Published in final edited form as:
Soc Biol. 2003 ; 50(3-4): 167–187.

How Big Are Educational and Racial Fertility Differentials in the U.S.?^{*}

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Abstract

Using pooled data from the 1980, 1985, 1990 and 1995 CPS and 1988 and 1995 NSFG surveys, we show that shifts in fertility timing have occurred disproportionately for the more educated and for whites (compared to the less educated and to African Americans). Such timing shifts imply that the underlying period quantum of fertility is considerably higher for college-educated women and for whites than suggested by the standard total fertility rate. Applying the Bongaarts-Feeney model (1998), we decompose observed racial and educational differences in age-order-specific fertility rates and TFR into tempo and quantum components. We find that a modest part of educational differences and a substantial part of racial difference in period fertility can be attributed to differential changes in tempo. Analysis by race and education shows a clear interaction: higher fertility among African Americans is confined to the less educated.

INTRODUCTION

In the U.S for the period 1940 to 1980, Rindfuss and Sweet (1977) (Sweet and Rindfuss, 1983) document substantial and persistent racial and educational differences in fertility. More recent studies suggests that these differences remain.¹ The key fertility measures used in these studies are period age-specific rates and their sum, the total fertility rate (TFR). Changes in these period measures can reflect changes in the number of children women have, *quantum*, and/or changes in the ages or timing of childbearing, *tempo* (Ryder, 1990). Over the past few decades, substantial increases in ages at childbearing have been observed, especially among better-educated women (compared to the less-educated, Martin, 2000; Rindfuss, Morgan, and Offutt, 1996) and whites (compared to blacks, Chen and Morgan 1991).² Have these timing changes masked convergence in the quantum component of fertility? If so, the usual interpretation of race/education differentials would shift from ones focusing on more births per woman to ones focusing on differential trends in fertility timing.

In this paper, we revisit fertility trends by race and educational groups. Using the Bongaarts-Feeney (1998) method for adjusting the observed TFR and U.S. time series data from 1960 to 1994 (constructed from Current Population Surveys and the National Surveys of Family

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^{*}Yang and Morgan share first authorship. Paper presented at the 2002 Annual Meetings of the Population Association of America, May 8–10, Atlanta, Georgia.

¹In recent decades our understanding of fertility trends by race and education come primarily from vital registration data, e.g., Hamilton, Sutton, and Ventura (2003) for most recent data on fertility by race. Matthews and Hamilton (2002) on shifting ages of childbearing, and Lewis and Ventura (1990) on fertility by mother's education.

²Chen and Morgan (1991) find that delayed child-bearing during the 1970s and 1980s was concentrated among whites. Matthews and Hamilton (2002) report similar increases for first births and all births for years 1989–2001.

Growth), we determine (1) whether the fertility differentials documented for the 1970s and 80s continue into the 90s and (2) whether current estimates and understanding of racial and educational differences are altered by adjusting the TFR for shifts in fertility timing.

RACIAL AND EDUCATIONAL DIFFERENTIALS IN FERTILITY

Social demographers focus substantial attention on fertility differentials by race and education. There are several important reasons. First, race and education are central factors in the American stratification system. As such, data on education and race are routinely collected (in censuses, surveys, and on vital registration records) allowing for examination over substantial periods of time. As noted above, these data show substantial and persistent differences. Social scientists evaluate theories of social change and structure partly on the basis of their ability to account for these “stylized facts.” Thus, getting these facts “right” is fundamental to our construction of basic explanations and has practical import.

For instance, based on a multi-decade study of U.S. fertility, Rindfuss and Sweet concluded that all major groups (including race and education groups) participated in pervasive period shifts in the post World War II period. Thus, compositional shifts (e.g., shifting educational distributions) in the population were not important factors influencing fertility trends in the 1940–80 period (Rindfuss and Sweet, 1977; Sweet and Rindfuss, 1983). The impressive stability of racial and educational differences (for race differences see Morgan 1996: Figure 17) led the U.S. Census Bureau during the 1990s (U.S. Bureau of the Census 1992; Day 1996: 4) to forecast no convergence in white and African American fertility in their long-term projections.³

There are two general scenarios used to theorize about the magnitude and change in educational or racial differences. The first is a modernization/assimilation scenario. Ryder (1973) personified the modernization aspect when he predicted that differential fertility would disappear as all regional, educational, and race/ethnic groups come to “participate more fully in modern life.” In his view, differential fertility was transitional since the effects of modernization (while initially concentrated in physical and social space) would, in time, become pervasive. The driving force in this theory is economic development that integrates key societal institutions and promotes frequent interaction among citizens.

