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Differential Fertility, Intergenerational Educational Mobility, and Racial Inequality

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Recent commentary has suggested that the relatively high fertility of poorly educated women tends to dampen the average intellectual qualifications of the population. To evaluate this claim requires a model of population growth that takes account of fertility differences among women with varying levels of educational attainment and patterns of intergenerational educational mobility. This article describes such a model and applies it to census, vital statistics, and survey data on fertility, mortality, and intergenerational mobility data for African-American and white women in the United States from 1925 to 1995. Although fertility rates are generally higher for women at the lower end of the educational distribution, this has had a negligible effect on the trend in average educational attainment. These fertility differences are neither large enough nor consistent enough to lower educational attainment. More important, high rates of intergenerational educational mobility almost completely offset the effects of differential fertility. Although black women have historically had more children than white women, fertility differences within and between the races have not had much effect impact on educational inequality between the races. Indeed, in the most recent period, only white women continue to exhibit a negative correlation between education and fertility. Thus, if recent fertility patterns persist, they will accelerate a convergence of educational attainment between blacks and whites.

A recurrent concern in many societies is that not all groups reproduce at the same rate. Differences in fertility among social groups alarm those who believe that changes in relative numbers portend changes in patterns of dominance,

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inequality, or average well-being. For example, Herrnstein and Murray (1994) speculates on the ‘‘dysgenic’’ effects of the relatively high rates of fertility among persons with low education and intelligence. The relatively high fertility rates of low ability and low education women, they argue, is likely to diminish the country’s average intellectual ability and to polarize a ‘‘cognitive elite’’ and a growing number of persons who have limited intellectual and economic capacity. But others have considered related demographic phenomena and drawn opposite conclusions. In his classic statement about the connections between demography and social stratification, Sibley (1942) argued that a large, steady influx of persons with low socioeconomic origins is essential to maintain high rates of upward social mobility and to prevent the class conflict that occurs in a demographically static society.

This paper reports an investigation of the effects of differential fertility patterns among African-American and white women for secular trends in educational attainment within each of these populations and for race differences in educational attainment. This investigation is part of a set of studies in which I examine the implications of demographic trends for aggregate trends in educational attainment and other socioeconomic outcomes in the United States over the past 70 years (Mare, 1995b). This research focuses on the combined effects of demographic factors—including differential fertility and mortality, marriage, assortative mating, family structure, and immigration—and of intergenerational social mobility on the distribution of socioeconomic characteristics. In this research I develop models that combine population renewal with intergenerational mobility for the 1925–1995 period and investigate the aggregate effects of demographic trends on socioeconomic well-being and inequality with an emphasis on the trend and distribution of educational attainment.

In a recent paper (Mare, 1996) I reported a preliminary investigation of the effects of relatively high fertility of poorly educated women on secular trends in educational attainment and other socioeconomic indicators. Relying almost entirely on published tabulations, I explored the degree to which the low fertility rates of highly educated women has dampened the secular growth of educational attainment. I also examined the degree to which the effects of differential fertility depend upon the degree of intergenerational mobility (Lam, 1993; Preston and Campbell, 1993). I developed a model of population growth that takes account of trends in differential fertility by educational attainments of mothers and of social mobility. The analysis suggests that fertility patterns have had a small effect on educational trends, partly because intergenerational mobility rates have been high and partly because fertility differences by educational attainment have not been large enough to have a large effect in the long-run.

The present article builds on the preliminary investigation analysis by exploring the effects of patterns of differential fertility and intergenerational mobility on racial inequalities in educational attainment. It shows the degree to which differential fertility within the black and white populations has contributed to differences in the educational attainments of these two groups. In addition, it extends my earlier analysis by considering a longer span of time (1925–1995 vs 1940–1990) and using a much more comprehensive and higher quality data on differential fertility, differential mortality, and intergenerational social mobility.

Although this article speaks to contemporary issues concerning social inequality, it is motivated by conceptual issues about social stratification as well. To understand how social inequality is maintained or modified over time, one must examine the process by which a socioeconomically differentiated population reproduces itself. The usual approach to such problems in the literature on social stratification and mobility is to focus on the intergenerational transmission of socioeconomic status. Most research on intergenerational mobility during the past three decades focuses on the associations between the socioeconomic positions of parents and offspring and elucidating the mechanisms that underpin these associations. Yet although these studies show superficially how socioeconomic distributions in one generation give rise to distributions in a subsequent generation, they do not reveal how intergenerational mobility is implicated in changing those distributions from one period to the next. The measurements of family background used in typical surveys of stratification do not represent any specific cohort or period and thus standard social mobility tables are not appropriate transition matrices required for transforming a population over time (Mukherjee, 1954; Duncan, 1966). Unfortunately, the argument has, for the most part, not served as a challenge to solve this problem. Rather, most researchers have simply lived with this limitation of their models.

As a result of this limitation, stratification research tends to avoid such aggregate, dynamic questions as: How is the socioeconomic distribution of persons or families in one period transformed into the distribution at a later period? How does intergenerational and intragenerational mobility contribute to that transformation? What are the contributions of status transmission, differentials in levels and timing of fertility, and exogenous change in socioeconomic opportunity to the transformation of socioeconomic hierarchies? How have demographic constraints on opportunity structures affected stratification processes? How have these effects changed over time? These central questions of stratification research require different models from those that are in widespread use and a change in orientation away from exclusive focus on microlevel statistical relationships.[1]

In the balance of the paper, I (1) briefly review previous research; (2) present the research questions that guide the analysis; (3) describe the population projection model that is used to investigate these questions and the way in which this model is used to simulate trends in educational attainment for blacks and

[1] In fact Blau and Duncan (1967) recognized the role of demographic processes by including detailed analyses of the effects of family structure, family size, assortative mating, fertility, and migration in their monograph. Like the chapters on social mobility and the process of social stratification, these analyses have spawned much subsequent work. Unfortunately, each of these topics has its own, largely independent literature. There has been relatively little effort to synthesize these topics into a common analytic framework.

whites; (4) describe the data that are used in these analyses; (5) present results of a variety of simulations carried out under alternative assumptions about trends in fertility, mortality, and intergenerational mobility; and (6) present the major conclusions of the analysis.

PREVIOUS LITERATURE

Despite the individualistic focus of most social stratification research, some demographers some have examined the aggregate relationship between fertility and intergenerational mobility. Matras (1961, 1967) presented a projection model for a one-sex population differentiated by both age and occupation. Preston (1974) analyzed the implications of differential fertility for differences in occupation distributions and occupational mobility opportunities for black and white men. Preston's article is a point of departure for the analyses reported in this paper. Johnson (1980) sketched a two-sex population model of assortative mating, differential fertility, and the intergenerational transmission of religious affiliation. Lam (1986) examined the effects of differential fertility and intergenerational mobility on the time path of income inequality in Brazil. Preston and Campbell (1993) developed a two-sex model for the intergenerational transmission of intelligence (IQ). They showed that, under broad conditions, fixed rates of fertility and assortative mating by level of IQ lead to a stable distribution of IQ rather than, as intuition might suggest, to a distribution that is increasingly concentrated at the level of IQ where fertility is highest.

The present investigation follows these prior studies, but differs from them in several important respects. First, it focuses on formal educational attainment, rather than IQ, occupation, or income. In addition to being an important barometer of social inequality, the distribution of formal schooling may, moreover, be especially well suited to an investigation of the effects of differential fertility on socioeconomic welfare. Whereas educational attainment is heavily affected by the resources and preferences of individuals and their families, other outcomes, such as occupation or income, are more strongly constrained by opportunity structures. The arguments and models used in this article assume that social mobility and fertility are separable at the aggregate level. They do not allow for the possibility that patterns of fertility may interact with the structure of available socioeconomic outcomes to force changes in patterns of social mobility (Preston, 1974). The latter type of effect occurs when socioeconomic distributions are determined by a relatively fixed distribution of socioeconomic opportunities which are, in turn, established by the demand for labor of various types. In 20th-century United States, however, it is likely that educational opportunities have not been seriously constrained by a relatively fixed number of educational "slots." Insofar as personal and family resources and preferences have been the principal forces behind educational change, it is sensible to analyze the combined effects of differential fertility and mobility on educational outcomes.

Second, I examine the effects of variation in demographic rates in more detail than most prior studies. Unlike the previous studies that have examined the effects of fertility differentials, the present study considers the separate effects of both the *level* and the *timing* of fertility. To accomplish this, I develop a projection model that incorporates the effects of the age pattern of fertility. In addition, I investigate the effects of differential mortality as well as fertility.

Finally, the emphasis in this analysis is on the effects of the observed historical sequence of fertility rates on educational growth during the past 70 years, rather than on the theoretical issue of deriving the equilibrium distributions of socioeconomic outcomes. Whereas these equilibria are useful for illustrating the long-run implications of a given regime of vital rates, they are less well suited to providing an assessment of the quantitative historical importance of demographic rates for changes in socioeconomic distributions.

