. In a typical case, it is not hard to hypothesize an alternative mechanism capable of explaining the correlation displayed between the dependent variable and a given proxy. Once such a counter-hypothesis has been introduced, it may not be easy to choose between the two rival explanations on the basis of the already-examined data.

These difficulties are unavoidable. We attempt to deal with them here by proposing several distinct proxy variables for life-cycle behavior and testing each separately. We hope thereby to demonstrate the consistent superiority of the life-cycle fertility model and to take some comfort in that consistency. We also hope that it will prove more difficult to devise a counter-hypothesis capable of simultaneously rationalizing our success with each of the variables. The proxies we are proposing tare designed to measure:

» the rate of out-migration of the 1830 population,

» the presence of nonagricultural employment opportunities, and

» the educational commitment of the adult population.

Since none of these variables may be self-evident indicators of the county's stage in its life-cycle transition, we shall discuss each in turn, sketching out the secondary hypothesis that, in our view, links it to life-cycle modes of behavior.

Out-Migration and Child Default

We have suggested that rising out-migration may have caused fertility to decline, since the departure of young adults left parents less secure about their support in old age. The evident risk of child default would have encouraged others in the community to attempt fertility control and to adopt life-cycle strategies of wealth accumulation. An obvious candidate for a quantitative index of this effect would be a measure of the volume of out-migration, particularly the out-migration of teenagers and young adults. It is not clear, however, how such an index should be used in a cross-section analysis. Child default, we suspect, was more of a catalyst to the life-cycle transition than an ingredient. In that case, the magnitude of the rate of out-migration may not be particularly relevant. Perhaps only the direction of migration should be measured. Moreover, the hypothesis applies directly only to the regions experiencing out-migration. Would married women living in states experiencing an in-migration be oblivious to the threat of child default, or would the newcomers import life-cycle values and strategies from their home states?[34]

Even if these questions are resolved, there remains the problem of measurement. There is no comprehensive data on interstate migration. Investigators have been forced to infer the migration flows between states using a technique known as the "census survival method," for which detailed age breakdowns of the population at two census dates are required. If the number of people of a given age residing in a state at the second census exceeds the number that can be expected to have survived from that age cohort as measured at the first of the two censuses, it is assumed that the increase was produced by in-migration. If fewer people remain in the cohort than can be expected after taking account of normal mortality, it is presumed that those missing have left the state.[35]

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34. We suspect that the new arrivals who came to take up land in the Western states would be likely to exhibit life cycle saving and fertility behavior. After all, they would be well aware of the possibility (even likelihood) of child default and of the potent lure of newly-open lands. Thus, in the two decades following their migration, we should expect to observe relatively low fertility rates in these regions. In other words, fertility should be lower in the west in 1850 and 1860 than it was in 1840. This is, in fact, what we observe. See the county-level maps of the CRS Fertility Index for 1840 and 1850 [Maps 1 and 2].

35. The census survival method measures *net* migration, the balance of inflows and outflows. This variable may understate the impact of child default for counties in states such as New York and Massachusetts that experienced considerable immigration from abroad during the 1830s. While the use of the census survival method requires estimates of mortality by age, sex, and region, which are not available for 1830 and 1840, a plausible assumption about mortality might be substituted for evidence. McClelland and Zeckhauser used the census survival technique to produce estimates of net migration between 1800 and 1860 for several broad regions: New England, the Mid-Atlantic states, the Old South, the New South, and the Old Northwest [1982: Map 1, p. xiv]. In the absence of reliable data, they assume a uniform death

Despite the conceptual and methodological difficulties of designing an appropriate test of the link between out-migration and fertility, we have undertaken a crude experiment. As a rough index of the magnitude of net migration we have calculated the ratio of the rural white population ten and over in 1840 to the rural white population of all ages in 1830. Since the children below ten years of age are excluded from the 1840 population for the purposes of this calculation, this growth ratio is unaffected by county differences in fertility. In a hypothetical case where the mortality rate applicable to the 1830 population can be assumed to have been constant across counties, irregardless of the age and gender distribution of the population, then the growth ratio will order counties by the magnitude of the net migration flows.[36] A high value suggests that the county experienced a net in-migration and a low value suggests an out-migration. The geographical pattern of this measure is displayed in Map 5.

[Map 5]

Because our theory suggests that only out-migration generates the child default that would catalyzes fertility reduction, we parse our growth index into three separate independent variables that jointly measure the migration rate. The first variable, "Ln(DECLINE)", is the natural logarithm of the growth ratio, top-coded at 1. It measures the rate of decline of populations that shrank between 1830 and 1840. The second, GROW, signals in-migration. It is a dichotomous variable that takes the value of 1 (and 0 otherwise) for counties where our growth ratio is greater than one. The third, FRONTIER, is defined equal to 1 (and 0 otherwise) for 1840 counties that reported no white population at all in 1830. The logic here is that we might expect fertility to be higher in frontier regions because of the high value of child labor in self-sufficient frontier economies.

As might be anticipated from the earlier discussion, the southern states have a higher fertility ratio than the northern states even after the relative magnitude of the out-migration is taken into

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rate, constant across all regions. For a more detailed discussion of the possibilities and limitations of the Census Survival Method see Carter and Sutch [1996].

36. For the U.S. white population as a whole, the national ratio according to the Census is 0.92, reflecting the decline due to mortality and the increase due to net international migration. The average of the ratio across counties retained in our sample, weighted by the number of women 15 to 44 years of age is 1.04. This value indicates that the included region experienced a level of net in-migration that slightly offset mortality experienced by the 1830 population over the decade of the 1830s.

consideration. We take account of this by including the variable, SOUTH, that takes on the value of 1 for the slave states and the value 0 for the northern states.[37]

We estimate of the impacts of the three joint measures of migration on rural white fertility in a cross-section of 984 rural counties using the weighted median regression technique.[38] The weights are equal to the number of white women 15 to 44 years of age, CRS MOMS. The dependent variable is the natural logarithm of the CRS Fertility Index for whites. The result is shown in Column 1 of Table 4. The regression experiment is quite successful. Out-migration is positively associated with fertility decline – the greater the out-migration during the decade of the 1830s, the lower is fertility in 1840. The experience of *in*-migration into settled counties is associated with a child-woman ratio 11.7 percent higher than that for the sample as a whole. The weighted median growth ratio for counties experiencing out-migration was 0.82. In the neighborhood of that value, a one-percent change in the out-migration rate is associated with a decline in fertility of about four children per 1,000 women. Contrary to our expectations, frontier conditions appear to have no additional measurable effect on fertility when compared with other growing regions. We find a strong North-South difference in rural white fertility that cannot be explained by regional differences in inter-county migration rates.

Next, we expand the universe of counties included to all counties, including those with towns and cities. At the same time, we add a categorical variable to indicate the presence of one or more settlements of 2,500 or more (TOWNS) and a measure of the proportion of the total county population living in urban areas (URBAN). We report our findings in Equation 2 of Table 4. This generalization of the Life-Cycle Transition model to the entire population does not reduce the explanatory power of the out-migration variables although it does reduce the magnitude of the coefficient on the logarithm of the growth ratio. Our measures of urban settlement, TOWNS and URBAN, have the expected negative effect on fertility, and we still observe higher levels of fertility among whites living in Southern states. The explanatory power of the equation as a whole is improved by the inclusion of urban areas. We draw this conclusion after observing a substantial increase in the Pseudo R^2 from the MAR and from the R^2 from the OLS in moving from Equation 1 to Equation 2.

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37. This is the same variable SOUTH that was introduced in Table 3. The Southern states in our analysis are states where slavery was legal in 1840: Maryland, Virginia, Delaware, North Carolina, South Carolina, Georgia, Mississippi, Alabama, Louisiana, Arkansas, Tennessee, Kentucky, and Missouri.

38. These are the same counties included in equations 1 through 5 of Table 3.

In Equation 3 we add the two joint variables that measure the adult Male-Female ratio, MEN SCARCE and WOMEN SCARCE, to the regression in order to examine the independent effect of differential marriage opportunities on inter-county fertility differentials in the presence of our growth variables. Recall that we suspected that Sundstrom and David's male-female ratio was in part picking up some of the effects of out-migration and child default on fertility. Counties that had experienced high rates of in-migration in the previous decade tended to have high male-female ratios and vice versa. In those counties where men were scarce, the natural logarithm of the male-female ratio is positively associated with fertility. That is, the more men per women, the higher would be nuptuality and thus the higher is fertility. The coefficient on WOMEN SCARCE is of inconsequential size. Significantly, the overall improvement as measured by the goodness of fit tests in the bottom row is not great and the coefficients of the growth variables remain relatively undisturbed. This supports our conjecture that the mail-female ratio is an alternative proxy for out-migration.[39] We conclude that our first candidate as a proxy for life-cycle attitudes does very well. The goodness of fit tests for Equation 3 indicates a fit approximately as good as that achieved by the augmented Sundstrom-David model displayed in Equations 6 and 7 of Table 3.

The Nonagricultural Labor Market and Child Default

The expansion of nonagricultural occupations as manufacturing and commerce developed in the years after 1815 was a major threat to the stability of the traditional farm-family economy. Young men and, increasingly young women, were tempted by the opportunities promised by such employment to leave their parents' farms. So we might suppose that a rough indicator of the threat of child default and hence of the degree to which families were beginning to adopt life-cycle attitudes would be the relative size of the nonagricultural sector in the region. This is one of the areas where Sundstrom and David's Intergenerational Bargaining Model and our Life-Cycle Transition Model yield the same prediction.[40] Sundstrom and David's justification for including the relative employment share in a cross-state model of fertility was the same as ours: "This variable is

39. When we rerun equation 3 without the three growth ratio variables, the pseudo R^2 is substantially below that of equation 2, suggesting that the growth ratio is a better proxy for the impact of child default than the male-female ratio.

40. Maris Vinovskis also introduced this variable in his work, which he calculated for each state directly from the published census returns [1981: Table 5.1, p. 82]. Vinovskis' interest in this variable was to indicate the fraction of the population of each region that was not a farm operator. The land-scarcity variables employed in an analysis of fertility patterns would presumably not be relevant to nonagricultural households, so Vinovskis' variable was intended as an indicator of the anticipated strength of the land-availability effect.

designed to take account of the fact that ... the development of more ubiquitous employment openings in construction, trade and manufacturing industries would influence perceptions of the potential attraction such outside opportunities would exert upon the farm family's young" [Sundstrom and David 1988: 56].