In this traditional social change scenario, the harbingers of change are the more educated. This traditional argument would suggest that cross-sectional educational differences imply continued fertility decline because a) in the future a larger proportion of women will have high levels of education and b) the anti-natalist forces that now impinge most directly on more educated women will become more pervasive in the future. Indeed, American women are obtaining higher educational degrees at unprecedented rates, and their attained educational levels now exceed those of men—a trend typical of many economically developed countries. Female labor force rates have been increasing consistently, and more women are entering career type jobs. While speculative, we would argue that this revolution in women's educational and career goals/attainments is irreversible.⁴ But does this irreversible shift make further fertility decline inevitable? Fertility levels among more educated women might provide a hint as to “how low fertility will go.”

An alternative scenario stresses historical/cultural continuity in key institutions that, in turn, perpetuate group differences in behavior.⁵ Education is a key stratification mechanism in

³Beginning in 1999 the Census Bureau projections did assume slowly narrowing racial differences. But differences remained in (middle range) projections for both 2050 and 2100 (see Hollmann, Mulder, and Kallan 2000: Table B).

⁴A major reason is that specialization in a housewife role is not rational in settings where long-term marriages cannot be guaranteed. When union dissolution is common, partners are motivated to invest in their own human capital (see Joshi, 1998).

contemporary American society. Those with low levels of educational attainment are likely to hold jobs where the pay is low, the work repetitive and typically uninteresting, and there is no job ladder (or career advancement opportunities). Such jobs may conflict less with childbearing/parenting because temporary exits from the labor force (due to births or child care) do not greatly affect earnings. Also, these jobs may compete less with parenthood because the real or expected experience of parenthood may be seen as more rewarding than these jobs. At the other extreme, those with high levels of education likely have jobs with higher wages, a steeper age-income profile, more interesting and challenging work tasks, and opportunities for occupational advancement up well-structured career ladders. Childbearing and parenting may compete with these more attractive nonfamilial opportunities. These contrasts may be sharpened further by the increased educational assortative mating in the U.S. (Kalmijn, 1991; Mare, 1991) and the reduced job discrimination against women.

Race/ethnic trends and differences are equally important in understanding American fertility trends and patterns. Like education, race/ethnicity plays a major role in U.S. social stratification. One common explanation for the high U.S. aggregate fertility level is the impact of minority groups. Indeed, the variation across the four major groups (white non-Hispanic, Hispanic, African American, and Asian measured in vital registration data) is substantial (Ventura et al., 2000). If Hispanic and African American (i.e., black) fertility converged to white levels, fertility in the U.S. would decline. But this answer only begs additional questions: why are there sharp race/ethnic differences? And will they persist? Moreover, it misses the point that even among non-Hispanic whites, the vital registration estimates the TFR to be 1.84, which is still high in contrast to many countries, like Italy and Japan. Because of data limitations (described in a subsequent section) we examine non-Hispanic whites and African Americans in this paper.

As in the case of education, there is an institution-based explanation that does not anticipate the disappearance of differentials. For instance, Morgan and colleagues have argued that African American families' different origins and experiences make their response to current situations different than those of European origin Americans (Morgan, McDaniel, Miller, and Preston, 1993; Pagnini and Morgan, 1996; Preston, Lim, and Morgan, 1992). These arguments could account for persistent racial differences in family structure, marriage, and fertility in the U.S. While a tendency to maintain traditional institutions may be widespread, this tendency is no doubt facilitated by race/ethnic segregation in key aspects of social life.