RESEARCH QUESTIONS

The empirical analyses presented in this article address six sets of questions:

1. Fertility levels during the past several decades have usually varied inversely with the educational attainment of women. This suggests that more poorly educated women reproduce themselves at a higher rate than women with higher levels of schooling and that, *ceteris paribus*, fertility differences may reduce average levels of educational attainment below what they would be in the absence of such differences. The strength of these differences has varied over time, suggesting that the effect might not be uniformly strong. Has the differential fertility of persons of diverse socioeconomic origins affected the trend in average educational attainment and the inequality of schooling during the past 70 years? If so, how large is this effect? How would the current educational distribution be different if all groups had the same level of fertility during the past 70 years?

2. Insofar as fertility does affect the level and distribution of schooling, are there separate effects of variation in both the *level* and the *timing* of fertility among socioeconomic groups? If more highly educated women bear their children at a later age, that pattern too should reduce average educational attainment. That is, absent historical patterns of fertility timing, education would have been higher. It remains, however, an open question how large this effect has been.

3. Whatever the historical effect of differential fertility, what are the implications of the large *recent* patterns of differential fertility? Recent period fertility differences across education groups of women have been particularly large during the late 1980s and early 1990s relative to the previous two decades (Mare, 1996). How would the trend in the distribution of schooling have been different if recent fertility differences had been in effect throughout the past several decades?

4. Does differential mortality affect the distribution of socioeconomic characteristics in the population? Inasmuch as lower socioeconomic groups tend to experience higher death rates and to die earlier, this may raise average socioeconomic levels. How big is this effect?

5. The degree to which fertility affects socioeconomic distributions is conditional on the openness of socioeconomic groups. Differential fertility has a

stronger effect when socioeconomic groups are more closed to intergenerational mobility and a weaker effect when mobility is greater. How big is this interaction between differential fertility and the rate of intergenerational mobility? If mobility chances were to change, would the effects of demographic rates become more or less important than they are now?

6. What are the implications of race-specific patterns of differential fertility for trends in attainment of blacks and whites? What are the implications of race-specific fertility patterns for race *differences* in educational attainment? Differential fertility patterns within each race are likely to have some dampening effect on educational attainment. Yet the complex ways in which fertility and intergenerational mobility patterns affect socioeconomic trends leave ambiguous the net effect of fertility on race differences in educational attainment. Both fertility levels and educational fertility differences have shifted over time and may not have moved in tandem for blacks and whites.

To investigate these issues, I construct discrete-time models of population growth that incorporate the effects of age-specific fertility and mortality as well as social mobility for blacks and whites. These models are generalizations of standard models for population projection (e.g., Keyfitz, 1985) that take account of movement across space or social strata (e.g., Rogers, 1975). The parameters of these models are mobility and demographic rates. By simulating the growth of each socioeconomic group under alternative assumptions about intergenerational mobility, fertility, and mortality, one can assess the interaction of demographic processes and mobility (Preston, 1974; Lam, 1986; Mare, 1996).

TRENDS IN EDUCATIONAL ATTAINMENT, 1920–1990

Table 1 documents the dramatic growth in formal educational attainment among women in the United States from 1920 to 1990. Inasmuch as secular growth in schooling occurs primarily as a process of cohort replacement, the 25- to 49-year-old age group represented in the table is very heterogeneous in attainment. Nonetheless, the secular pattern of growth for narrower age ranges is the same as the one shown in the table for the broader age group. For white women, average years of school completed increased by more than 4.5 years between 1920 and 1990. During this period, the schooling distribution was radically transformed from a heavy concentration of women with little or no high school education at the end of World War I to almost half of women having at least some college by 1990. In 1920, less than 10% of women had more than a high school education, whereas by 1990, barely more than 10% of women had less than a high school degree.[2]

For black women, the growth of educational attainment is even more dramatic. Average years of school completed increase by more than 7 years over this period. In 1920, more than 85% of women had less than a high school education, a

[2] Recent educational levels are elevated somewhat because Census and Current Population Survey data include GED recipients among those with a high school degree.

TABLE 1
Trends in Educational Attainment of Women Ages 25–49, 1920–1990

Years completed	1920	1930	1940	1950	1960	1970	1980	1990
				White				
				Percentage distribution				
0–8	63.11	53.31	39.95	26.10	17.22	9.81	5.78	4.32
9–11	14.30	17.74	21.20	21.77	21.92	17.63	16.22	8.04
12	13.56	17.35	25.80	35.09	42.13	45.31	38.48	39.98
13–15	5.49	7.09	8.32	10.28	11.90	16.59	22.91	24.21
16+	3.54	4.51	4.72	6.77	6.82	10.66	16.62	23.46
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
				Means and standard deviations				
Mean	8.34	9.02	9.83	10.68	11.17	11.87	12.60	13.08
SD	3.50	3.41	3.12	3.02	2.75	2.65	2.73	2.67
				Black				
				Percentage distribution				
0–8	86.57	81.82	74.38	52.68	37.56	18.65	7.37	3.25
9–11	6.98	9.63	13.79	23.29	29.03	30.65	27.65	15.68
12	3.67	4.84	7.41	15.91	23.33	35.37	33.89	42.29
13–15	1.58	2.26	2.90	4.47	6.24	10.05	21.97	25.58
16+	1.20	1.46	1.52	3.64	3.84	5.29	9.12	13.20
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
				Means and standard deviations				
Mean	5.32	6.05	6.75	8.47	9.46	10.72	11.95	12.61
SD	3.40	3.40	3.40	3.58	3.30	2.85	2.60	2.24

Source. 1940–1980 Censuses and March 1990 Current Population Survey.

percentage that drops below 50% only as late as 1960. By 1990, however, fewer than 5% of women have this little schooling. Conversely, in 1920, less than 10% of black women were high school graduates, a percentage that reaches 50% as late as 1970. By 1990, this percentage exceeds 80%.

One should keep in mind not only the direction but also the magnitude of these changes in considering the impact of trends in fertility, mortality, and intergenerational mobility on the trend in educational attainment. Whatever the harmful impact of fertility differences on average educational attainment, it has not offset the revolutionary growth in formal schooling during this century. The size of the estimated effects of demographic rates should, moreover, be assessed in view of the scale of the total observed change in attainment during this period.

TRENDS IN FERTILITY

Tables 2 and 3 document trends in fertility rates for white and black women from 1925 to 1990. These estimates reflect well known fluctuations in levels of

TABLE 2
Trends in Fertility for White Women, 1920–1990

Age	Schooling	1925	1930	1940	1950	1960	1970	1980	1990
				Age-specific fertility rates					
15–19	0–8	34.0	32.5	20.0	58.7	62.3	52.9	46.2	23.0
	9–11	20.7	22.0	9.4	56.1	75.9	40.1	13.9	21.4
	12	6.2	5.9	7.3	16.3	24.4	24.7	22.2	31.5
	13–15	2.8	2.8	1.1	6.5	8.0	7.6	2.0	10.2
	16+	1.4	1.2	5.1	1.8	2.3	1.7	3.3	0.0
20–24	0–8	82.5	76.7	62.6	100.3	105.3	87.3	74.4	103.5
	9–11	64.3	63.4	54.4	99.2	123.7	75.8	41.5	106.9
	12	41.9	38.3	35.7	85.8	116.8	86.4	80.5	62.2
	13–15	31.7	27.5	22.1	72.0	97.4	59.8	28.9	27.6
	16+	13.0	10.8	12.4	32.1	44.9	23.0	14.2	16.1
25–29	0–8	75.7	69.9	53.1	79.1	86.8	68.8	55.0	65.2
	9–11	58.9	55.3	44.5	71.5	81.6	51.3	34.5	50.1
	12	51.9	48.3	41.3	79.9	93.8	68.3	61.1	48.0
	13–15	55.8	49.4	43.4	89.7	103.8	72.3	56.6	57.6
	16+	37.3	33.4	35.7	82.2	99.3	71.0	54.8	43.3
30–34	0–8	61.5	52.7	37.3	50.8	56.2	43.5	31.8	43.3
	9–11	43.4	41.4	31.7	44.5	47.4	28.9	18.6	23.3
	12	37.5	33.5	29.8	50.2	54.6	34.3	26.3	26.9
	13–15	42.7	37.1	29.4	58.5	60.1	37.5	32.1	39.0
	16+	31.9	32.7	31.3	61.9	67.9	47.9	47.3	48.6
35–39	0–8	42.8	36.9	20.8	29.1	30.4	22.8	16.0	21.0
	9–11	30.9	24.2	16.7	22.4	24.7	14.1	7.5	9.7
	12	21.6	18.3	12.1	26.6	27.1	15.2	8.3	8.4
	13–15	23.4	23.3	16.8	27.6	29.0	15.6	10.8	13.2
	16+	19.4	13.2	12.8	31.6	31.0	17.8	16.3	20.7
40–44	0–8	20.4	16.0	8.6	10.5	10.6	7.7	4.9	4.3
	9–11	12.3	9.9	6.6	7.8	7.9	4.4	2.4	1.7
	12	8.6	6.2	3.6	8.1	8.3	4.2	1.9	1.4
	13–15	12.0	8.2	4.3	7.8	9.5	3.9	2.2	2.2
	16+	7.5	7.3	4.0	10.0	9.2	4.5	2.7	3.5
				Gross reproduction rate					
	0–8	1.58	1.42	1.01	1.64	1.76	1.42	1.14	1.30
	9–11	1.15	1.08	0.82	1.51	1.81	1.07	0.59	1.07
	12	0.84	0.75	0.65	1.33	1.62	1.16	1.00	0.89
	13–15	0.84	0.74	0.59	1.31	1.54	0.98	0.66	0.75
	16+	0.55	0.49	0.51	1.10	1.27	0.83	0.69	0.66
				Mean age of fertility schedule					
	0–8	28.4	28.1	27.5	26.3	26.3	26.1	25.6	26.5
	9–11	28.3	27.8	27.9	25.9	25.4	25.5	26.3	25.1
	12	29.1	28.8	28.1	27.7	27.0	26.2	25.6	25.3
	13–15	30.1	30.0	29.7	28.5	28.0	27.6	28.5	28.3
	16+	31.0	30.9	29.8	30.2	29.6	29.6	29.9	30.7

Sources. 1940, 1960, 1970, and 1980 Censuses: 1985 and 1990 Vital Statistics of the U.S.; June 1985 and 1990 Current Population Survey.