As before we measure non-farm employment options as the nonagricultural share of total employment (NON-AG JOBS). We also include the two dichotomous variables indicating access to a rail head (RAIL) or to a waterway (WATER). Equation 4 in Table 4 displays the success of these Life-Cycle Transition indicators in explaining rural fertility differentials. All three measures of nonfarm employment options for young adults perform as predicted by the model. That is, all three are associated with lower levels of fertility. Equation 4 can be thought of as a Sundstrom-David equation stripped of the male-female ratio variables that we now believe were, in part, indicating child-default. We note for the record that this equation, which accounts for differences in nonfarm opportunities, cannot explain the higher white rural fertility in Southern as compared with Northern counties.

The Rise of Education and the Life-Cycle Transition

Once families found alternatives to patriarchal dominance as a means of providing old-age security, the Life-Cycle Model predicts that parents would no longer feel compelled to postpone until old age or death their bequests to their children. Once the Life-Cycle Transition was underway, parents would transfer resources to their children at much earlier points in their lives. In many cases this meant that parents helped children establish themselves on a farm or in some other occupation when the children were still in their early twenties. Such help might take the form of an outright gift or, more typically, parents would offer their children a loan on favorable terms.

Perhaps the most far-reaching change in the pattern of inter-generational transfers produced by the Life-Cycle Transition had to do with the choice between child labor and schooling. In the traditional farm family, children were expected to work year-round on their parents' farms. The historical record is unclear about the age when children were put to work and what sorts of tasks they assumed at tender ages, but the opinion of scholars is unanimous on one point. Prior to the nineteenth century, children as young as four or five years of age were seen as miniature adults with corresponding expectations regarding their responsibilities for the support of the family economy [Beales 1985, Morgan 1944]. Boys helped in the fields. Girls tended to younger siblings and assisted with garden plots and poultry and engaged at home manufactures. Children's labor was an integral part of the household economy and its loss was seen as too dear a price to pay for extensive schooling.[41] Besides, parents perhaps felt that their children would have little need for more than a rudimentary education since traditional family farming did not require the sorts of skills taught in early-nineteenth-century schools.

After the Life-Cycle Transition, child labor and schooling were viewed quite differently. Children were no longer seen as an "investment" in old-age-security. The "consumption" motive for having children came to the fore. With the decision to have children driven by anticipation of the enjoyment such children would bring, parental focus shifted toward a desire to offer their children the opportunity to develop themselves and to improve their options in the larger world. The idea that parents should put their children to full-time labor and thus compel them to contribute to the family income became unfashionable. Parents began to excuse children from year-round farm labor and to enroll them in school. In effect, parents made transfers when their children were still young and the children received an inheritance well before their parents died.[42] The Life-Cycle Transition enhanced the freedom of both generations. The new ethic gave children the freedom to leave home, escape parental control, and establish their own households while they were still young. It gave parents freedom to manage their assets (including the farm) to suit themselves. The increase in the educational attainment of the population was an important consequence of this profound shift in these intergenerational relations.

As a proxy indicating the extent to which parents had adopted these new attitudes about children we introduce a variable measuring the extent of enrollment in schools.[43] The variable is based on the census returns for 1840. The number of students who were enrolled in academies and grammar schools and the number of scholars enrolled in primary and common schools at any

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41. We do not mean to suggest that most children in eighteenth-century New England grew up illiterate. Literacy was encouraged for religious reasons and literacy rates were quite high. Formal schooling beyond the point of acquiring an ability to read the Bible, however, did not become common until the early decades of the nineteenth century [Carlton 1908: chapter 1, Kaestle 1983: chapter 1].

42. The cost to parents of permitting their children to attend school should not be underestimated. The major component of that cost was the foregone labor of the children. But there were tuition expenses as well. Before the 1840s even the public schools were not free. In New York parents were charged user fees called "rate bills" and those who did not pay could not send their children to school. In Massachusetts only a short regular session was provided at public expense, parental fees were charged to lengthen the term [Kaestle and Vinovskis 1980: 16]. Initially, the fees were often relatively high, but they were abolished in the 1850s and 1860s [1983: 117].

43. Susan Carter [1986a] notes that the fertility decision and the schooling decision are made simultaneously in a life-cycle plan. Mark Rosenzweig [1977] made the same point in his discussion of fertility in India. Nigel Tomes [1981] found evidence of simultaneity between education and family size in a study of high-IQ children in twentieth-century California. Carter has estimated a simultaneous system of equations for schooling and fertility in the antebellum United States using county-level census data for 1840 and 1850 and two-stage estimation procedures.

time during the preceding year was recorded in the 1840 census.44 We divided the total enrollment enumerated by the white population aged 5 to 19 to provide a rough index of enrollment rates.[45] The school attendance rate, thus defined, is called the SCH RATE. Our interpretation of schooling rates is the same as John Caldwell's, whose work on less-developed countries today has emphasized the importance of the change in the direction and timing of intergenerational income transfers on fertility rates in those countries [1982]. Caldwell took the parents' decision to send a child to school as evidence of their willingness to transfer resources to their children while still alive and consequently as evidence that they no longer relied upon children to provide old-age security.

We also include a measure of the education of the parents themselves. This is the white adult illiteracy rate, or ILLIT. We do so in order to test a widespread assertion in the literature that education is a powerful correlate of modern, post-life-cycle transition values – especially of attitudes toward and values of one's children. Reinterpreting some of this literature in our own terminology, we would speculate that the access to the larger world and the release from the specific control of parents that literacy and education generally provides to youth may have been the most powerful, self-reinforcing process unleashed by the Life-Cycle Transition. Educated youth better understand the full range of their options. Educated parents are more likely to educate their own children. If one adds in educational externalities – the appearance of an educated person in the community raises the probability that children will attend school – then the stage is set for a powerful, irreversible, path-dependent process. Early adopters of the Life-Cycle Transition supported public educational developments that encouraged neighbors to adopt the same set of values. The illiteracy rate is defined as the number of whites 20 years of age and older who are unable to read and write divided by the number of whites 20 and older in the population. We view it as an indicator of difficulties parents' may face in trying to embrace the behaviors and attitudes implied by a post-Life-Cycle transition world.

The result of the experiment with this third proxy indicator of the life-cycle transition is reported as Equation 5 in Table 4. The variables perform remarkably well. The fit of the equation is the best yet. Perhaps this is not surprising since the schooling ratio measures the extent of life-

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44. While far from perfect, these data from the 1840 Census are deemed to be reliable indicators of enrollment [Fishlow 1966: 66-67].

45. The index is rough because the numerator represents the cumulative enrollment over the preceding year whereas the denominator counts the population at the time of the census. The measure will thus overstate the average enrollment rate and may be distorted in unpredictable ways by the impact of migration. Nevertheless, the measure is the best we can devise with the available data and has often been used as an index of schooling intensity by other scholars. See the careful discussion of this problem by Kaestle [1980: 13-14 and 29-31].

cycle behavior directly, while the out-migration and employment opportunity variables are intended to capture the child-default catalytic effect and thus are only indirect measures of the life-cycle transition. In any case, both of the educational intensity variables have large coefficients and both are associated with fertility as we predicted. Higher school attendance rates are associated with lower fertility and higher levels of adult illiteracy are associated with higher fertility. Of great significance, which we shall return to below, is the fact that in the presence of these educational variables, the coefficient on the dummy variable SOUTH becomes insignificantly small (it even has a negative sign in Equation 5). It would appear that what makes the South different is its reduced commitment to education. An examination of Map 6 reveals a sharp north-south difference in the schooling ratio.

[Map 6]

We are not the first to enter an educational variable into cross-state fertility regressions. Maris Vinovskis demonstrated that the illiteracy rate for those over twenty "was the single best predictor of fertility differentials among the states in 1850 and 1860" [1976: 393].[46] Vinovskis clearly intended the illiteracy rate to capture the direct impact of their own education on the parents' desire or ability to control fertility [1976: 381]. Elsewhere Vinovskis interpreted measures of adults' educational attainment as indexes of "modernization" [1981: 118-129] and he cited demographers and development economists who interpret literacy as an indicator of knowledge about contraceptive technique [p. 123].[47] If Vinovskis' idea of a "modern cultural outlook" means nothing more or less than what we mean by life-cycle modes of behavior or what Caldwell means by a

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46. Vinovskis' other variables included the sex ratio, the percentage of the free population that was foreign born, the degree of urbanization, and the value of an average farm [1981]. Despite the fact that school enrollment rates and the illiteracy rates of those over twenty are highly correlated (the correlation coefficient between the respective (weighted) logarithms of the two measures in 1840 is minus 0.5, the two variables measure very different phenomenon. The schooling rate refers to children between the ages of 5 and 19; illiteracy rates for adults say something about those children's parents.

47. We would give little credence to an argument that explains the power of educational variables in empirical fertility models by claiming some level of education is necessary to master contraceptive technology. There is evidence that American women practiced fertility control within marriage as early as the first decades of the nineteenth century [Sanderson 1979 and Osterud and Fulton 1976] and also in response to unusual situations in the early decades of the eighteenth century [Smith 1972 and Wells 1982]. The primary birth control methods at that time were infrequent intercourse, coitus interruptus, long lactation periods, abstinence, and induced abortion. Douching and the vaginal pessary were introduced at least as early as 1832. Knowledge of these methods was commonplace and did not seem to depend upon literacy or educational attainment [David and Sanderson 1986, LaSorte 1976, and Reed 1978, 6-11]. Also see McLaren [1990: 178-213].

regime that favors intergenerational transfers from parents to children when the children are young, then we have no disagreement about the interpretation of an educational variable in fertility models.

A Multivariate Test of the Life-Cycle Fertility Model

The battery of tests with life-cycle proxies has been remarkably successful. In each case the proxy tested was significantly correlated with the rural fertility index.[48] Given this success, it might seem appropriate to combine all of the life-cycle proxies into a single regression with multiple independent variables. There is, of course, considerable multi-collinearity between these variables, so it would be remarkable if each one proved to contain unique information. The experiment is reported as Equation 6 in Table 4. We regard the results as highly favorable. All of the proxy variables have the appropriate sign and are substantively significant and precisely measured. The magnitude of the coefficients on the growth ratio, the urban population share, the non-farm employment share and the railroad variable are attenuated in the multivariate version. This is to be expected since the various proxies are alternative attempts to capture the presence of life-cycle strategies. It is remarkable, however, that all of these variables nevertheless retain individual explanatory power in the presence of other measures. The schooling ratio is even more powerful in Equation 6 than in Equation 5. The dummy variable indicating a slave state has no effect and enters Equation 6 with a perverse sign.