The significant fertility differentials by education attainment and racial/ethnic group may also be owing to the differentials of unintended fertility among these groups. Belanger and Ouellet (2002) and Frejka (2004) noted the role of high prevalence of unplanned births in the U.S. in explaining the "curiously high" fertility of the USA in the era of low fertility in the developed societies (Caldwell and Schindlmayr, 2003). Frejka (2004) also noted the positive association between poverty, low levels of education, and unplanned childbearing in all race/ethnic groups. He found that unplanned fertility was considerably higher among the poorly educated of all race/ethnic groups than among the majority of the population due to their limited access to contraceptive technology. He believed that this gave rise to the much higher total fertility among the poorer and poorly educated segments of the population. This perspective is helpful to understanding the components of fertility differentials by intentions of births and is viewed as complementary to the structural/institutional explanations outlined above. In fact, the kinds of forces in each explanation could all operate at once. We endeavor, however, to illuminate the role played by the tempo effect in affecting the estimate of period TFR and, therefore, focus on data on fertility by education and race for children ever born and the temporal trends of the overall fertility differentials.

⁵Inglehart and Baker (2000) acknowledge the import of cultural values and propose revisions of modernization theory.

Another reason “why we care” about fertility differences by race and education can be found in the minority group status literature. This literature contrasts a social characteristics hypothesis with a minority group status hypothesis. According to the social characteristics explanation, fertility differences between majority and minority groups (whites and African Americans, respectively) are viewed as arising primarily from differences in their socioeconomic characteristics (frequently measured by educational attainment). It is argued that once minorities achieve parity in socioeconomic characteristics with the majority group, fertility disparities are eliminated (Bean and Marcum, 1978). From this perspective, fertility differentials between whites and minority racial groups will diminish once structural assimilation with respect to education takes place, an argument largely compatible with the traditional modernization argument that we attribute to Ryder above.

The minority group status hypothesis, as formulated by Goldscheider and Uhlenberg (1969), posits that race or minority group membership can have an independent effect on fertility, even when the effects of other socioeconomic factors are controlled. The primary mechanism is greater fertility limitation among minority group members in order to counteract the disadvantages they face when struggling for upward social mobility. This mechanism operates only among minority group members that have some success obtaining skills that might allow for upward mobility. Therefore, in this context the minority group status hypothesis suggests an interactive effect of race and education on fertility (i.e., the more educated segment of the minority group would curtail fertility even more than do comparable persons in the majority group). While this literature contains mixed results (some due to a focus on different minority groups. See Johnson and Nishida, 1980; Lee and Lee, 1959; Sly, 1970); most studies find some evidence for interactive effects. For instance, Johnson's (1979) study found higher African American than white fertility among the less educated but no racial differences among the highly educated. The sharp differential among African Americans is consistent with an effect of minority group status. Bean and Swicegood (1985) entertained an alternative theoretical framework, namely, the opportunity costs hypothesis, to the minority status hypothesis in their studies of female education and fertility among Mexican Americans and blacks in the U.S. The tests of statistical interactions show support for the steeply declining fertility with rising education predicted by the minority status hypothesis among blacks, but show that the opportunity costs perspective better explained the education-fertility relationship among Mexican Americans.

We do not conduct a formal test of these theories in this study. Instead, we present evidence on patterns of the race-education-fertility relationship that may shed light on previous theories on group disparities in fertility. We achieve this in two ways. First, we stress that adequate explanation of fertility differentials by race and education must take into account differential timing. Explanation and consequences of differential timing can be different than for differential family size (i.e., quantum). Second, data analyzed in most studies on fertility differentials have been limited to the 1960s and 1970s, so relatively little is known on the trends in fertility differentials in the late 1980s and into the 1990s. We examine racial and educational differences into more recent periods.

DATA AND MEASUREMENT

In order to examine differential change across multiple decades, we combine data from the 1980, 1985, 1990, and 1995 Current Population Surveys and data from recent (1988 and 1995) rounds of the National Survey of Family Growth. Our analysis will examine fertility trends and differentials by the following factors: age, parity, education, race, and year. The unit of analysis in this study is *a year at risk of a birth*. The dependent variable is whether a birth occurred, *yes/no*. We calculate birth rates combining risk sets across parity but distinguishing

births by parity. This strategy allows age-parity specific rates to be summed to equal parity specific TFRs. Parity specific TFRs, in turn, can be summed to equal the population TFR.

Each CPS survey contains a *partial* fertility history for women aged 15–65⁶ at the time of the survey. Women are asked the dates of their first four births and their last birth; thus for women who have borne 5 or fewer children the CPS contains a complete birth history. Birth dates for higher parity births are not recorded unless they are the last birth. Rindfuss, Morgan, and Offutt (1996: Figure 2) show a comparison of total fertility rates (TFR) estimated from vital registration data and the pooled CPS. The correspondence is impressive and differences result from the omission of some higher order births in the CPS. In our results, this bias will be concentrated in estimates of parity 3+ birth rates for pre-1975 time periods.