TABLE 3
Trends in Fertility for Black Women, 1920–1990

Age	Schooling	1925	1930	1940	1950	1960	1970	1980	1990
				Age-specific fertility rates					
15–19	0–8	44.7	44.2	26.3	76.3	81.5	81.1	42.8	18.8
	9–11	33.5	33.8	15.5	74.8	92.2	60.5	22.8	43.2
	12	20.3	14.3	17.4	30.9	37.6	54.3	37.2	65.6
	13–15	*	*	*	20.4	20.5	28.1	7.3	27.1
	16+	*	*	*	7.7	7.9	10.4	4.3	0.0
20–24	0–8	67.9	61.8	44.4	104.9	119.9	83.9	55.0	45.1
	9–11	55.7	51.0	51.4	103.1	131.7	78.9	45.4	102.0
	12	29.3	29.7	32.7	84.7	112.3	90.7	84.2	100.0
	13–15	*	*	*	81.8	95.1	68.8	38.7	46.6
	16+	*	*	*	35.1	48.1	35.7	20.2	23.7
25–29	0–8	63.9	49.5	35.7	81.2	101.9	61.9	41.2	40.1
	9–11	62.1	42.4	41.8	75.2	95.7	54.7	35.8	46.2
	12	35.9	41.6	20.4	62.0	87.2	61.4	53.8	49.6
	13–15	*	*	*	64.7	77.8	54.4	45.6	53.0
	16+	*	*	*	52.4	66.5	54.0	44.1	46.9
30–34	0–8	60.0	42.9	28.2	52.9	73.3	40.1	26.5	32.3
	9–11	32.4	39.7	20.0	53.1	64.0	35.7	24.2	22.3
	12	31.7	38.9	22.2	42.9	53.7	37.1	29.1	30.2
	13–15	*	*	*	46.0	52.2	33.0	27.3	36.1
	16+	*	*	*	29.4	45.6	39.4	34.6	42.8
35–39	0–8	41.6	34.7	19.3	33.6	42.0	26.9	18.1	10.6
	9–11	28.4	21.5	14.2	33.6	37.6	21.9	13.8	11.8
	12	25.1	27.5	18.9	23.3	30.6	20.8	14.4	10.9
	13–15	*	*	*	21.6	28.3	18.5	10.3	11.0
	16+	*	*	*	18.6	25.3	18.6	16.1	14.8
40–44	0–8	28.1	18.8	7.5	17.0	17.2	10.3	7.2	2.4
	9–11	33.5	9.6	8.7	12.2	15.6	9.6	7.0	2.3
	12	17.5	13.1	5.8	6.4	11.9	9.1	5.5	1.9
	13–15	*	*	*	17.3	12.9	8.6	4.1	2.2
	16+	*	*	*	6.4	7.9	8.1	1.6	2.6
				Gross reproduction rate					
	0–8	1.53	1.26	0.81	1.83	2.18	1.52	0.95	0.75
	9–11	1.23	0.99	0.76	1.76	2.18	1.31	0.74	1.14
	12	0.80	0.83	0.59	1.25	1.67	1.37	1.12	1.29
	13–15	0.66	0.66	0.35	1.26	1.43	1.06	0.67	0.88
	16+	0.73	0.46	0.15	0.75	1.01	0.83	0.60	0.65
				Mean age of fertility schedule					
	0–8	28.6	27.9	27.3	26.3	26.6	25.5	26.0	26.8
	12	28.9	27.3	27.2	26.1	26.0	25.7	26.9	24.5
	12	29.5	29.8	27.9	26.7	26.9	25.8	25.6	24.1
	13–15	28.9	28.2	27.6	27.9	27.7	26.8	27.8	26.5
	16+	31.2	29.7	28.3	28.7	28.9	28.8	29.3	29.7

Sources. 1940, 1960, 1970, and 1980 Censuses; 1985 and 1990 Vital Statistics of the U.S.; June 1985 and 1990 Current Population Survey.

*Sample frequencies are too small to provide reliable estimates of rates.

fertility during this period, namely very low fertility during the Great Depression, a surge in fertility following World War II which peaked in the late 1950s, and the subsequent fall to near replacement level fertility in the 1970s and 1980s.[3] Trends in fertility levels are similar for black and white women, although black fertility on average exceeds that of whites in every period.

During most periods, fertility rates tend to vary inversely with women's educational attainment, although there are notable exceptions. Among whites, the Gross Reproduction Rate of college graduates was less than half of that for women with no high school from the 1920s to World War II. This ratio rose was about two-thirds during the 1950–1970 period and has fallen to about one-half since then. Overall, however, one can see a monotonic relationship between women's schooling and their fertility prior to 1960 and in 1990, but not in the intervening period. Except at the extreme ends of the educational distribution, there is no discernable gradient of attainment and fertility between 1960 and 1980. This suggests that the aggregate impact of fertility on educational trends may be ambiguous, at least during some periods. Nonetheless, it is striking that, among white women, the strong association between educational attainment and fertility that occurred prior to World War II has reemerged in 1990. This large recent pattern of fertility differences is apparently an important source of the concern raised by some commentators about the negative effects of fertility differences on educational attainment and cognitive ability (Herrnstein and Murray, 1994, pp. 348–351).

Over most of the period examined here, patterns of differential fertility for African American women are similar to those for whites. From 1925 to 1970, educational attainment and fertility are inversely associated. After 1970, however, this relationship disappears and, for 1990, there is no sign of the strong reemergence of the education–fertility gradient that appears so clearly for white women. Whatever negative consequences recent patterns of differential fertility may portend for whites, the trends in Table 3 suggest that these consequences will not be borne by blacks.

Tables 2 and 3 also document trends in the timing of fertility by education level for white and black women. The mean ages at which women bear children indicate that for both races, in almost every period, more poorly educated women bear their children earlier than their better educated counterparts. Except for the contrast between women with college degrees and women with lower levels of education, however, differences in average age at childbearing are modest in most

[3] The age-specific rates in Tables 2 and 3 measure the annual number of female children born to 1000 women of the given age group. The gross reproduction rate denotes the number of female children born to a hypothetical cohort of women, all of whom survived until the end of their childbearing years, who experienced the age-specific fertility rates of that year. It is estimated as the sum of the age-specific rates for the given year multiplied by 5/1000. The means and standard deviations of the fertility schedule presented in Table 2 are the means and standard deviations, respectively, of the ages represented in the table weighted by the age-specific fertility rates.

years. Educational differences in the timing of fertility are similar for black and white women. Given the differences in average educational attainment levels between black and white women, black women as a whole bear their children earlier than white women. Within categories of educational attainment, however, the average ages at childbearing of black and white women are very similar.

For most of the 1925–1990 period, educational attainment is negatively associated with both the level and the speed of reproduction for black and white women. This does suggest that varying rates of reproduction across education groups may exert downward pressure on levels of educational attainment. That the strength of these associations has varied considerably over time, however, makes it hard to know how important educational fertility differences have been for educational growth during the past three-quarters of a century. To investigate this requires an explicit model of fertility, educational attainment, and population growth.

A ONE-SEX MODEL FOR DEMOGRAPHIC AND EDUCATIONAL CHANGE

To examine the effects of fertility, mortality, and mobility regimes on trends in educational distributions, I use a projection model for a population differentiated by educational attainment. This is a one-sex model and, given the superior quality of fertility data specific to educational attainment level for women, is applied only to women.[4] Elaborations of this model are discussed elsewhere (Mare, 1995b). Rates of fertility, mortality, and mobility are variables in the projection model. My strategy is to predict the trend in the distribution of schooling given an initial education distribution and alternative assumptions about demographic rates.