The Anomalous South? Slavery and White Fertility

As we have noted, the life-cycle hypothesis ought to be applicable to the white population of the slave states.[49] Higher fertility in the South was the consequence of a delayed and perhaps incomplete transition to life-cycle behavior. For the minority of Whites who were slave owners, the threat of child default would be minimized by the presence of slave servants and field hands. This effect of slavery was reflected in the empirical tests that employed the growth ratio as an independent variable (Equations 1-3 in Table 4) and those that measured nonagricultural

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48. Using state-level data Steckel (1977) also showed the strong impact of the existence of banks in a fertility regime. This, too, would be a proxy for the life-cycle transition, a point that Steckel explicitly uses to motivate his model.

49. The fertility history of slaves is an entirely different issue. There is abundant evidence that slave fertility was, at least in part, subject to the influence of the slave owners and, in any case, the problems of old-age security and the accumulation of a bequest were hardly ones to trouble or motivate slaves. On the subject of slave breeding, see Sutch [1975, 1986]. See Richard Steckel [1977] on slave fertility.

employment opportunities (Equation 4). Those proxies were independent attempts to quantify the potential threat of child default. Not surprisingly, the regressions were improved by the inclusion of a dummy variable, SOUTH, designed to shift the constant of the equation for the slave states. Child default seems to have been a less powerful catalyst in the south because slaves to some extent could substitute for children to provide security in old age.

The third life-cycle proxy, the school enrollment ratio, measures the extent of the life cycle transition directly. In the regression containing the educational intensity variables (Equation 5) the relationship between fertility and the life-cycle variables was not different for the southern than for the northern states. In this sense then, white fertility is not inexplicably high in the south, it was high because the south lagged behind the north in adopting modern values. This does mean that the institution of slavery was not relevant to story. An indirect effect of slavery, reflected through the other variables in the equation (primarily schooling and nonagricultural labor opportunities), was responsible for the high fertility actually observed.

It would also be our prediction is that the presence of slavery should have had the direct effect of lowering white fertility among slave masters. Slave-owning families would have had less reason to depend upon children for old-age security or farm labor. To test for this possibility we introduce a final variable, the proportion of the total population of the county that was enslaved, SLAVES. We conjecture that the higher the proportion of slaves, the greater would be the fraction of the white population that was part of the slave owning class. Equation 7 in Table 4 repeats the multivariate specification of Equation 6 with the addition of the SLAVES variable. The negative sign on this indicator confirms our prediction, while the return of the positive sign on SOUTH balances the negative pull of the proportion of slaves.[50] The anomaly of southern white fertility seems to be adequately explained by the life-cycle fertility hypothesis.

Three Conclusions

This chapter proposes an explanation for the American fertility decline based on the idea that life cycle determinants of fertility gradually came to dominate the traditional old-age security motive for high fertility. This was part of a more general development, which we have called the life-cycle transition, initiated by the rising out-migration of young adults.

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50. Susan Carter was the first to report a significant negative effect of slavery on white fertility [1986a: 14].

We asserted that a satisfactory model of the American fertility decline should be able to pass three tests. It should explain the time trend of the decline and particularly the onset of the decline shortly after 1800. It should be able to explain the pattern of regional fertility differences that existed in an intermediate year such as 1840. It should be able to explain the special case of white fertility in the slave states. We have assembled evidence to demonstrate that our life-cycle transition model successfully passes all three tests.

Finally, we believe we can draw three specific conclusions:

» Child default was the catalyst that triggered the American fertility decline. As the public domain was opened to settlement and as the nonagricultural labor market expanded, children frequently left home to take up new opportunities. This reduced the value of children as "assets" who could provide old-age security for their parents.

» The target-bequest model specified with land-availability variables intended to be applicable to the fertility decisions of a nineteenth-century rural population is rejected. That model, first introduced by Richard Easterlin, is difficult to reconcile with the time-series evidence on fertility, performs poorly in cross-section tests, and consistently fails in the presence of alternative variables suggested by the life-cycle model of fertility proposed in this chapter.

» The David-Sundstrom model of intergenerational bargaining is best interpreted if it is embedded into an explicitly path-dependent story of the adoption of life-cycle behavior.

Table 1

Sequence of Tests of the Land-Availability Hypothesis

Cross-Section Linear Regressions, Twenty-Seven States, 1840
(Adjusted R^2, Ordinary Least Squares)

Measure of Land Availability	Reference	Dependent Variable	
		Yasuba Index	Rural Yasuba Index
Persons per Square Mile	Tucker	0.637	0.573
Persons per 1000 Arable Acres	Yasuba	0.545	0.496
Adults, 1830, per Farm, 1860	Forster	0.744	0.675
Value of Average Farm, 1860	Vinovskis	0.278	0.163
Density of Rural Settlement	Schapiro	0.538	0.527
mean of the dependent variable		1,579	1,695
standard deviation		347	388

Note: The twenty-seven states included in these tests are Alabama, Arkansas, Connecticut, Delaware, Florida Territory, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, and Virginia.

Sources: The Yasuba index of white fertility is the number of children under ten per thousand women, 16 to 44. Yasukichi Yasuba, *Birth Rates of the White Population in the United States, 1800-1860* (Johns Hopkins University Press, 1962): Table II-7, pp. 61-62. The rural Yasuba index is defined using the white rural population of each state and has been standardized to correct for the effect of the age distribution of the women. Our source is Colin Forster and G.S.L. Tucker, with the Assistance of Helen Bridges, *Economic Opportunity and White American Fertility Ratios, 1800-1860* (Yale University Press, 1972): Table 6, pp. 40-41.

George Tucker, *Progress of the United States in Population and Wealth in Fifty Years* (Press of Hunt's Merchant's Magazine, 1855), first observed the relationship between fertility and persons per square mile. We have used the population density per square mile for 1840 given in U.S. Bureau of the Census, *Historical Statistics of the United States* (U.S. Government Printing Office, 1975): I, Series A196.

Yasuba's measure of the availability of land is the number of persons per thousand acres of crop land in 1949. Our source is Yasuba, *op cit*: Table V-9, pp. 163-164.

Forster and Tucker (with Bridges) use a measure of economic opportunity they call the "adult-farm ratio." The white population over the age of 15 in 1830 is divided by the number of farms in 1860 [see Forster, Tucker, and Bridges, *op cit*: pp. 11-12, 19-21, and 41, for an explanation of this variable]. We have calculated this ratio using the population data in U.S. Census Office, Fifth Census [1830], *Fifth Census or Enumeration of the Inhabitants of the United States, 1830*, and the number of farms for each state reported in *Historical Statistics*: Series K20-K63.

Maris A. Vinovskis, "Socioeconomic Determinants of Interstate Fertility Differentials in the United States in 1850 and 1860," *Journal of Interdisciplinary History* 6 (Winter 1976), used the average value of farms as a measure of the relative cost of obtaining a working farm [p. 381].

He entered the 1850 average value into a regression explaining the Yasuba index for 1850. The average value of a farm is not available from the census of 1840. As a rough substitute we have entered the 1850 value into our 1840 regression. This procedure may perhaps be justified by suggesting that the expected cost of a farm fifteen to twenty years in the future should be relevant to the child-bearing decisions of the 1830s. The R^2 for a linear regression with the 1850 Yasuba index as the dependent variable and the 1850 average farm value (27 observations) was 0.268. The rural Yasuba index is not available for 1850. Our data on the average value of a farm in 1850 is taken from *Historical Statistics*: Series K20-K63.

The density of rural settlement is a measure designed by Morton Owen Schapiro, "Land Availability and Fertility in the United States, 1760-1870," *Journal of Economic History* 42 (September 1982). It is defined as the rural population of the state in 1840 divided by the local maximum rural population observed for that state [pp. 586-587 and Table 1, p. 589]. We used the variant of the Schapiro measure advocated by William A. Sundstrom and Paul A. David, "Old-Age Security Motives, Labor Markets, and Farm Family Fertility in Antebellum America," *Stanford Project on the History of Fertility Control Working Paper* Number 17 (February 1986): 47-48. This replaces the "first clear peak" in rural population with the maximum rural population observed between 1790 and 1940. For this variable the data on rural populations come from *Historical Statistics*: Series A203.

Table 2

Determinants of the Rural White Refined Birth Ratio, Sundstrom-David [1988]
OLS Cross-Section Regressions, State-Level Data,1840

Variable	All States	North	South
Ln RES40	-0.180 (0.024)	-0.155 (0.067)	-0.155 (0.015)
Ln RW50	-0.823 (0.212)	-1.042 (0.491)	-0.854 (0.107)
Ln MFR40	0.508 (0.287)	0.361 (0.631)	0.653 (0.143)
Ln DSR40	0.027 (0.048)	0.0078 (0.0915)	0.046 (0.032)
Constant	4.72	4.09	4.07
N	29	16	13
Adj. R^2	0.78	0.61	0.95

Notes: Standard errors in parentheses.

Definitions:

Dependent variable is the natural log of the Rural White Refined Birth Ratio, number of children under age 10 divided by the number of women at ages 16-44 from Forster, Tucker, and Bridge [1972, pp. 40-41].

Ln RES40: Natural log of the "relative employment share" of nonagricultural employment, calculated as the ratio of the nonagricultural to the agricultural labor force, from Easterlin [1960, Table A-1]

Ln RW50: Natural log of the relative wage outside of agriculture, calculated as the ratio of the daily common labor wage to the monthly farm labor wage, both with board from Lebergott [1964, pp. 539 & 541]. These data pertain to 1850 rather than 1840.

Ln MFR40: Natural log of the male-female ratio in rural areas for the population aged 10 and over.

Ln DSR40: Natural log of the "density of rural settlement," measured as the ratio of the state's rural population in 1840 and the maximum rural population of the state during the period 1790-1940.

Source: Sundstrom and David [1988], Table 4, p. 190.