Several issues require discussion here; others will be discussed in conjunction with the substantive results. First, given the race and ethnic fertility differences that exist and the expectation that race/ethnic group might interact with education, it is important to allow for separate estimates. In analyses that follow we will examine non-Hispanic whites and African Americans. We exclude Hispanics for three reasons. First, as many have noted (see for instance, Bean and Tienda, 1987) the Hispanic category contains diverse groups with very different levels of fertility. Second, the relative sizes of the constituent Hispanic groups have changed dramatically within the period of study. Finally, substantial portions of the Hispanic population are recent immigrants (Bean and Tienda, 1987: Ch. 3). Only in the 1995 CPS and NSFG data can we distinguish which parts of an immigrant woman's fertility history occurred in the United States. Together these factors make interpretation of Hispanic changes across time especially problematic.

A disadvantage of the educational data in the CPS is that it measures educational levels at the time of the interview. These educational reports may differ from 1) the education attained at the time of the birth of a child and 2) the highest level of education that women might eventually complete. The first occurs because some women return to school after they have become a mother. Such sequencing is relatively unusual and usually occurs at a comparatively young age. But the likelihood of post-birth schooling varies by characteristics such as race (Rindfuss et al., 1988: Table 17) and by time period (Rindfuss, 1991) that suggests caution in the interpretation of results. The second possibility can be quite common for women at the youngest ages. Such women have not had time to attain high levels of education and thus, by being included in the denominator, they bias downward the fertility of those who will accumulate less education. We have reduced this bias here by using educational information for women 22 years of age and over at the time of the survey.⁷ Also, note that we examine only the contrast of 12 or fewer years of schooling with 13 or more. Thus, our results are affected only to the extent that women pass the 12 vs. 13-year threshold at or after age 22⁸.

For our purposes, the CPS and NSFG data have a number of advantages over other potential data sets. Childbearing in any given year in the U.S. is a relatively rare event, and so the large sample size in the combined CPS file allows us to estimate age and period specific rates at much finer detail than would be possible with any other available survey or set of surveys. Second, compared to rates calculated from vital registration data, the CPS data has the

⁶This age range is 15–65 in the 1990 and 1995 CPS and 18–65 in the other two CPS's (we used all women 15–65 in CPS 90 and 95 for our analysis).

⁷Note we do not exclude women less than age 22 at the survey because this would hinder our ability to estimate fertility for the most recent periods. Since data at these ages is only problematic for education, we use observed data on all variables except education and impose educational differentials observed in the previous 5-year period for these youngest women. See Appendix A for more discussion.

⁸We do not exclude these younger women from our analysis since measurements of all other characteristics are not impacted by current age. For those at young ages *at the time of the survey*, we assign the age-specific educational fertility differential estimated for the previous five year period (i.e., from women older at the time of the survey). Interested readers should write to the authors for details. Appendix B includes these details for reviewers.

advantage that the attributes of women used to calculate the numerators and denominators come from the same source. In the case of rates calculated using vital registration data, the denominators are supplied from census data, which is projected forward during the intercensal years. While for many characteristics the vital registration rates are fine, for education the wording of the question is substantially different in the two data sources. Further, some states do not collect data on the education of parents on birth certificates. For example, in 1988, the following states did not collect data on the education of parents: California, Texas, Washington, and New York (except New York City). Morgan et al. (1999) also show that differential measurement of race in vital registration and census affects trends estimated from vital registration data. They argue that the CPS (and retrospectively reported data in general) provides a more reliable source.