A model for intergenerational educational mobility can be developed through an analogy to established models for interregional mobility and population growth. The general discrete-time multiregional projection matrix for a single sex is discussed in detail by Feeney (1970), LeBras (1971), and Rogers (1975). The model for educational mobility used here is a special case of the general model. Suppose that a population is divided into A 5-year age groups and R groups, which are regions in the context of geographic mobility or socioeconomic groups in the context of social mobility. Let $\mathbf{P}_t$ denote an $RA \times 1$ vector of population totals at time t, with typical entry P_{rat}, which is the population in the rth education group and the ath age group in the tth year ($r = 1, \ldots, R$; $a = 0$–4, 5–$9, \ldots, 45$–49; $t = 0, 5, \ldots, T$). The age-education specific populations 5 years later are linked

[4] Educational inequality has historically been somewhat greater for men than women. That is, men have tended to have disproportionate numbers who drop out of school very early or who attain the highest possible levels of schooling. These sex differences, however, have declined in recent decades (Mare, 1995a).

to the totals at time t by a multigroup projection matrix, that is, $\mathbf{M}_t\mathbf{P}_t = \mathbf{P}_{t+5}$. $\mathbf{M}_t$ is an $RA \times RA$ matrix of transition probabilities with the following structure:

$$\mathbf{M}_t = \begin{matrix} 0 & 0 & \mathbf{B}_{10t} & \mathbf{B}_{15t} & \mathbf{B}_{20t} & \mathbf{B}_{25t} & \mathbf{B}_{30t} & \mathbf{B}_{35t} & \mathbf{B}_{40t} & \mathbf{B}_{45t} \\ \mathbf{S}_{0t} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \mathbf{S}_{5t} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \mathbf{S}_{10t} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \mathbf{S}_{15t} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \mathbf{S}_{20t} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \mathbf{S}_{25t} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \mathbf{S}_{30t} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mathbf{S}_{35t} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mathbf{S}_{40t} & 0 \end{matrix} \qquad (1)$$

where the $\mathbf{S}_{0t}, \mathbf{S}_{5t}, \ldots, \mathbf{S}_{40t}$ are $R \times R$ submatrices of 5-year age-specific survival and mobility probabilities and the $\mathbf{B}_{10t}, \mathbf{B}_{15t}, \ldots, \mathbf{B}_{45t}$ are $R \times R$ submatrices of 5-year age-specific birth and mobility probabilities, adjusted for maternal and childhood mortality. The typical element of submatrix $\mathbf{S}_{at}$, S_{ijat}, is the probability that a woman aged a to $a + 5$ and group i at time t is living 5 years later in group $j (I = 1, \ldots, R;\ j = 1, \ldots, R)$. The S_{ijat} reflect the joint processes of group-specific adult mortality and intragenerational mobility. The typical element of submatrix $\mathbf{B}_{at}$, B_{ijat}, is the probability that a woman aged a to $a + 5$ and in group i has a child who survives and is living 5 years later in group j. The B_{ijat} reflect the joint processes of group-specific fertility, adult mortality, child mortality, and intergenerational mobility.

When the multigroup projection model is applied to educational mobility, it is possible to simplify $\mathbf{M}_t$. Inasmuch as one cannot "migrate" from a higher to a lower level of educational attainment, $S_{ijat} = 0$ whenever $I > j$. Thus, all of the $\mathbf{S}_{at}$ are upper triangular submatrices. Such a simplification does not apply to the $\mathbf{B}_{at}$ because both upward and downward *inter*generational educational mobility are possible. One can further simplify the $\mathbf{S}_{at}$ if one assumes that all educational attainment is completed by a given age, say c. In this case, the $\mathbf{S}_{at}$ are diagonal submatrices whenever $a > c$. In practice I further simplify $\mathbf{M}_t$ because of data limitations and my intention to focus the analysis on intergenerational rather than intragenerational mobility. In particular, I assume that ultimate educational attainment is determined at birth; that is, that there is no intragenerational educational mobility.[5] This detracts somewhat from the realism of the model, but it is of no important consequence for the analysis of the effects of demographic rates and intergenerational mobility on education distributions. Furthermore, I focus on the educational distributions of women of childbearing ages, rather than

[5] In addition, in projecting the survival of the population, I assume that children follow the mortality schedule of their ultimate educational attainment group, rather than the mortality schedule of their mother's education group.

all adults. Finally, I assume that fertility rates for women below age 15 or above age 45 are zero. Given these simplifications, the $\mathbf{S}_{at}$ are all diagonal submatrices in which the S_{ijat} equal the age-education specific 5-year survival rates if $i = j$ and equal zero if $i \neq j$. Specifically, when $i = j$, $S_{ijat} = {}_5L_{i,a+5},t/\ {}_5L_{iat}$, where ${}_5L_{iat}$ is the life table population between ages a and $a + 5$ for education group i in year t.

A typical element of the $\mathbf{B}_{at}$ submatrices, B_{ijat}, incorporates information on the fertility of women aged a to $a + 5$, the survival of women during that age interval, the mortality of children during the first 5 years of life, and the probabilities that women in education group i have daughters who attain education group j. That is, $B_{ijat} = {}_5L_{i0t}\ (F_{iat} + S_{iat}\ F_{i,a+5,t})M_{ijt}$, where ${}_5L_{i0t}$ denotes the life table population between ages 0 and 5 for the offspring of women in education group i in year t, F_{iat} denotes the rate of female births to women aged a to $a + 5$ in education group i in year t, S_{iat} denotes the age-education specific 5-year survival rate for women aged a to $a + 5$ in education group i in year t, and M_{ijt} denotes the proportion of women in year t in education group i who have daughters who attain education group j.

SIMULATIONS

The ingredients of the projection model are the age–education-specific female fertility rates (F_{iat}) and survival rates (S_{iat}) and the educational mobility rates (M_{ijt}). By making alternative assumptions about how these quantities vary across education groups and over time, I explore the effects of demographic and mobility regimes on education distributions for the period from 1925 to 1995. Given the model; an assumed pattern of fertility, mortality, and mobility rates; and an initial population distribution, one can derive the subsequent sequence of population distributions. Under alternative assumptions, I estimate the implied distribution of educational attainment in 1995 separately for blacks and whites.

To simulate the impact of fertility patterns on recent educational distributions, it is necessary to use an initial distribution that is sufficiently far in the past that subsequent fertility rates completely determine the current distribution. For example, women aged 25 to 49 years old in 1995 were born between 1945 and 1970. Thus, to assess the effects of past fertility on this group of women, one must use an initial distribution for 1945 or earlier. I use the age–education distribution of women aged 25–49 years in 1925 as the initial distribution, but results are robust to using alternative age groups of women (e.g., 15- to 44-year-olds) and alternative starting points for the simulations.

Each of these simulations is carried out separately for whites and blacks. They show the effects of fertility patterns and trends on trends in schooling distributions within each race. In addition to these simulations, I investigate how the trends in educational attainment for blacks and whites would have differed in the absence of race differences in levels, timing, and educational differences in fertility and mortality. To do this, I also simulate the trend in educational attainment for blacks under the assumption that their fertility levels and patterns were the same as those for whites between 1925 and 1995. This shows the contribution of fertility patterns to trends in race differences in educational attainment.

DATA

To carry out these analyses I use Vital Statistics and Census data for the computation of fertility rates by several methods; mortality data from both published and survey microdata sources; and survey data on intergenerational educational mobility, which are suitable for the study of differences in mobility patterns by sex, race, and birth cohort.

Fertility. I estimate age–sex–education-specific fertility rates at 5-year intervals using both vital statistics and census data specific to race. For 1980, 1985, and 1990, I compute numerators of fertility rates from microdata birth records from Vital Statistics. These data provide tabulations of births specific to mother's age, educational attainment, and race. Denominators for fertility rates during this period are calculated from the Decennial Census for 1980 and the Current Population Surveys for 1985 and 1990. Several months of CPS data are pooled to obtain reliable population estimates. Using the CPS for the denominator of the 1990 fertility rates avoids the complications created by the change in the measurement of educational attainment in the 1990 Census (Mare, 1995a). Because parents' educational attainments and mother's marital status are not recorded on death certificates for every state in every year, I adjust the Census and CPS-based denominators by excluding states that do not provide the necessary birth data in the vital statistics.

From 1925 through 1975, I estimate quinquennial age–race–education-specific fertility rates by the "own children in the household" method from the 1940, 1960, 1970, and 1980 Censuses (Cho, Grabill, and Bogue, 1970; Grabill and Cho, 1965; Rindfuss and Sweet, 1977). This method uses information on the number of children aged k of mothers aged a at census year t to infer the number of births that occurred to women aged $a - k$ in year $t - k$. The estimated number of children and mothers are adjusted for childhood and maternal mortality during the period from $t - k$ to t, using the data on socioeconomic mortality differences that are discussed below. The own-children estimates may be distorted with the propensity of children to live apart from their mothers. This bias, however, can be minimized by basing estimates on the numbers of relatively young children in the household—that is, children aged 0 to 14 in each census. The 1940 and 1960 Public Use files are 1% random samples of the U.S. Population; the 1970 file is a 6% sample; and the 1980 and 1990 files are 5% samples. To offset the instability of estimates for single years from the own children method, I average the fertility rates of surrounding years and use a broader time band for the two earlier censuses. The years for which fertility rates are estimated, the band of surrounding years used to estimate the rates, and the census that is used for constructing the estimates are as follows:

Year estimated	Time band	Census
1925	1925–1927	1940
1930	1928–1932	1940
1935	1933–1937	1940
1940	1938–1940	1940
1945	1945–1947	1960
1950	1948–1952	1960
1955	1953–1957	1960
1960	1959–1961	1970
1965	1964–1966	1970
1970	1969–1971	1980
1975	1974–1976	1980