Table 3
Determinants of the White Child-Woman Ratio in the Spirit of Sundstrom-David [1988]
Cross-Sectional Weighted Median (MAR) Regressions, County-Level Data, 1840
Dependent Variable: natural logarithm of the White Child-Woman Ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	All Rural Countie s	Northern Rural Countie s	Souther n Rural Counties	All Rural Countie s	All Rural Countie s	All Countie s	All Countie s
Ratio of Nonagricultural to Total Employment	-1.40 (0.055)	-1.30 (0.161)	-0.95 (0.057)	-0.99 (0.053)	-0.83 (0.107)	-0.67 (0.035)	-0.51 (0.022)
Ln [White Male-Female Ratio top coded at 1.1]	0.75 (0.186)	2.32 (1.051)	1.05 (0.149)	1.11 (0.167)	1.12 (0.323)	1.54 (0.159)	1.41 (0.087)
Ln [Improved Acres per Rural White Resident in 1850]	-0.126 (0.0110)	-0.264 (0.0510)	-0.151 (0.0089)	-0.166 (0.0104)	-0.143 (0.0204)	-0.049 (0.0035)	-0.038 (0.0019)
SOUTH				0.192 (0.0134)	0.143 (0.0275)	0.097 (0.0094)	0.101 (0.005)
RAIL					-0.098 (0.0259)	-0.169 (0.0079)	-0.137 (0.0043)
WATER					-0.035 (0.0230)	-0.047 (0.075)	-0.048 (0.0041)
TOWNS							-0.095 (0.0075)
Constant M/F>=1.1 Dummy	0.295 0.019	0.315 -.0125	0.325 0.021	0.162 0.031	0.175 0.034	0.006 0.015	-0.050 0.034
N	984	320	664	984	984	1079	1079
Pseudo R^2 from MAR R^2 from OLS	0.243 0.361	0.170 0.296	0.401 0.567	0.306 0.489	0.334 0.546	0.445 0.666	0.456 0.675

Notes: Standard errors in parentheses. The observations in each regression are weighted by the number of women 15 to 44 in the county. Rural counties have no reported urban place with 2,500 persons or more.
Sources and Definitions: See Tables 5A and 5B.

Table 4
Determinants of the White Child-Woman Ratio, Life-Cycle Model
Cross-Sectional Weighted Median (MAR) Regressions, County-level Data, 1840
Dependent Variable: natural logarithm of the CRS Fertility Index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	Rural Counties	All Counties	All Counties	All Counties	All Counties	All Counties	All Counties
Ln(DECLINE)	0.465 (0.079)	0.295 (0.054)	0.229 (0.033)	--	--	0.158 (0.003)	0.125 (0.011)
GROW	0.082 (0.031)	0.137 (.021)	0.149 (0.013)	--	--	0.071 (0.001)	0.077 (0.004)
FRONTIER	0.001 (0.043)	0.017 (0.027)	0.020 (0.016)	--	--	0.090 (0.002)	0.097 (0.006)
SOUTH	0.276 (0.021)	0.221 (0.013)	0.235 (0.009)	0.047 (0.007)	-0.024 (0.009)	-0.005 (0.001)	0.036 (0.005)
TOWNS	--	-0.121 (0.031)	-0.134 (0.016)	-0.143 (0.014)	-0.108 (0.015)	-0.067 (0.002)	-0.070 (0.005)
URBAN	--	-0.435 (0.078)	-0.139 (0.034)	0.162 (0.034)	-0.346 (0.032)	-0.170 (0.004)	-0.136 (0.014)
Ln(MEN SCARCE)	--	--	0.977 (0.159)	--	--	0.867 (0.017)	0.834 (0.053)
WOMEN SCARCE	--	--	-0.019 (0.011)	--	--	0.015 (0.001)	0.025 (0.004)
NON-AG JOBS	--	--	--	-0.463 (0.032)	--	-0.230 (0.004)	-0.273 (0.012)
RAIL	--	--	--	-0.189 (0.007)	--	-0.063 (0.001)	-0.059 (0.003)
WATER	--	--	--	-0.020 (0.007)	--	-0.025 (0.001)	-0.024 (0.002)
SCH RATE	--	--	--	--	-0.247 (0.017)	-0.340 (0.002)	-0.349 (0.006)
ILLIT	--	--	--	--	0.350 (0.025)	0.291 (0.003)	0.249 (0.010)
SLAVES	--	--	--	--	--	--	-0.159 (0.009)
Constant	-0.209	-0.226	-0.309	0.007	-0.038	0.035	-0.031
N	984	1079	1079	1079	1079	1079	1079
Pseudo R^2 from MAR R^2 from OLS	0.254 0.432	0.422 0.613	0.443 0.649	0.394 0.587	0.467 0.656	0.614 0.817	0.617 0.818

Notes: Standard errors in parentheses. The observations in each regression are weighted by the number of women 15 to 44 (CRS MOMS). "Rural Counties" are defined as those with no reported urban place with 2,500 persons or more. Ln(.) denotes a natural logarithm.

Sources and Definitions: See Table 5.

Table 5A Definitions, Means, and Deviations of Continuous Variables County-Level Data, 1840, 1079 Observations			
Variable Name	Variable Definition	Mean Value	Standard Deviation
CRS Fertility Index	The number of white children under age 5 divided by number of white women ages 15 to 44	0.9365	0.1900
CRS KIDS	The number of white children under age 5	2162	2690
CRS MOMS	The number of white women ages 15 to 44	2736	4600
LAND ABUNDANCE	The number of improved acres reported in farms in 1850 divided by the rural white population in that year	9.01	7.45
Growth Ratio	The white population aged ten and over in 1840 divided by the total white population in 1830	1.199	1.312
DECLINE	The *Growth Ratio* top coded at the value of one	0.836	0.154
URBAN	The proportion of the population of the country residing in towns or cities with populations over 2,500 persons	0.0285	0.1143
Male-Female Ratio	The number of white males 15 to 49 divided by the number of white females 15 to 44	1.157	0.198
MEN SCARCE	The male-female ratio top coded at the value of 1.1	1.069	0.048
NON-AG JOBS	Employment in mining, commerce, manufactures, hand trades, navigation of the ocean, navigation of canals, lakes, and rivers, and those engaged in the learned professions or as engineers divided by total employment which includes all of the above plus agriculture	0.1519	0.1557
SCH RATE	The number of students who were enrolled in academies and grammar schools and the number of scholars enrolled in primary and common schools at any time during the year preceding the date of the 1840 census divided by the white population aged 5 to 19	0.2419	0.2381
ILLIT	The number of whites 20 years of age and older unable to read and write divided by the number of whites 20 and older in the population	0.1569	0.1465
SLAVES	The number of slaves divided by the total population of the country	0.1992	0.2182

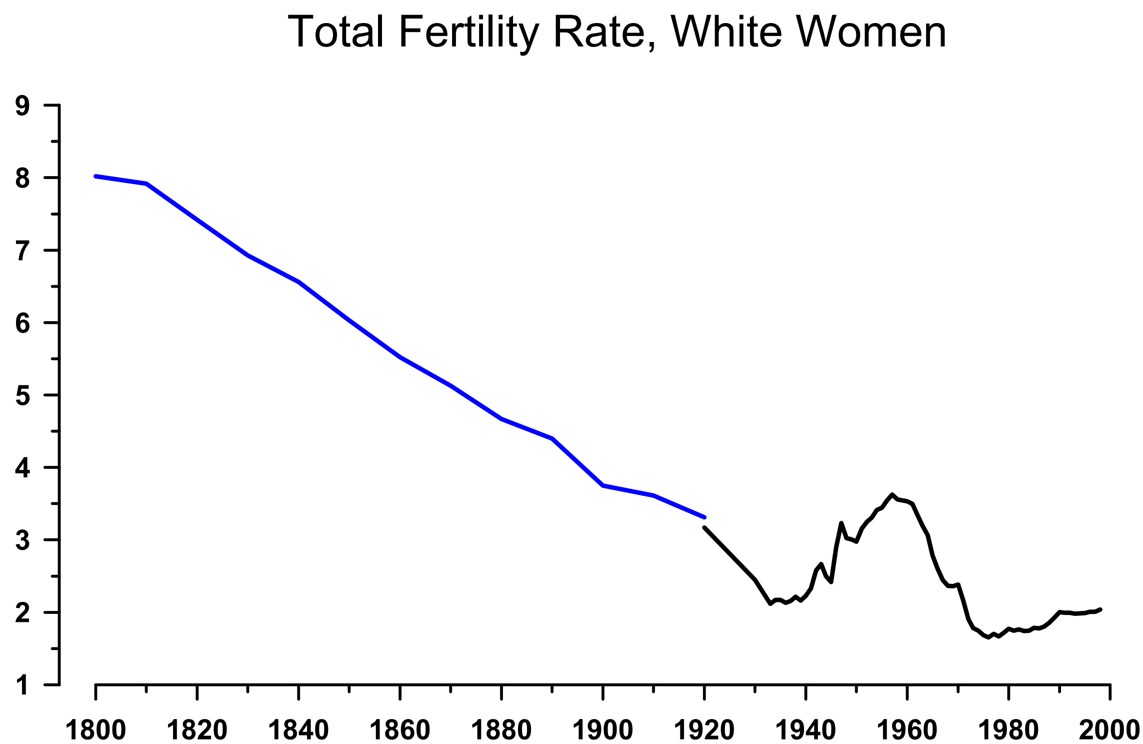
Source: Authors' calculations from county-level data published by the U.S. Census (1830, 1840, and 1850) and corrected and compiled by Michael Haines, "Historical Demographic, Economic and Social Data: The United States, 1790-1970," Department of Economics, Colgate University, Computer File, 2001.