ANALYTIC STRATEGY

Demographers have long known the weakness of period rates of fertility as measures of quantum (or number of children). The widely used total fertility rate (TFR), for instance, reflects both quantum and tempo components. Bongaarts and Feeney (1998) have recently proposed a method for adjusting the observed TFR. Their adjusted rate (TFR') is an estimate of what the TFR would have been if there were no shifts in fertility timing. It is not a prediction of eventual cohort fertility; rather it is a better measure of the concept of "period quantum" (compared to the unadjusted TFR). We use their procedure on 35 years of U.S. time series data to estimate racial and educational differences in fertility as purged of tempo effects. In order to detect whether the observed educational/racial differences in birth rates are due to tempo changes, that is, different timing of births by birth orders, we apply the Bongaarts-Feeney model to adjust for the effect of timing on estimated birth rates. As proposed by Bongaarts and Feeney, the timing of births during a particular year may be estimated by dividing the observed TFR_i at each birth order by $(1 - r_i)$ where r_i is the change in mean age at childbearing (MAC) at order i during the time period. This can be expressed as the following equation:

$$TFR'_i = TFR_i / (1 - r_i) \quad (1)$$

To calculate r_i , the rate of change in mean age at childbearing for a calendar year, we adopt B-F's method that averages the values of MAC_i for years $y - 1$ and y to obtain a value for the beginning of year y , and the values for years y and $y + 1$ to obtain a value for the end of year y , and then take the difference, which reduces to

$$r_i(t) = 0.5 * (MAC_i(y+1) - MAC_i(y - 1)) \quad (2)$$

Since the observed data on TFR and MAC are subject to certain degrees of sampling variances, we employed a modeling strategy that fits smoothed curves to the data. We estimated multivariate group logit regression models of birth rates by parity using the following covariates: education, race, age, and year. The subsequent results are presented using the predicted TFR and MAC from the preferred models for each of the four parity groups. Further discussion of model selection is included as Appendix B.

The Bongaarts-Feeney approach has its critics (see Kim and Schoen, 2000; Van Imhoff and Keilman, 2000). But the model has also performed well in a number of formal statistical tests and applications (Bongaarts and Feeney, 1998; Zeng and Land, 2001, 2002). Our position is that the B-F adjustment can be a useful tool if used and interpreted appropriately.

RESULTS

Figure 1a and 1b show observed and predicted (i.e., smoothed by statistical analysis on a parity by parity basis) TFR by education and by race from 1960 to 1994. These trends are clearly not consistent with convergence expected from an assimilation model, but are reminiscent of the remarkably pervasive changes documented by Rindfuss and Sweet (1977), Sweet and Rindfuss (1983), and Ventura et al. (2000) and thus suggest the effect of persistent structural factors. However, these data are highly aggregated and have not been adjusted for timing differences, thus we reserve subsequent comment.

A key hypothesis is that differential changes in birth timing are impacting levels and trends of educational and racial groups differently. Figure 2a and 2b show observed and estimated trends in mean age at childbearing (MAC) for two educational groups and two racial groups. The differential trends are in the direction expected from previous work. Specifically, after 1975 or so the trends toward later ages at childbearing are concentrated among those with more education (Rindfuss, Morgan, and Offutt, 1996) and among whites (Chen and Morgan, 1991). For the more educated (Figure 2a), mean age at childbearing increased by approximately 2 years over the period of study. And the less educated show a modest increase and then a decline to levels similar to those of 1960. The mean age at child-bearing educational differential increased consistently across the period of study. (The changes documented here occurred disproportionately at parity 0 (1st birth) and parity 1 (2nd birth), results not shown here.)

Figure 2b shows changes in mean age at childbearing for blacks and whites (all parities combined). Both whites and African Americans show an increase, roughly two years for whites and one for African Americans. The racial differential expands substantially only beginning in the 1980s.

In sum, results from Figures 1 and 2 suggest that a portion of educational and racial differences might be attributed to differential tempo changes. We use the Bongaarts-Feeney adjustment to isolate the quantum component of TFR (i.e., TFR'). For instance, in Figure 3a and 3b we show parity specific TFR and the associated adjusted TFR, for less and more educated subgroups. As suggested by the aggregate data on mean age at childbearing, adjustments for tempo changes have minor effects for the less educated. Thus, the predicted TFR and adjusted TFR (TFR') are virtually identical at each parity. In contrast, the adjustments for the most educated show clear effects for parity 0 and 1. This means that postponement of the 1st and 2nd birth has had a clear, depressing effect on the predicted period TFR. Interestingly, since the change in MAC was roughly constant across this entire 1960–90 period, *trends* for the more educated are not greatly affected. One can see this more clearly when the results are combined across parity, as in Figure 4. The level of quantum TFR (or adjusted) is underestimated consistently for the more educated. As noted earlier, although demographers know well that timing shifts influence period rates, the ability of timing shifts to have consistent effects across multiple decades is non-obvious. This reflects the lasting impact of the tempo effect on period fertility level over time. First, the continuation of the pattern of delayed childbearing among better educated women over the decades translates into the continuation of the decline in period fertility. This is shown by the largely downward trends of the TFR's in Figure 4. Second, since the timing shifts of births operate relatively constantly for the time period examined (the slope of the MAC for more educated in Figure 2a is approximately linear), the distance between the TFR and tempo-adjusted TFR' representing the tempo effect remains approximately constant. Bongaarts and Feeney (1998) show similar sized biases at the national level that persist for approximately two decades.