For several years these data provide more than one set of fertility estimates. These multiple estimates provide a check on the reliability of the estimates and on the robustness of the simulation results to alternative assumptions about fertility and mother's educational attainment. The vital statistics and own-children estimates based on very young children in the household provide estimates specific to the educational attainment of mothers at the time that they gave birth. The own-children estimates that are based on somewhat older children are more likely to classify births by mothers' *eventual* educational attainment, which may differ from the level of schooling that she had achieved at the time that her child was born. In general, where multiple estimates of fertility rates are available, these estimates are very similar to one another. One exception is for the youngest women (aged 15–19) who are at the highest levels of educational attainment. The vital statistics estimates for these women are lower than the own-children estimates because the latter are based on eventual rather than current educational attainment. These discrepancies, however, affect relatively few women and do not have much impact on the simulation results.[6]

Mortality. I use two sources of data on socioeconomic differences in adult mortality: the 1960 Mortality Followback Survey, based on deaths to persons in the 1960 Census from May through August 1960 (Kitagawa and Hauser 1973); and the National Longitudinal Mortality Survey (NLMS) (Preston and Elo, 1994; Elo and Preston, 1995). Data from the 1960 study are only available in published form and are limited to age–sex–education-specific death rates for whites. The

[6] In ongoing work I am calculating own children estimates from the 1990 Census, which will permit the calculation of a time series of fertility rates from 1925 through 1990 using a common method. Although one can, in principle compute own children estimates from the 1950 Census, the Public Use Sample includes too few women to provide reliable estimates. The long form of the 1950 Census was administered to a sample of *persons* rather than households. Because educational attainment was a long-form item, educational attainment is recorded for only a fraction of women of childbearing ages in the 1950 Public Use Sample.

NLMS covers the years 1979–1985 and gives estimates by age, sex, race, and educational attainment.

The projection models and fertility estimates also require estimates of educational differences in infant and child mortality. I use two sources of data. One is the 1964–1966 National Sample Surveys of Natality and Mortality (National Center for Health Statistics, 1970), which are based on a 1 in 1000 sample of registered births to married women occurring between 1964 and 1966 and a 1 in 36 sample of registered infant deaths during the same period. The other source of data are the 1985 linked birth and infant death records, which are based on all registered births and infant deaths in that year (National Center for Health Statistics, 1990). Records from the 1985 data for California, Texas, and Washington are excluded from the analysis because they do not include information on maternal educational attainment.

Using these data I calculate age–race–education-specific mortality estimates for infants and adults.[7] These data provide information neither for children and teenagers nor for mortality rates for most of the period from 1925 to 1995. I obtain temporal information using published decennial age–race–sex-specific death rates based on vital statistics and census data. To get education-specific mortality estimates for children and teenagers and for each census year from 1925 to 1995, I fit a third-order polynomial to the log odds of mortality, using the available survey and vital statistics based rates as data points. This polynomial incorporates the assumptions that mortality varies with educational attainment, age, race, sex, and time, but that educational mortality differences do not vary by race, sex, age, and time.[8] I use the estimated polynomial to interpolate rates for ages and years for which data are not available and to obtain smoothed estimates for all combinations of age, race, educational attainment, and year for females. Figure 1 illustrates the estimated mortality probabilities for two selected years (1930 and 1990). By construction, the estimated differences in mortality by educational attainment do no vary by race or over time, although the mortality estimates do show higher death probabilities for blacks than for whites and for 1930 than for 1990. Averaged over all groups and years, there is substantial variation in mortality among persons in varying education groups. The death probabilities for children born to women without any high school are approximately 60% higher than those born to college graduates. From childhood into middle age, death probabilities vary inversely with educational attainment. The largest contrast is between women with high school or better versus those with less schooling. Although these adjustment procedures are not ideal, it is unlikely that the simulation results will be sensitive to alternative assumptions about mortality.

[7] The adult mortality rates are specific to persons' own educational attainments; the infant mortality rates are specific to their mothers' educational attainments.

[8] The NLMS enables one to estimate separate patterns of education differences in mortality by race, sex, and age. Because the estimated interactions between education and the other variables are not statistically significant, I retain only additive effects of schooling in the polynomial used in the analysis.

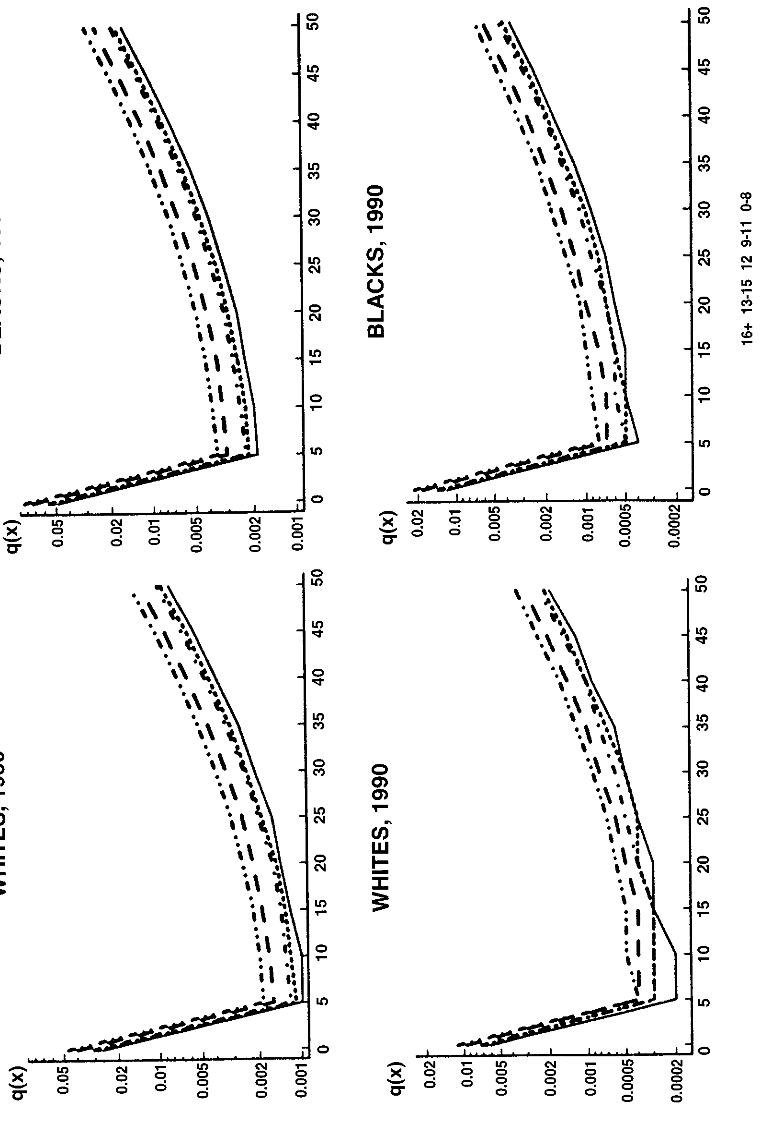

FIG. 1. Mortality hazard ($_5q_x$) for women by race and year.

Intergenerational mobility. To estimate intergenerational educational mobility rates, I use three national surveys. Each is a large national sample, represents mobility during the 1925–1990 period, includes a cross section of the adult population, and contains measures of family background and socioeconomic achievements of the respondents. The surveys are:

1. 1987–1988 National Survey of Families and Households (NSFH) (Sweet, Bumpass, and Call, 1988). This sample contains 13,011 persons aged 18 and over, including a cross-section sample of 9643 households and a double sampling of blacks, Puerto Ricans, Mexican American, single-parent families, families with stepchildren, and persons in marriages of short duration. To minimize recall bias and biases in estimated educational attainment of persons who are still in school, I restrict the NSFH sample to persons aged 20–69.

2. General Social Surveys (GSS) from 1972 to 1994 (Davis and Smith, 1992). This self-weighting sample contains approximately 35,000 persons aged 18 and over who were interviewed in one of the 23 repeated national cross-sectional surveys from 1972 through 1994. To minimize recall bias and biases in estimated educational attainment of persons who are still in school, I expect to restrict the GSS sample to persons aged 20–69.

3. Wave 2 data from the 1986, 1987, and 1988 Survey of Income and Program Participation (SIPP). This self-weighting sample contains 43,446 persons aged 25 to 64, who were administered a survey module on family background and intergenerational mobility (Hauser and Jordan, 1992). Although some respondents were outside the 25–64 age range, mother's educational attainment is not measured for persons outside this age range.

Each survey is used to construct outflow rates of intergenerational educational mobility (that is, proportions of persons in each category of educational attainment within categories of parents' educational attainment). In each of these surveys, the respondent is sampled from a cohort of *offspring* and parental information is obtained retrospectively. Thus the samples provide distributions of parents of sampled offspring, rather than the progeny of a sample of adults of childbearing age. To take this feature of the design into account, I weight the NSFH, GSS, and SIPP observations inversely proportional to one plus their reported number of sisters. When these samples are restricted to women in the age ranges described above and observations with missing data on mother's schooling, offspring's schooling, race, or number of sisters are eliminated, the resulting sample size is 34,431, which includes 16,507 observations from SIPP, 12,729 from GSS, and 5198 from NSFH.