Table 5B
Definitions of Dichotomous Variables
County-Level Data, 1840, 1079 Observations

Variable Name	Variable is zero or equal to one if	Number of observations equal to one
GROW	The *Growth Ratio* is equal to or greater than one	387
FRONTIER	The population in 1830 was equal to zero	44
SOUTH	The county is located in Maryland, Virginia, Delaware, North Carolina, South Carolina, Georgia, Mississippi, Alabama, Louisiana, Arkansas, Tennessee, Kentucky, or Missouri	694
TOWNS	The county has a town or city with at least 2,500 persons in 1840	95
WOMEN SCARCE	The *Male-Female Ratio* is greater than or equal to 1.1	588
RAIL	The county had a railhead in 1850	320
WATER	The county is located on a coastal or inland waterway in 1850	585

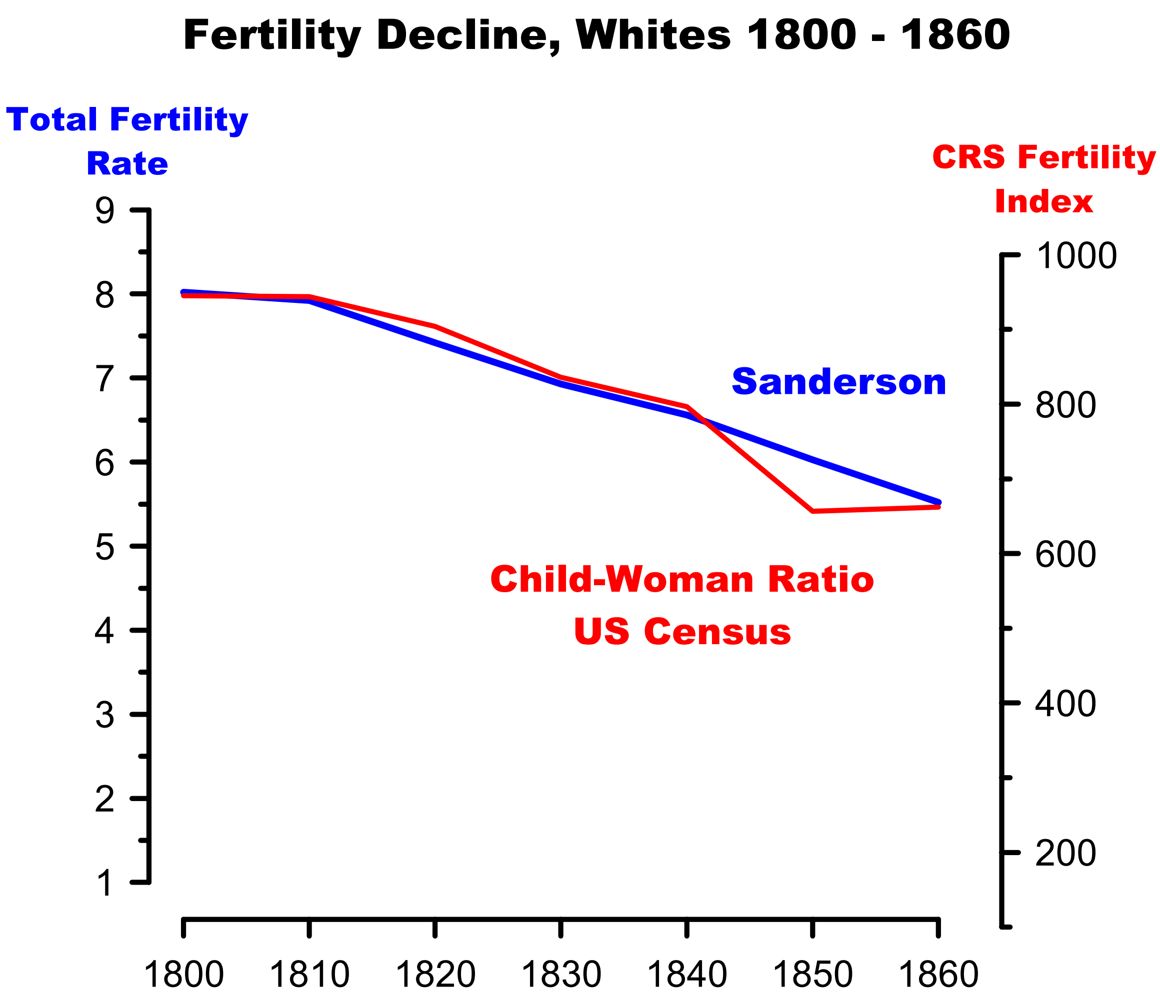
Source: Authors' calculations from county-level data published by the U.S. Census (1830, 1840, and 1850) and corrected and compiled by Michael Haines, "Historical Demographic, Economic and Social Data: The United States, 1790-1970," Department of Economics, Colgate University, Computer File, 2001. The RAIL and WATER data are based on maps consulted by Lee A. Craig, Raymond B. Palmquist, and Thomas Weiss, "Transportation Improvements and Land Values in the Antebellum United States: A Hedonic Approach," *Journal of Real Estate Finance and Economics* (March 1998): 173-189.

Figure 1



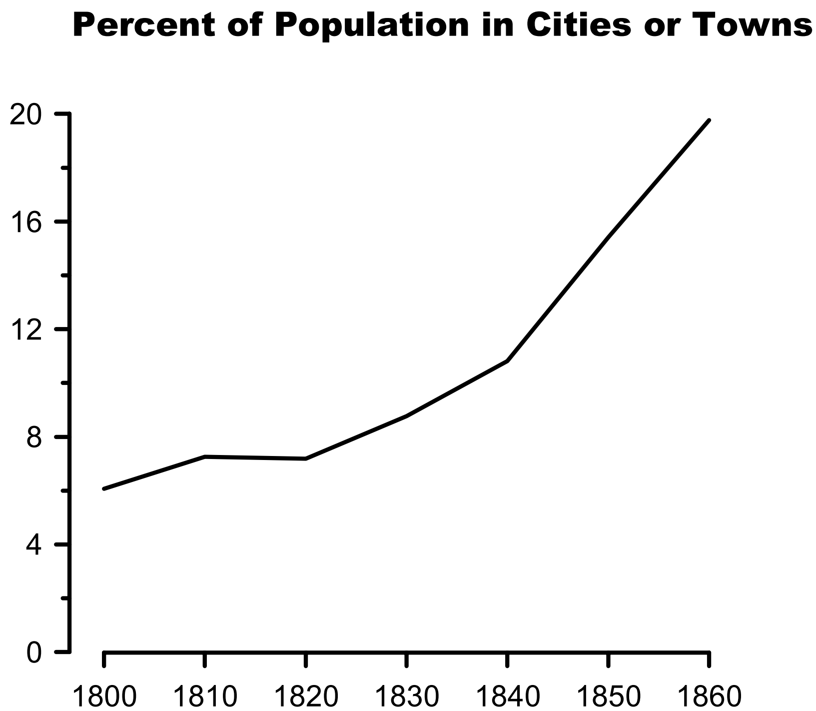
Source: Sanderson (1979) and Carter, et al (2002).

Figure 2



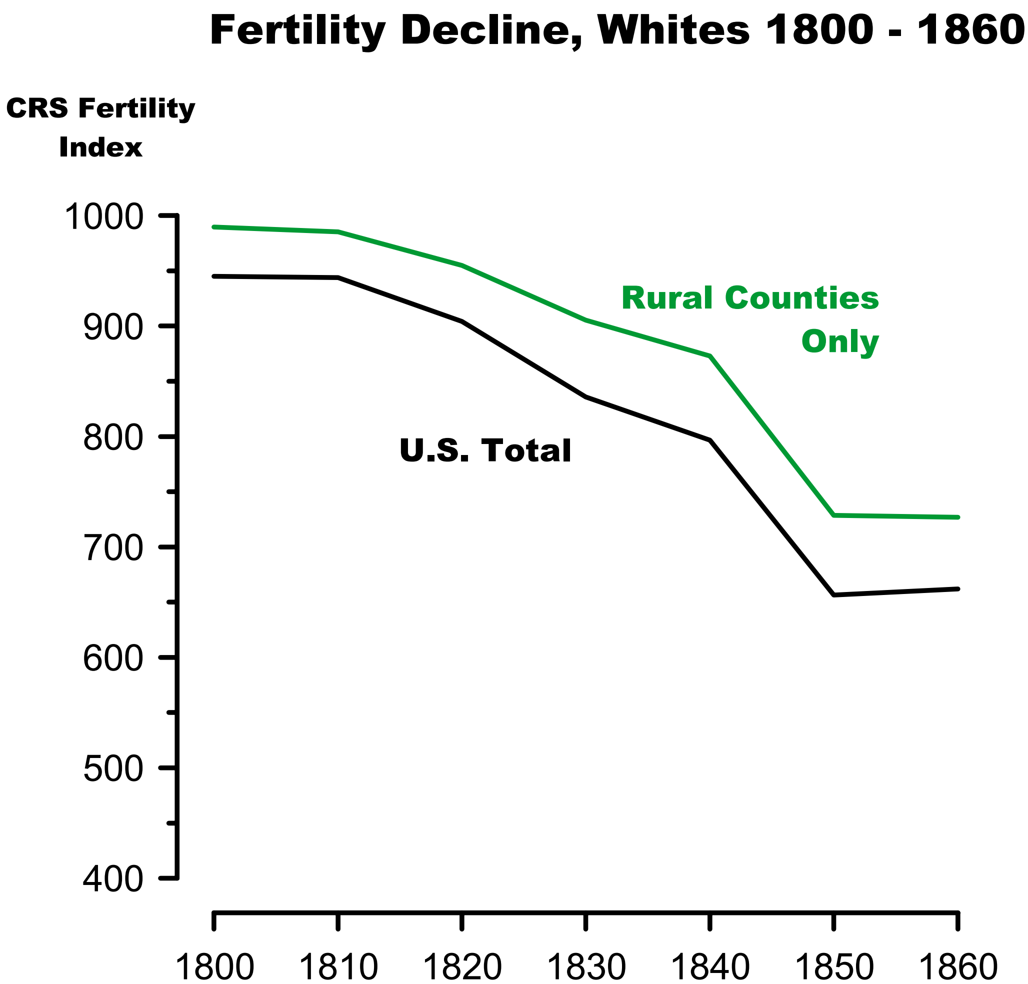
Source: Sanderson (1976) and authors' calculations.