Parallel adjustments on racial differences have similar effects by parity (i.e., greatest at lower parities) but have a more dramatic effect *on trends*. We show only the results for all parities

combined in Figure 5. The result is quite dramatic: the black and white adjusted TFR's have almost converged to the same level by the end of the study period. In other words, corrected for different trends in fertility timing, racial differences in number of births (quantum) have declined substantially. Given well-known differences in educational attainment by race, we now examine race effects for those with less and more education. Figure 6 shows the trend in education by year and race 1960 to 1990. Educational attainment is increasing across time for both blacks and whites. There is no evidence of convergence in educational trends measured by this dichotomy (< 13 and 13+).

For each education/racial group, Figure 7 shows the estimated TFRs as solid line. The adjusted TFRs are shown as a line with a set of marked points. The data for each of the four groups is represented by a different color. The degree of tempo bias is reflected in the distance between the two lines of the same color. The trends in TFR and TFR' are very similar for blacks and whites with 12 or fewer years of education. Both measures indicate a clear racial difference of about 0.5 birth for the majority of the period. Trends for more educated whites and blacks are more complex. First, for whites there are clear differences in TFR and TFR'. For the entire period, TFR is less than TFR', indicating the effects of a persistent shift toward later ages of childbearing. TFR' is about 1.1 times as great as TFR. For blacks the pattern is different with timing effects substantial early in the series and much smaller in more recent years.

The second feature of the trends for the more educated is the disappearance of higher black fertility and the convergence of black-white quantum fertility in the 1990s. This trend is observed whether one focuses on TFR or TFR'. Johnson (1979) found that racial disparities in average number of children ever born vary by educational categories. Among those having an elementary school education and those dropping out of or having completed high school, black women had more children on the average than their white peers. But within each level of college attendance, no black-white differences in mean fertility were found. Therefore, our results are highly consistent with Johnson's findings on racial disparities in fertility in 70s. And we find that this trend has continued into the 90s. In sum, education effects remain strong throughout and racial differences persist only among the less educated.

DISCUSSION AND CONCLUSION

We began with the observation that fertility tempo changes were different by education and by race. We speculated that these differences might consistently affect our interpretation of trends. More specifically, we speculated that some convergence in the underlying quantum component of period fertility was occurring but was being obscured by differential timing shifts. Analysis of race-specific and education-specific trends provided some support for these expectations (results not shown here). But analysis of race-and-education-specific trends (our focus in this paper) shows the weakness of separate analyses: the effects of race and education are clearly interactive. By 1990, the fertility trends show three distinct groups defined by race and education: less educated blacks have the highest fertility (TFR = 2.2–2.4), educated whites and blacks have the lowest fertility (TFR = 1.6–1.8). Less educated whites have fertility levels between these two groups (TFR = 2.0–2.1).

One can see the effect of tempo changes on fertility levels clearly in Figure 8. The correction for tempo changes increases the adjusted TFR for all race-education subgroups except for blacks with fewer than 13 years of education. The quantum component of TFR for more educated whites increases by a factor of 1.11 in the 1990–1993 period. The effects of the adjustment are less for other groups.

The persistence of educational differences fits well with arguments at the outset that nonfamilial alternatives would compete with childbearing more strongly in the case of the more educated. The view that the more educated are harbingers of future change suggests that the

behavior of the less educated would converge toward that of the more educated. We see no evidence of educational convergence and anticipate that educational differentials are stable features of the modern American fertility pattern. Although the substantially higher TFR' for the more educated still implies below replacement fertility, the levels estimated are not dramatically below replacement. For the more educated women in the latter part of the 1980s, our adjusted TFRs implied roughly 20 percent of white women childless and a TFR of 1.78.