Table 4 presents the estimated percentages of women at each level of schooling conditional upon their mother's schooling by race and three 20-year birth cohorts. These percentages are estimated from weighted observations, although the table reports unweighted race–cohort-specific sample counts. In the simulations reported below I allow mobility rates to vary by race and the broad cohorts depicted in Table 4. This cohort classification captures some temporal variability in

TABLE 4
Intergenerational Educational Mobility of Women by Race and Birth Cohort[a]

Mother's schooling	White: Daughter's schooling 0–8	9–11	12	13–15	16+	Total		Black: Daughter's schooling 0–8	9–11	12	13–15	16+	Total	
							1915–1934							
0–8	13.2	17.9	48.5	13.0	7.5	100.0	(48.1)	28.9	26.8	24.3	12.6	7.3	100.0	(61.4)
9–11	3.4	15.0	42.7	20.8	18.0	100.0	(13.6)	7.9	35.0	27.8	16.4	12.9	100.0	(16.0)
12	1.4	6.1	45.7	25.0	21.7	100.0	(25.4)	2.5	19.0	38.6	21.2	18.8	100.0	(17.1)
13–15	1.0	2.7	24.3	33.8	38.1	100.0	(7.8)	3.3	3.8	24.3	49.6	18.9	100.0	(3.2)
16+	0.1	3.3	14.3	25.9	56.4	100.0	(5.1)	0.0	3.2	16.3	37.1	43.4	100.0	(2.4)
Total	7.3	12.6	43.4	19.4	17.4	100.0	(100.0) $N = 6644$	19.5	25.5	27.1	16.5	11.4	100.0	(100.0) $N = 729$
							1935–1954							
0–8	9.4	15.8	47.7	16.2	11.0	100.0	(21.8)	9.9	23.9	32.8	22.6	10.8	100.0	(36.3)
9–11	1.4	9.7	50.0	21.6	17.3	100.0	(15.8)	3.4	18.0	35.8	29.9	12.9	100.0	(24.7)
12	0.7	3.9	37.2	30.5	27.6	100.0	(42.8)	1.7	9.3	35.8	33.1	20.1	100.0	(25.0)
13–15	0.1	2.4	19.4	35.3	42.8	100.0	(11.0)	0.7	4.1	18.1	42.1	34.9	100.0	(8.7)
16+	0.5	0.5	9.5	26.0	63.5	100.0	(8.6)	0.0	1.5	10.8	27.3	60.4	100.0	(5.3)
Total	2.6	6.9	37.2	26.1	27.1	100.0	(100.0) $N = 14257$	4.9	15.9	31.9	29.0	18.3	100.0	(100.0) $N = 1915$
							1955–1974							
0–8	10.2	19.8	42.7	16.8	10.5	100.0	(10.2)	5.0	20.9	39.2	27.0	7.9	100.0	(15.5)
9–11	2.2	16.8	48.6	23.1	9.3	100.0	(13.3)	0.5	21.2	39.7	30.0	8.6	100.0	(21.3)
12	0.5	5.8	40.9	31.1	21.6	100.0	(47.5)	1.0	11.9	36.4	36.6	14.1	100.0	(37.7)
13–15	0.4	2.7	21.2	41.5	34.2	100.0	(14.6)	1.7	7.5	19.2	50.5	21.1	100.0	(15.4)
16+	0.3	1.4	10.4	30.7	57.2	100.0	(14.5)	0.0	1.4	13.2	45.1	40.3	100.0	(10.1)
Total	1.7	7.6	34.8	30.1	25.8	100.0	(100.0) $N = 8213$	1.5	13.5	32.6	36.7	15.7	100.0	(100.0) $N = 1403$

Sources. General Social Survey, Survey of Income and program participation, and National Survey of Families and Households.

[a] Numbers in parentheses denote distribution of mother's schooling. Percentages are based on weighted observations (see text). N's are unweighted.

mobility, but provides enough observations for each cohort to obtain stable estimates of mobility rates.

EFFECTS OF DIFFERENTIAL FERTILITY AND MORTALITY

The first six rows of Table 5 present the results of simulations that show the impact of fertility and mortality patterns on average educational attainments of blacks and whites, given the observed patterns of intergenerational educational mobility for the 1925–1995 period. Each row of the table presents the results from a single simulation. Each of these first six simulations assumes the observed intergenerational mobility pattern and thus is denoted O in the Mobility column of

TABLE 5
Projected Schooling Distributions under Alternative Simulations of Fertility, Mortality, and Mobility

					Projected 1995 schooling distributions								
Simulation	Mobility	Mortality	Fertility level	Fertility timing	White mean	Black mean	W − B	White <12	Black <12	W − B <12	White 16+	Black 16+	W − B 16+
1	O	O	O	O	13.71	13.02	0.69	8.44	16.93	−8.49	26.64	14.91	11.72
2	O	O	HSG	HSG	13.96	13.26	0.70	7.13	14.75	−7.62	30.60	17.74	12.87
3	O	O	O	HSG	13.77	13.06	0.71	8.21	16.62	−8.42	27.68	15.36	12.31
4	O	O	HSG	O	13.89	13.21	0.68	7.40	15.18	−7.77	29.32	17.07	12.25
5	O	O	1990	1990	13.68	13.20	0.48	8.75	14.67	−5.93	26.27	16.34	9.93
6	O	HSG	O	O	13.70	13.01	0.69	8.49	17.05	−8.55	26.55	14.83	11.72
7	Perfect	O	O	O	13.63	13.12	0.52	9.30	15.85	−6.55	26.06	16.12	9.93
8	Perfect	O	HSG	HSG	13.63	13.12	0.51	9.30	15.85	−6.55	26.06	16.12	9.93
9	Perfect	O	O	HSG	13.63	13.12	0.52	9.30	15.85	−6.55	26.06	16.12	9.94
10	Perfect	O	HSG	O	13.63	13.12	0.51	9.30	15.85	−6.55	26.06	16.12	9.93
11	Perfect	O	1990	1990	13.63	13.12	0.51	9.30	15.85	−6.55	26.06	16.12	9.93
12	Perfect	HSG	O	O	13.63	13.11	0.52	9.32	15.94	−6.62	26.04	16.10	9.94
13	None	O	O	O	8.53	6.97	1.55	74.78	93.52	−18.75	1.73	0.39	1.35
14	None	O	HSG	HSG	9.80	7.74	2.06	57.77	84.23	−26.46	5.11	2.07	3.04
15	None	O	O	HSG	8.63	6.98	1.65	72.95	93.15	−20.19	2.01	0.41	1.61
16	None	O	HSG	O	9.67	7.71	1.96	59.79	84.97	−25.19	4.36	1.84	2.52
17	None	O	1990	1990	8.58	8.97	−0.39	74.05	70.99	3.06	1.67	0.95	0.72
18	None	HSG	O	O	8.49	6.94	1.55	75.29	93.83	−18.54	1.69	0.36	1.32
19	Const. rel.	O	O	O	13.71	13.02	0.69	8.49	16.95	−8.47	26.68	14.94	11.74
20	Const. rel.	O	HSG	HSG	13.96	13.27	0.68	7.21	14.55	−7.34	30.56	17.89	12.67
21	Const. rel.	O	O	HSG	13.77	13.06	0.71	8.26	16.61	−8.35	27.70	15.43	12.27
22	Const. rel.	O	HSG	O	13.89	13.22	0.67	7.48	15.00	−7.52	29.30	17.19	12.12
23	Const. rel.	O	1990	1990	13.68	13.21	0.46	8.78	14.28	−5.50	26.31	16.39	9.92
24	Const. rel.	HSG	O	O	13.70	13.02	0.69	8.54	17.08	−8.54	26.60	14.85	11.74
25	Const.	O	O	O	13.80	12.97	0.83	7.82	19.29	−11.47	29.09	17.73	11.36
26	Const.	O	HSG	HSG	14.05	13.25	0.80	6.66	16.50	−9.84	32.96	20.86	12.10
27	Const.	O	O	HSG	13.86	13.01	0.85	7.61	18.91	−11.30	30.10	18.24	11.86
28	Const.	O	HSG	O	13.98	13.19	0.79	6.90	17.00	−10.10	31.73	20.13	11.60
29	Const.	O	1990	1990	13.76	13.21	0.56	8.16	15.95	−7.79	28.59	19.19	9.40
30	Const.	HSG	O	O	13.80	12.96	0.84	7.87	19.44	−11.57	29.01	17.64	11.37
31	O	O	Pooled	Pooled	13.71	13.08	0.63	8.44	16.39	−7.95	26.64	15.56	11.08
32	O	Pooled	O	O	13.71	13.02	0.69	8.44	16.97	−8.53	26.64	14.88	11.75
33	Pooled	O	O	O	13.71	12.97	0.74	8.49	17.47	−8.98	26.65	14.37	12.27

Note. O, observed; HSG, high school graduate; 1990, 1990 rates in effect for entire period; Perfect statistical independence of mother's and daughter's schooling; None, daughter's and mother's schooling are equal; Const. rel., constant relative mobility over cohorts; Const., constant absolute and relative mobility over cohorts; Pooled, no race difference.

the table. The Mortality, Fertility Level, and Fertility Timing columns present alternative assumptions about differential fertility and mortality. An O in any of these columns denotes that the simulation incorporates the observed pattern of mortality or fertility rates, so far as they are estimable with available data. HSG denotes an assumption that all persons have the fertility or mortality levels of persons with exactly 12 years of schooling; that is, there are no differences in fertility or mortality by educational attainment. 1990 denotes an assumption that the pattern of fertility rates observed in 1990 had been in effect throughout the 1925–1995 period. The final six columns of the table present summary statistics for the projected 1995 educational attainment distribution for 25- to 49-year-old women and for race differences between the white and the black distributions. The bulk of the following discussion focuses on average years of educational attainment because the percentages above or below a given level of educational attainment lead to similar qualitative conclusions.