Figure 3



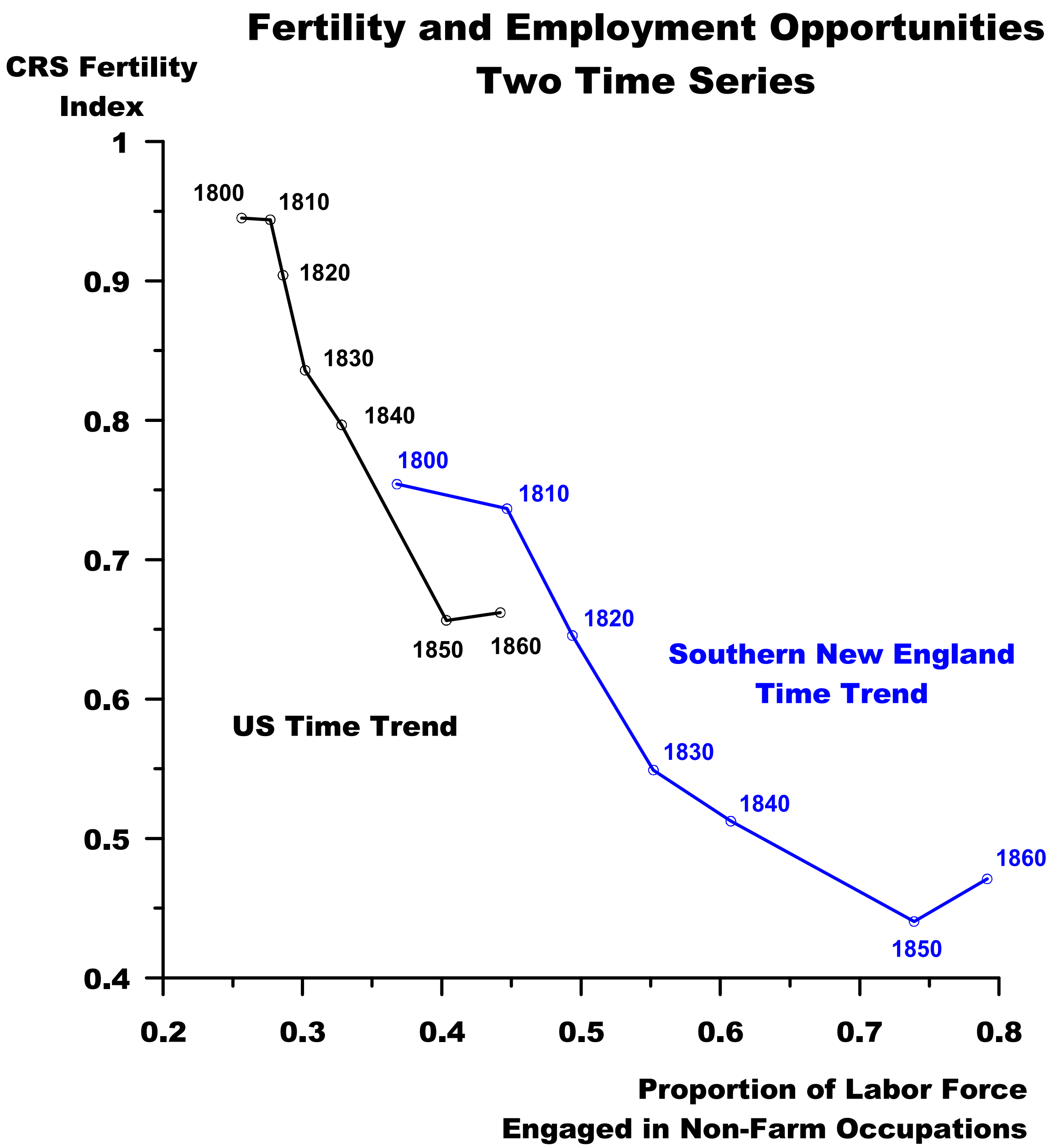
Source: Authors' calculations.

Figure 4



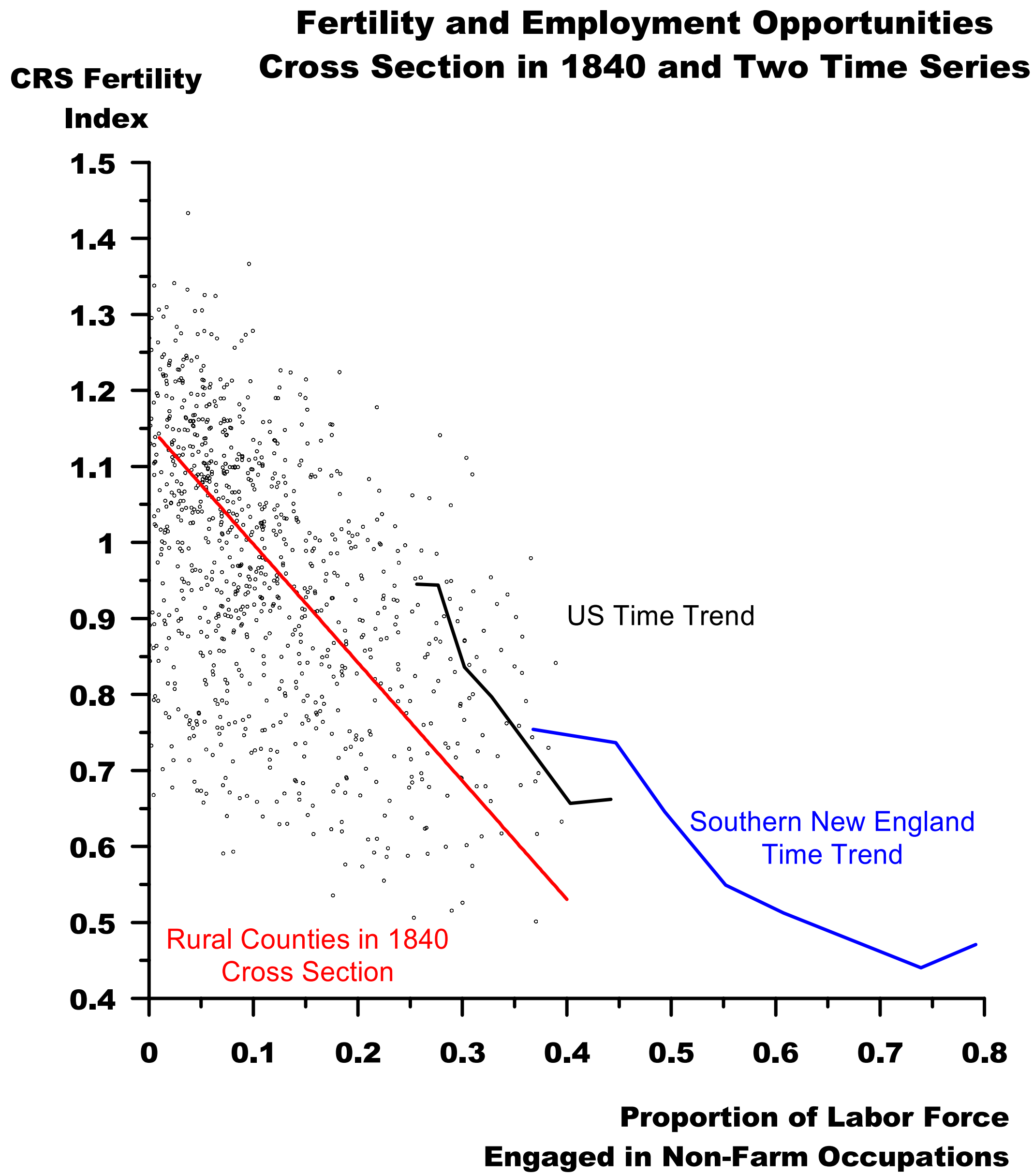
Source: Authors' calculations.

Figure 5



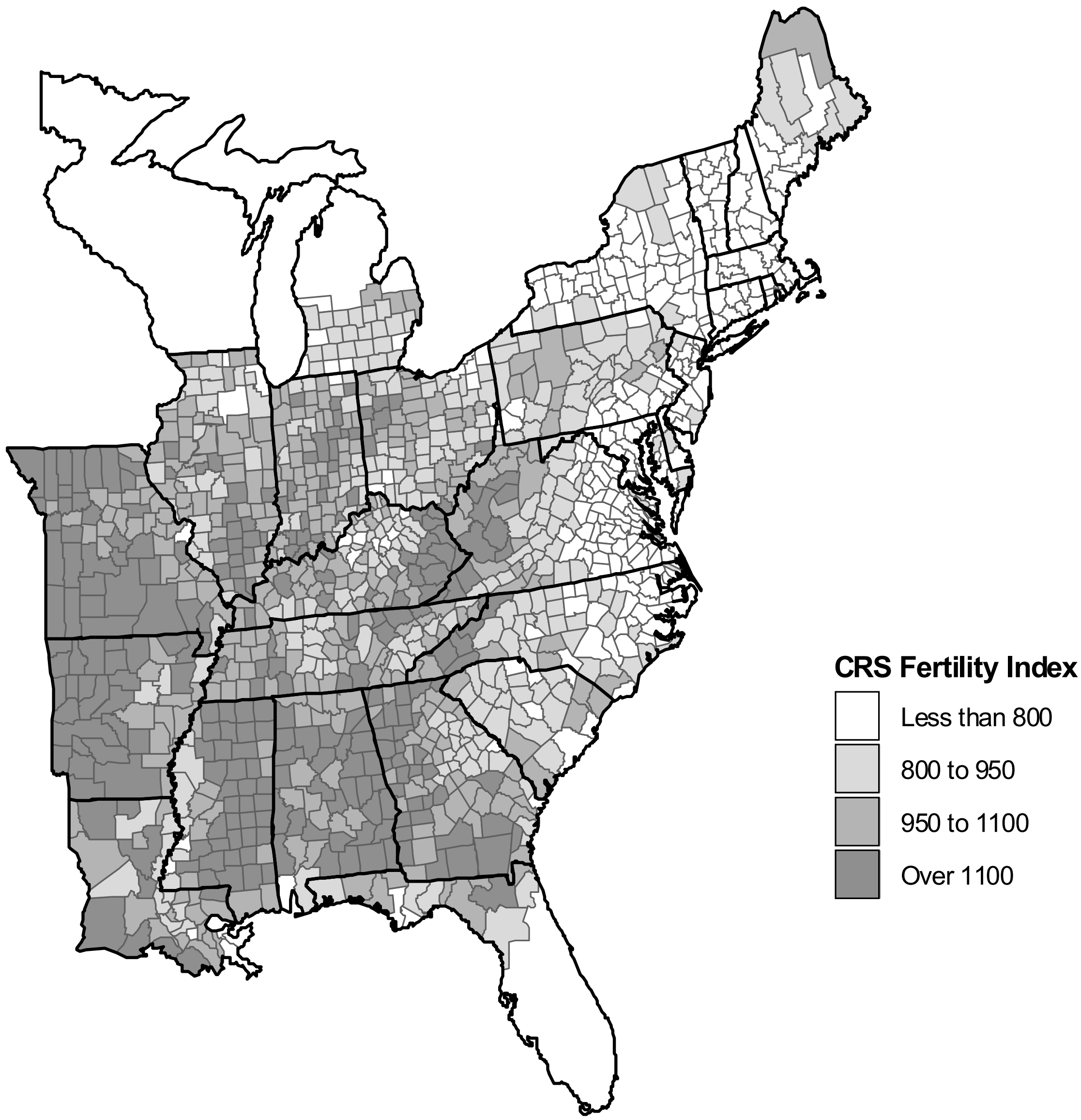
Source: Weiss [1992] and authors' calculations.