We based our analyses on only two education categories, namely, those having high school education or less and those having some college or more. This dichotomy may concern some who would prefer a less aggregated measure. But both previous research and our preliminary analyses suggest that this contrast captures well the essence of educational differences on fertility timing and number. Johnson (1979) examined racial differences in mean fertility within three educational categories: college education, high school, and elementary school education. And she found that the largest proportion of the variance in fertility by race and education was produced by the difference in college educated women and those with less education, although those having attended college and having completed high school each had significantly fewer children ever born than those with less schooling. And no significant differences in mean fertility were found between women with elementary school education and those with high school education or less. We used four educational categories in the preliminary analyses: < 12, 12, 13–15, and 16+ and found very close trends in fertility for high school schooling or less and for some college or more. Therefore, we combined them into two groups for convenience of final analyses and presentations without significant loss of information on educational differences in fertility.

In terms of our arguments about race, our results are mixed. We find stable differences for the less educated and convergence for the more educated. Thus, neither the assimilation model nor a cultural/historical continuity model finds consistent support when education is taken into account. The trend, however, is consistent with Johnson's findings on interactive effects of race and education on fertility (1979): black fertility is greater at lower levels of education, but this difference disappears at high education levels. She labeled this the “weak form of the social characteristics hypothesis.” Her findings were considered more reliable than those obtained earlier because she sorted out the effects of education and race after controlling for a great number of socioeconomic and demographic variables (Kposowa, 1997). Consistent with Johnson, our results suggest that because of their greater integration into major economic, educational, and political institutions, highly educated blacks have undergone a sociodemographic transition such that their fertility behavior becomes similar to that of whites with equivalent education. Absent this integration, the fertility pattern of the less educated blacks remains distinct. The persistent divergence of black fertility by education levels is also consistent with evidence of increasing socioeconomic bifurcation in the black population in general (Bean and Bell-Rose, 1999; Farley, 1996; Grant, Oliver, and James, 1996). Therefore, the black fertility differentials may reflect one of many forces that contributed to the dualistic portrait of African Americans overall well-being at the end of the twentieth century.

It is known that the merit of the B-F method rests on the assumption of an invariant shape of the fertility schedule and the violation of such assumption may lead to inflated adjustment of the tempo effect (see Zeng and Land, 2001 for detailed empirical tests). Recent methodological studies in formal demography, however, suggest that the possible bias may not be large enough to affect the above results. Zeng and Land (2001, 2002) show that the annual changes in the shape of the fertility schedules in the United States for most of the 20th century are approximately constant except in abnormal conditions. Both their sensitivity analysis (2001) and Kohler and Philipov (2001)'s work show the biases in the B-F formula are quite small in this circumstance and the B-F method is not sensitive to its underlying assumption about the invariant fertility schedules and equal changes in timing across ages. Furthermore, we applied,

in supplemental analyses, Zeng and Land (2002)'s method of adjusting for the potential bias in the period tempo of fertility under conditions of changing tempo. We found nearly identical results. In all, the findings of persistent education differences in fertility and convergence of fertility levels for highly educated black and white women are real rather than artifactual.

Acknowledgments

This paper has benefited from comments by our colleagues in seminars at Duke. This research was supported by a grant from the National Institutes of Health (HD41042). Zeng Yi and Ronald R. Rindfuss have contributed valuable advice.

APPENDIX A

Imputation for Missing Data

By selecting women aged 22+ at survey date, the shaded area in Figure A.1 is excluded (for each education-race-parity group). These data are excluded because women have not yet had time to accumulate 13+ years of education. The same problem does not exist for the race variable that is an ascribed status. We impute values in this area for each race-education-parity subgroup. Note that ONLY education cannot be observed directly. Thus, the imputed values sum to equal the observed race-parity marginals and education specific values are constrained to have differentials observed in the previous 5-year period. Thus there is no “new” information on educational differences gleaned from data represented in the shaded area but imputing these data allow us to extend the analysis to 1994.

APPENDIX B

Model Selection

Observed TFRs were modeled using group logit regression techniques (STATA command: `blogit`). The following table lists the content and coding of all covariates in the models.