The effect of differential fertility. These simulations show that differential fertility by educational attainment of mother negatively affects average educational attainment, but this effect is very small for both blacks and whites. Simulation 1 projects the 1995 schooling distribution under the assumption that the population experienced the observed patterns of fertility and mortality from 1925 to 1995. This simulation yields an average number of years completed of 13.71 for whites and 13.02 for blacks.[9] Simulation 2 assumes that fertility does not vary by educational attainment of mother, although it does vary by race and over time. A comparison the two simulations provides an estimate of the effect of differential fertility on educational attainment over the 70-year period. Had there been no educational fertility differences, educational attainment would have been about one-fourth of a year higher than the level implied by observed rates of fertility. Although this estimate indicates that relatively high rates of reproduction of more poorly educated women lowers average educational attainment, it is a small effect in the context of overall educational change during this period. As noted above, actual educational attainment increased by 4.5 and by 7.0 years for whites and blacks, respectively, during this period. In the absence of fertility differences, the expected growth in educational attainment would be similar to the actual growth.

Fertility levels vs fertility timing. Simulations 3 and 4 provide information on the relative importance of the level and timing components of the effect of differential fertility on educational attainment. Simulation 3 assumes no differences in the timing of fertility among women with varying educational attainment, but allows fertility rates to be governed by observed variation in fertility levels by educational attainment. Conversely, simulation 4 assumes no differences in fertility levels by mother's educational attainment, but allows the timing of fertility to vary by education.[10] These simulations, in conjunction with simulations 1 and 2, show how timing and levels components make up the total effect of fertility. For whites, for example, eliminating education differences in fertility

[9] The projected education distribution for 1995 in simulation 1 is somewhat less favorable than the actual 1990 distribution. This discrepancy is the result of several factors, including errors in fertility and mortality rates and immigration, and the fact that the age range of persons included in the mobility matrix is broader than for the observed 1995 distribution. For the purposes of this analysis, however, these discrepancies are unimportant. The effects of demographic rates can be assessed by comparing among alternative simulated distributions, all of which are discrepant from the observed distribution for the same reasons.

[10] In simulation 3 the age-specific fertility rates were calculated by multiplying the age-specific rate for each education group by the ratio of the gross reproduction rate (GRR) for high school graduates to its own GRR. In simulation 4 fertility rates were calculated by assigning all education groups the age-specific rates of high school graduates and then multiplying the assigned rate for each education group by the ratio of its own GRR to the GRR of high school graduates.

timing (but allowing for variation in fertility levels) raises educational attainment by .06 of a year over the 70-year period, whereas eliminating differences in fertility levels (but allowing for variation in timing) raises attainment by .18 of a year. The pattern of effects is similar for blacks. These results show that the small effect of differential fertility is mainly the result of differences in the level of fertility, rather than differences in the timing of fertility.

Effects of recent fertility differences. An examination of trends in education differences in fertility shows that these differences vary considerably over time (see Table 2). For whites, recent differences are larger than at any period since the Depression era. For blacks, in contrast, recent differences do not follow their typical historical pattern and indeed show markedly higher fertility for high school graduates than for persons with less schooling. It is thus interesting to examine the long-run implications of current fertility patterns for educational trends. Simulation 5 projects the distribution of educational attainment that would result if 1990 fertility patterns had been in effect for the entire 70-year period.

Because fertility differences by educational attainment differ between blacks and whites during the most recent period, they have markedly different effects for the two groups. For white women, if the 1990 pattern of educational fertility differences had been in effect from 1925 to 1995, average educational attainment in 1995 would have been slightly lower than the observed level (simulation 5 vs simulation 1). Compared to the level of attainment implied by no fertility differences over this period (simulation 2), average attainment would have been .18 of a year lower. This effect is slightly smaller than the effect of actual patterns of differential fertility over the past 70 years (simulations 1 and 2). Current patterns of differential fertility for whites, therefore, will have a small negative effect on educational attainment if they persist into the future. For blacks, in contrast, the 1990 pattern of fertility differences would imply a *higher* level of educational attainment in 1995 than is implied by actual patterns of fertility since the 1920s ($13.20 - 13.12 = .18$ of a year), and only a slightly lower (.06 year) level than is implied by no fertility differences from 1925 to 1995. This is a consequence of the absence of an inverse association between fertility and educational attainment for black women in 1990. Taken together, the current fertility differences of blacks and whites imply less educational inequality than predicted by the observed sequence of fertility rates (compare .48 of a year to .69 of a year). If recent fertility patterns prevail, they will slightly reduce educational attainment below its long-run trend, but they will have a somewhat larger ameliorative effect on racial inequality in educational attainment than the typical pattern of fertility differences observed throughout the 1925–1995 period.

Differential mortality. The effects of differential mortality on educational distribution are even smaller than those of differential fertility. For both black and white women, average attainment in 1995 would have been .01 years lower than the level implied by observed mortality differences if there had been no differential mortality by educational attainment from 1925 to 1995. Although the direction of this discrepancy implies that the superior survival chances of more educated persons raise average attainment levels, the size of this effect is trivial.

THE EFFECTS OF INTERGENERATIONAL MOBILITY

The effect of fertility patterns on trends in educational attainment depends on the degree of intergenerational mobility in the population. If educational strata are relatively closed—that is, if intergenerational mobility is limited—differences in reproductivity of the educational strata have a clear effect on average levels of attainment. If educational strata are relatively open—that is, intergenerational mobility is substantial—the effects of reproductivity are muted. Although more poorly educated women may have a disproportionate share of the offspring, enough of those offspring experience upward mobility that the effects of differential reproductivity are reduced. It is, therefore, instructive to examine the size of this interaction between differential fertility and social mobility. In addition, in view of continuing concern about declining mobility opportunities in the United States, it is important to investigate how much stronger the effects of differential fertility would be if rates of intergenerational mobility were lower than their historic levels.

Simulations 7–30 examine the effects of differential fertility and mortality under four alternative mobility regimes: (1) independence of mother's and daughter's schooling (Perfect Mobility) (7–12); (2) no mobility at all—that is, mothers and daughters have identical educational attainments—(13–18); (3) constant relative mobility—that is, the association between mothers and daughters educational attainment is invariant across cohorts, although upward mobility engendered by secular shifts in the educational distribution may occur—(19–24); and (4) constant mobility—that is, invariant association between mother's and daughter's schooling and an invariant marginal distribution of schooling.

Independence. If mother's and daughter's educational attainments are statistically independent, differential fertility has no effect at all on the distribution of educational attainment (simulations 7–11). This is true by definition because no matter how many more children are born to poorly educated women than to highly educated women, all of these children have equal chances of educational success and failure. As shown in lines 7 through 11 of Table 3, the varying assumptions about differential fertility that were made in simulations 1–6 do not affect schooling distributions. Independence of mother's and daughter's schooling, therefore, establishes a lower bound on the potential impact of differential fertility on educational attainment. In contrast, perfect mobility does not necessitate that differential mortality has no effect on average educational attainment. The mortality effect, however, is as small under perfect mobility as it is under the observed pattern of mobility.

Differential fertility effects under complete inheritance. I next examine the other extreme on the range of mobility—that is, a regime in which daughters achieve exactly the same status as their mothers. To do this, it is necessary to modify both the associations between mother's and daughter's schooling in the observed mobility tables and also the marginal distribution of schooling. A large amount of the intergenerational educational mobility during the 20th century has resulted from large secular increases in average levels of schooling between the mother's and daughter's generations. Thus, it is impossible to retain the same mothers' and daughters' education distributions in a table that represents no mobility as are observed in actual mobility data. Instead, for each period, I assume a mobility table that is simply an identity matrix, yielding an expected daughter's education distribution that is approximately the same as the 1925 initial distribution. This preserves complete ''inheritance'' of mother's educational attainment and allows for no ''structural mobility'' between mothers and daughters. Simulations under this assumption yield, by construction, much lower predicted levels of educational attainment than those based on observed mobility tables (1–6) or on independence of mother's and daughter's schooling subject to the observed marginal distributions of daughter's schooling (7–12). From the standpoint of this analysis, however, the important issue is how predicted education distributions vary *within* sets of simulations that make a common mobility assumption.