Figure 6

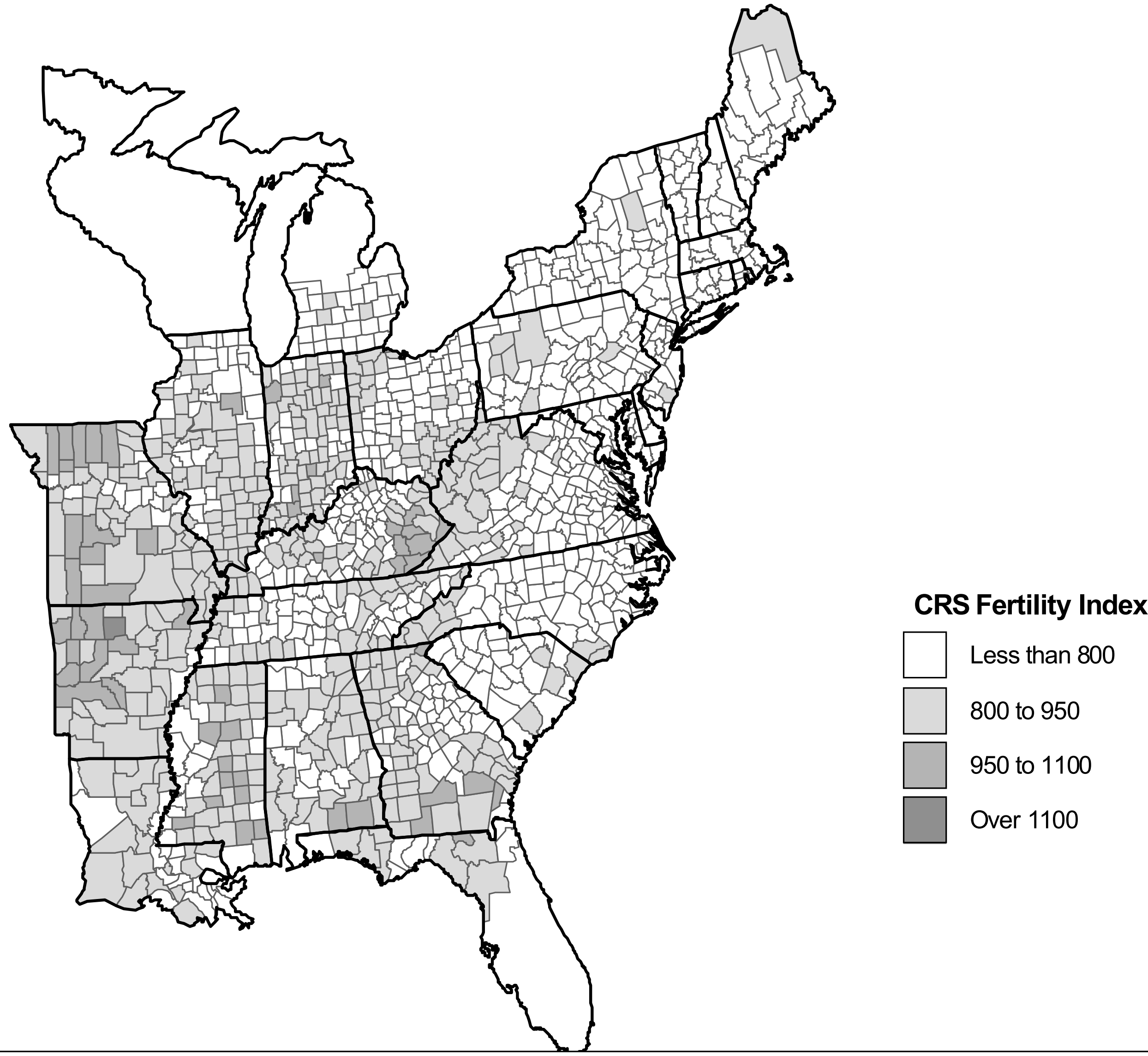


Source: Figure 5 and authors' calculations.

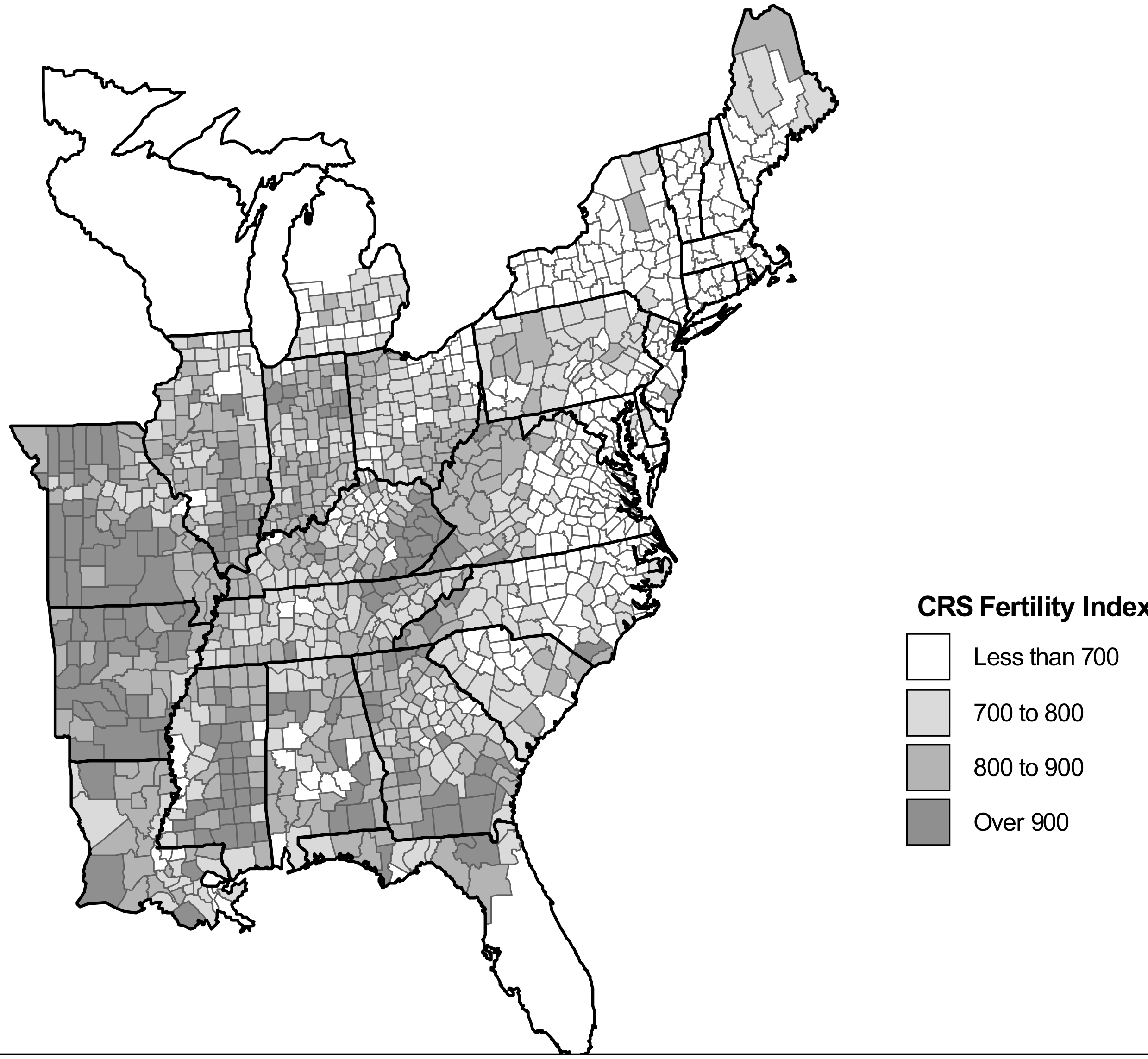
Map 1: White Fertility in the United States, 1840