Variable	Content and Coding
B/Risk	Dependent Variable: the log odds of birth = Birth/Number of women at risk
A1 – A4	Age and its functional form A1 = linear scoring ([15–44]–30) A2 = (A1) ² A3 = (A1) ³ A4 = (A1) ⁴
Y1 – Y4	Year and its functional form Y1 = linear scoring ([1960–1990]–1975) Y2 = (Y1) ² Y3 = (Y1) ³ Y4 = (Y1) ⁴
R	Race = 1 if White; = 0 if Black
E	Education = 1 if years of education <= 12

Variable	Content and Coding
	= 0 if years of education > = 13
Y1A1 – Y2A2	Interactions between Year and Age $Y1A1 = Y1 * A1$ $Y1A2 = Y1 * A2$ $Y2A1 = Y2 * A1$ $Y2A2 = Y2 * A2$
Y1R Y2R	Interactions between Year and Race $Y1R = Y1 * R$ $Y2R = Y2 * R$
Y1E Y2E	Interactions between Year and Education $Y1E = Y1 * E$ $Y2E = Y2 * E$
A1R A2R	Interactions between Age and Race $A1R = A1 * R$ $A2R = A2 * R$
A1E A2E	Interactions between Age and Education $A1E = A1 * E$ $A2E = A2 * E$
RE	Interaction between Race and Education
Y1A1R – Y2A2R	Three way interactions between Year, Age, and Race: $Y1A1R$ $Y1A2R$ $Y2A1R$ $Y2A2R$
Y1A1E – Y2A2E	Three way interactions between Year, Age, and Education: $Y1A1E$ $Y1A2E$ $Y2A1E$ $Y2A2E$
A1RE A2RE	Three way interactions between Age, Race, and Education
Y1A1RE – Y2A2RE	Four way interactions between Year, Age, Race, and Edu

We conducted BIC tests to search for a preferred model for each parity. The results of the BIC test for parity 0 are shown below as an example. Model 13 is the preferred model and fitted to the data at parity 0. This yields the predicted TFR at parity 0. Similar procedures yield predicted TFR's for parity 1 to parity 3+. The sum of parity-specific TFR's is the total predicted TFR.

Model	Covariates	Log-L	χ^2	d.f.	np	ln(N)	BIC
1.	Y1 A1 R E	-374843		4		14.883	
2.	Y1Y2Y3Y4 A1A2A3A4 R E	-357848	33990	10	6	14.883	33900.70
3.	Model 2+(Y1A1 – Y2A2)	-357246	35194	14	10	14.883	35044.87
4.	Model 3+(Y1R Y2R)	-357209	35268	16	12	14.883	35089.43
5.	Model 4+(Y1E Y2E)	-357132	35423	18	14	14.883	35214.14
6.	Model 5+(A1R A2R)	-355244	39197	20	16	14.883	38959.00
7.	Model 6+(A1E A2E)	-350328	49030	22	18	14.883	48761.63
8.	Model 7+RE	-350146	49393	23	19	14.883	49110.27
9.	Model 8+(Y1A1R – Y2A2R)	-350049	49587	27	23	14.883	49244.82
10.	Model 9+(Y1A1E-Y2A2E)	-349866	49954	31	27	14.883	49552.49
11.	Model 10+(Y1RE)	-349864	49957	32	28	14.883	49540.63
12.	Model 10+(A1RE+A2RE)	-349775	50136	33	29	14.883	49704.33
13.	Model 10+(A1RE+A2RE) + Y1RE	-349765	50156	34	30	14.883	49709.14

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Fig. 1.
Observed and Predicted TFR by Education and Race: CPS & NSFG

Fig. 2.
Observed and Predicted MAC by Education and Race: CPS & NSFG

Fig. 3.
TFR by Parity and Education

Fig. 4.
Estimated TFR and Adjusted TFR': By Education

Fig. 5.
Estimated TFR and Adjusted TFR': By Race

Fig. 6.
Percentage Women with Some College Education or More (Educ ≥ 13)

Fig. 7.
TFR and TFR' (Adj. TFR) by Race and Education

Fig. 8.
1990–1993 TFR and TFR': By Race and Education

Fig. A.1.
Data Imputed as a Result of Selecting Women Age 22+ at Survey Date