The effects of differential fertility and mortality in the absence of mobility are much larger than for the observed mobility regime, but are still small relative to historical variation in average educational attainment. For white women, if there were no intergenerational mobility, the observed sequence of fertility and mortality rates would imply a 1995 education distribution with a mean of 8.5 years, with 74.8% of women having less than a high school degree, and with less than 2% of women graduating from college (simulation 13). In contrast, when there are no fertility differences—that is, when all women have the fertility rates of high school graduates—the predicted average 1995 educational attainment is 9.8 years, the percentage of women who do not finish high school is 58%, and the percentage who graduate from college is 5.1% (simulation 14). The difference in the mean of 1.3 years between the simulation that assumes the actual fertility patterns and the one that assumes no fertility differences is an estimate of the depressing effect of differential fertility on average educational attainment under a regime of complete immobility. As under the observed mobility regime, the depressing effect of differential fertility in the absence of mobility is mainly the result of differences in the level of fertility rather than the timing (simulations 15 and 16). For black women, the impact of differential fertility under a regime of no intergenerational mobility is qualitatively similar to the effect for whites, with some differences in the sizes of the effects.[11]

The effect of differential fertility is much larger in the absence of mobility than under observed mobility rates. For whites this effect is about 5 times larger (1.3 vs

[11] The estimated differences in educational attainment between blacks and whites that is implied by observed fertility and mortality rates are considerably larger when no mobility is assumed than when the observed pattern is assumed. This, however, is simply an artifact of constraining the 1995 education distribution to equal approximately the 1925 distribution. Because the difference in attainments between blacks and whites was much greater in 1925 than in 1995, a large race difference in attainment is projected forward to 1995 under the no mobility assumption.

.25 years) and for blacks it is nearly 4 times larger (.87 vs 24 years). The estimates under a regime of no mobility provide an upper bound on the potential impact of differential fertility on the distribution of educational attainment. The contrasts among the effects of differential fertility under perfect mobility, the observed mobility pattern, and complete immobility demonstrate the important role that intergenerational mobility plays in offsetting the effects of differential rates of reproduction across education groups. These estimates also show that actual mobility patterns have been much closer to a regime of statistical independence of mother's and daughter's schooling that to a regime of complete immobility.

Recent fertility patterns and immobility. As in the case of the observed mobility table, it is possible to explore the effects of the large 1990 differentials in fertility in the absence of mobility by assuming that the 1990 differences were in place throughout the 1925–1995 period. This assumption yields markedly different implications for educational trends between black and white women. For whites, the implied 1995 average level of education is 8.58 years, .05 of a year lower than implied by the observed sequence of fertility rates and 1.22 years lower than implied by the absence of fertility differences (compare simulation 17 to simulations 13 and 14). The contrast in educational attainment for the recent fertility pattern and a pattern of no fertility differences by educational attainment is several times as large as one observes for the observed mobility regime. This illustrates that differential reproductivity has a much bigger effect on relative group size when groups are closed to mobility. It does not indicate, however, that recent fertility differences imply an unusually large negative effect on educational attainment. For black women, the effects of recent fertility patterns are in the opposite direction from those for whites. If 1995 fertility rates had been in effect from 1925 to 1995 under a regime of complete inheritance of educational status, average educational attainment for black women would be almost 2 years higher than is implied by observed fertility rates and 1.2 years higher than is implied by fertility regimes in which there are no differences in fertility among women with varying amounts of schooling (compare simulation 17 to simulations 13–14). This paradoxical outcome occurs because recent fertility rates for black women are not inversely associated with educational attainment. Indeed, fertility is highest for women who have a high school degree, a level of educational attainment that is at the mode of the current education distribution and well above average for black women throughout most of the 1925–1995 period. By itself, this result shows that recent fertility patterns for blacks do not favor the high reproductivity of poorly educated women and thus do not portend a drop in educational attainment. Taken with the implied pattern for white women, it suggests that recent fertility patterns favor a reduction in educational inequality between blacks and whites. In the absence of intergenerational mobility, this reduction would have occurred more quickly and more completely than in the presence of historical patterns of mobility.

Other mobility regimes. The patterns of intergenerational educational mobility observed during the 1925–1995 period provide an important offsetting influence to the impact of differential fertility on the distribution of educational attainment. Comparisons between the observed, perfect, and no mobility patterns suggest that the effects of differential fertility under the observed mobility regime more closely resemble those that would occur under perfect mobility than under complete inheritance; that is, whereas differential fertility has the expected negative effect on educational growth, these effects are very small. In considering the ways that mobility regimes condition the effects of differential fertility, however, it is important to consider other mobility patterns than simply the extremes of perfect mobility or perfect inheritance. Future mobility patterns, for example, may differ from those in the past, but are unlikely to vary toward extreme mobility or immobility.

I consider two additional mobility patterns, one in which the association between mother's and daughter's schooling does not vary over time, but in which the distributions of mothers and daughters do change (constant relative mobility), and one in which neither the association between mother's and daughter's schooling nor the marginal distributions of mothers' and daughters' schooling vary over time (constant mobility). Simulations that show the hypothetical effects of differential fertility and mortality under the assumption of constant relative mobility and constant mobility from 1925 to 1995 are shown in lines 19–24 and lines 25–30 of Table 5 respectively. Under these two mobility regimes, the effects of differential fertility are very similar to those observed under actual patterns of mobility. Under constant relative mobility, the expected 1995 educational distributions, under various assumptions about fertility and mortality, are virtually identical to those obtained under observed mobility patterns. This is not surprising inasmuch as patterns of intergenerational relative educational mobility have been very stable for cohorts born during the 20th century (Mare, 1981; Hout, Raftery, and Bell, 1993). Under constant mobility, the qualitative pattern of effects of fertility and mortality, as well as their overall size, is also very similar to the effects of fertility and mortality effects under the observed mobility patterns. This suggests that if prevailing patterns of relative mobility, which has been stable during this century, were to continue in the future, but secular growth in educational attainment were to abate, the effects of differential fertility would continue to be very small.

Race differences in fertility, mortality, and mobility. As a final set of comparisons, I consider the implications of race differences in fertility, mortality, and intergenerational mobility for educational inequality between the races. Simulations 31–33 project from 1925 to 1995 the distributions of educational attainment for blacks and whites under the assumption of no race differences in fertility, mortality, and intergenerational educational mobility, respectively. In each instance, the expected educational distribution of blacks and whites is similar to the expected distribution derived from observed race-specific fertility, mortality, and mobility patterns (simulation 1). If blacks and whites had identical education-specific fertility rates from 1925 to 1995, the racial disparity in education would be only .06 of a year less than what is implied by race-specific fertility patterns. If blacks and whites had identical patterns of mobility over this period, the race difference in educational attainment would be .05 of a year greater than is implied by race-specific mobility patterns. These results indicate that differences between the races in the demographic rates examined in this paper are not important sources of racial disparity in educational attainment.

CONCLUSIONS

The analyses reported in this paper provide answers to the six questions posed at the outset of the paper.

1. Differential fertility by educational attainment of mother has retarded the growth of average educational attainment over the past 70 years, but this effect is small. Had there been no fertility differences between 1925 and 1995, average educational attainment for prime age women would have been about a fourth of a year lower than the actual 1995 attainment level. When one considers that the average educational attainment of women increased by about 4.5 years for whites and 7 years for blacks over this period, this effect as negligible.

2. Whereas the differential *level* of fertility by women's educational attainment depresses average attainment slightly, the differential *timing* of fertility has almost no effect. Education differences in fertility timing among women who attain less than a college degree are small and variable. In some periods, these differences have little or no effect on differential reproductivity.

3. Although 1995 fertility differences by education for whites are stronger than at any other period since the 1930s, even these differences do not have much effect on the distribution of schooling. Had 1995 fertility patterns been in effect for the past 70 years, the average level of educational attainment in the population today would be only slightly lower than it is. For blacks during the recent period, fertility is highest for women in the middle of the schooling distribution. If this pattern affects the trend in the education distribution, the effect is positive rather than negative.

4. Differential mortality does raise the average level of educational attainment because less educated persons die earlier than their more educated counterparts. This effect, however, is trivial in size.

5. In a world of perfect mobility (that is, independence of social origins and destinations), differential fertility cannot affect education distributions. The greater the degree of resemblance between mother and daughter on educational attainment (that is, the lower the rate of intergenerational mobility), the greater the effect of differential fertility. In the extreme case in which each daughter has the same educational attainment as her mother, the effects of differential fertility are considerably larger than under the actual regime of intergenerational mobility observed during the past several decades. It is this extreme (and unrealistic) condition that is sometimes mistakenly assumed in discussions of the presumed harmful effect of differential fertility (Preston and Campbell, 1993; Lam, 1993). Even in this case, however, the impact of differential fertility over a 70-year period is small relative to the overall change in average attainment.

Even under a pessimistic forecast for the prospects for future intergenerational mobility in the United States, it is extremely unlikely that the future will approximate the extreme condition of complete educational immobility. A more realistic scenario is that average attainment levels will converge to a somewhat higher level than they are now, subsequent generations will average similar levels of attainment to those of their parents, and the *association* between parents and offspring will not change much from its historical pattern. These expectations are in line with the stable patterns of parental effects on offsprings' educational attainment throughout this century and the long-run trend in educational growth (Mare, 1981, 1995a; Hout *et al.,* 1993). Under these conditions, the effects of differential fertility on educational distributions will be very modest.

6. Differences in fertility, mortality, and interegenerational mobility have modest effects on racial inequality. Although both fertility and mortality rates have historically been higher for blacks and whites, differences in these rates across educational strata are similar between the races. A potentially important difference in these patterns has occurred in recent years, during which the traditional negative association between educational attainment and fertility has reemerged for whites but not for blacks. If this recent pattern persists, white average attainment will be subject to somewhat greater downward pressure as a result of differential fertility than black attainment. This will reinforce the secular pattern of convergence in educational attainment between the races (Mare, 1995a).

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