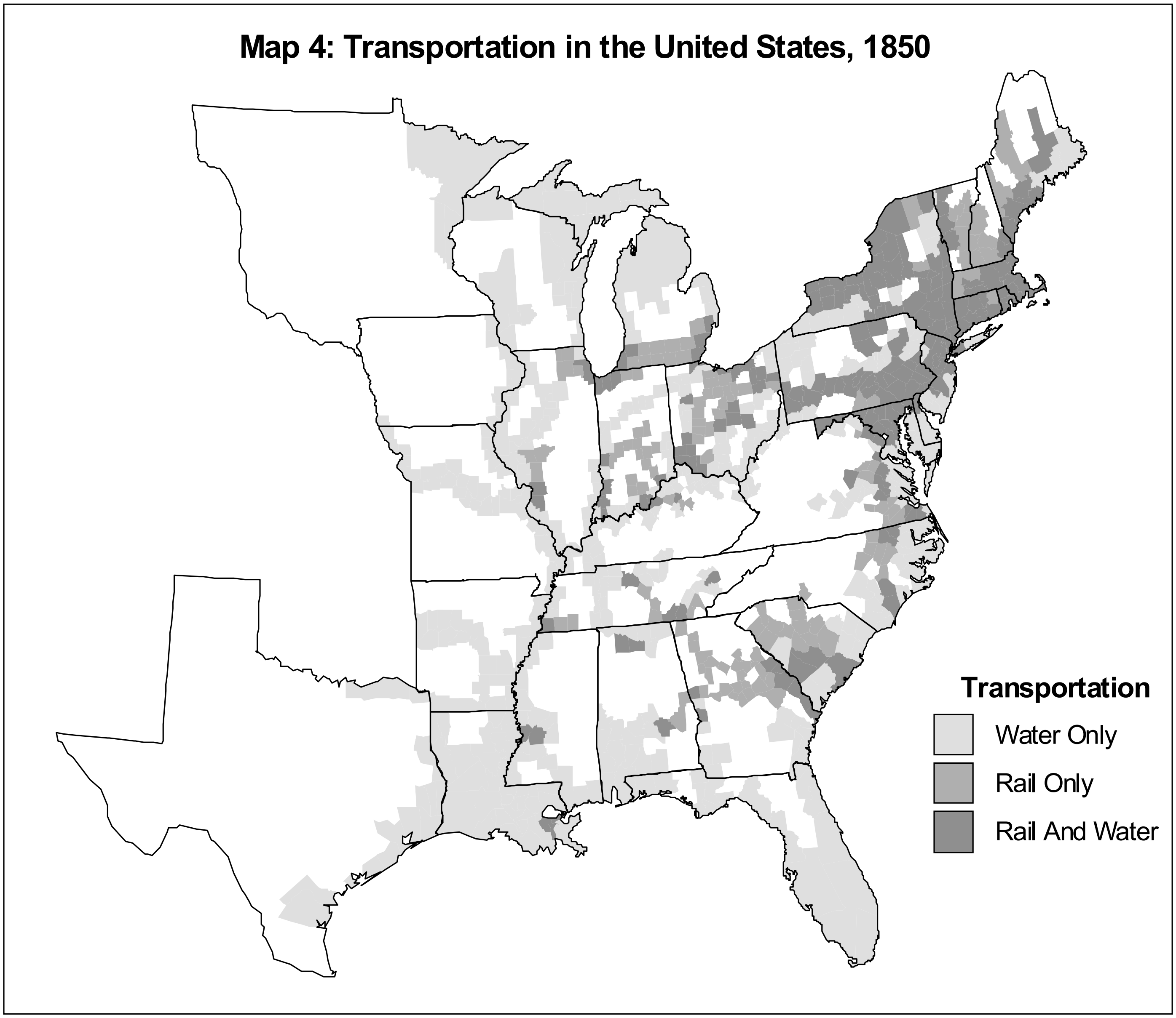


Map 2: White Fertility in the United States, 1850

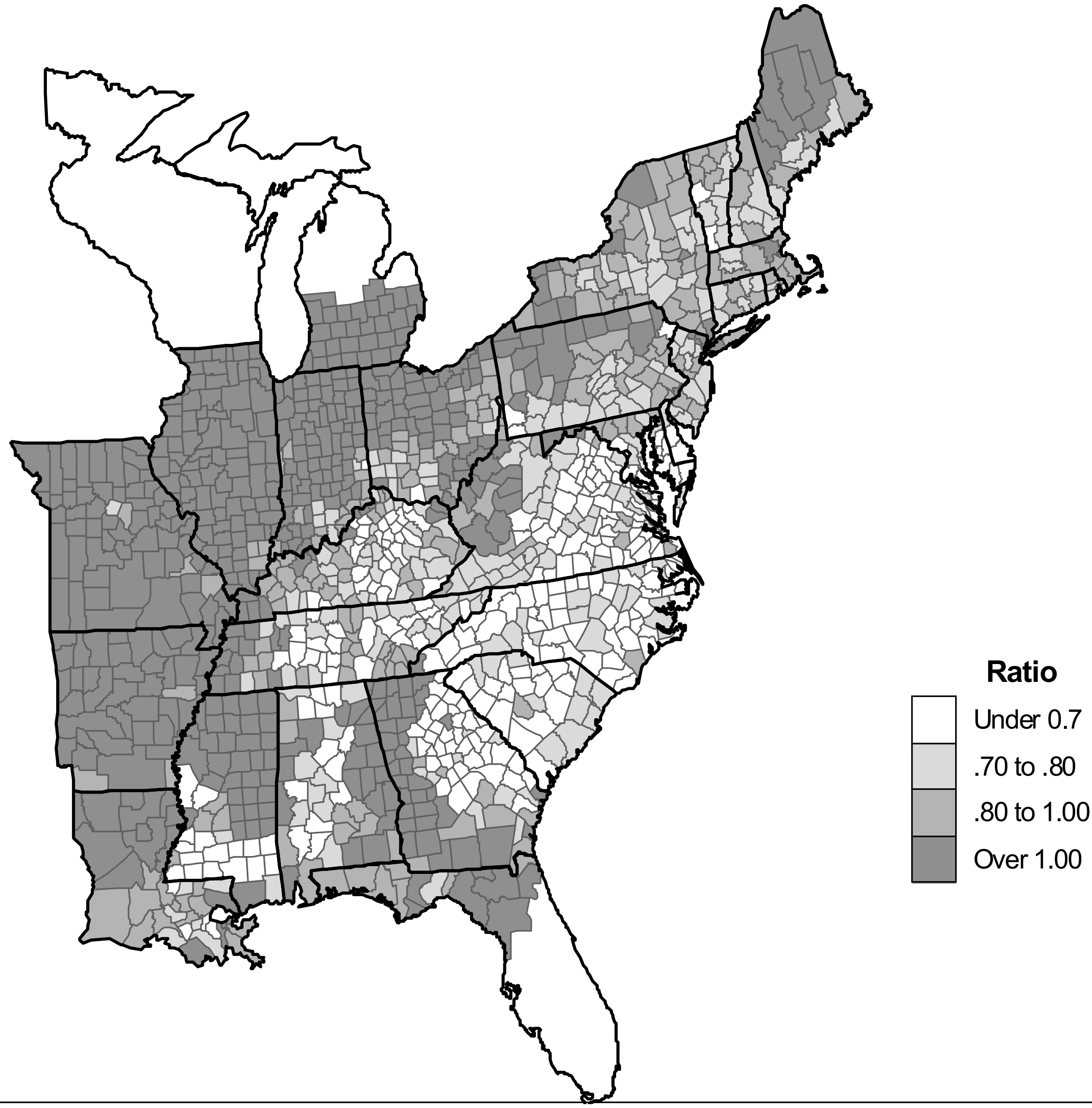


Map 3: White Fertility in the United States, 1850

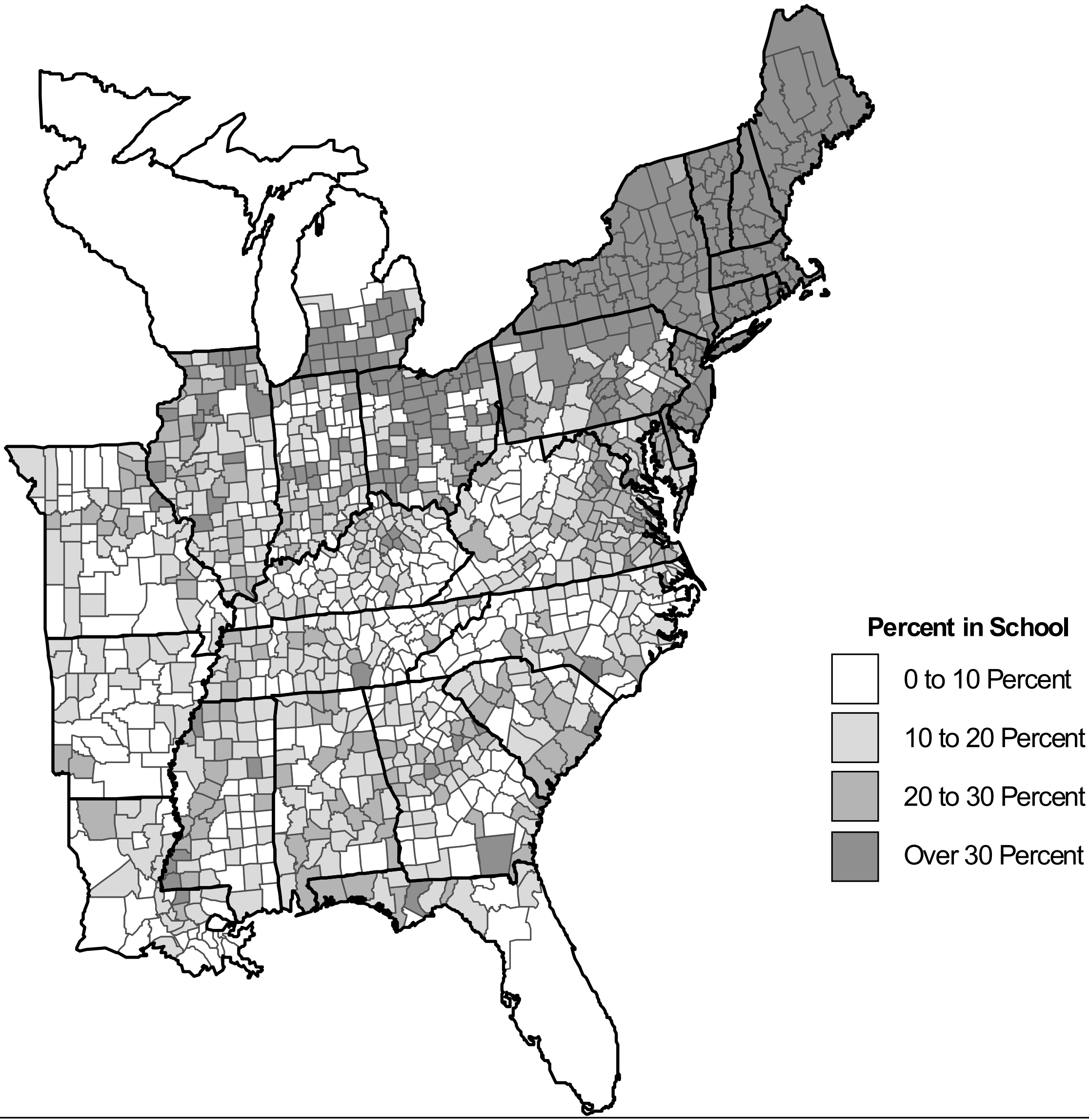



Map 4: Transportation in the United States, 1850
Transportation
Water Only
Rail Only
Rail And Water

Map 5:
Ratio of the Population 10 and Over in 1840 to the Total Population in 1830



Map 6:
Percent of White School-Age Children in School in the United States, 1840



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