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The Demography of Social Mobility: Black-White Differences in the Process of Educational Reproduction[1]

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Increases in women's education represent one of the most wide-reaching socioeconomic changes of recent decades. But how much will future generations benefit from these gains, and will black and white Americans benefit equally? Using data from the Panel Study of Income Dynamics, this study examines differences in the process of educational reproduction for black and white Americans. The approach considers the implication of race and education differences in marriage, assortative mating, and fertility in the parent generation on the distribution of schooling in the next generation. The analyses use a dynamic, multidimensional model that allows for intergenerational pathways at the individual, family, and population levels. The results show that these demographic mechanisms play an important role in explaining race differences in educational reproduction. Ignoring these pathways underestimates intergenerational effects for whites and overestimates them for blacks.

Increases in women's education represent one of the most fundamental and wide-reaching socioeconomic changes of recent decades. In most developing countries, girls have made large gains in primary and secondary edu-

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cation, while young women in many industrialized nations are pursuing postsecondary schooling in unprecedented proportions. Indeed, women now outpace men in rates of college completion in the United States, Canada, and much of Europe. In 2004, for example, women received 58% of all bachelor's degrees awarded in the United States, and this advantage was even larger for some groups, such as black women, who earned 67% of college degrees received by African-Americans (DiPrete and Buchmann 2006). Given the important role that education plays in processes of social, economic, and health stratifications these expansions in American women's schooling have attracted much attention both in the academic literature and in the popular press (Fonda and Berryman 2000; Goldin 2004; Marklein 2005; Buchmann and DiPrete 2006; DiPrete and Buchmann 2006; Goldin, Katz, and Kuziemko 2006). Few studies, however, have explored the implications of women's educational gains for intergenerational mobility and educational inequality in future generations. The intergenerational effects of women's education are particularly important because parents' education is an important determinant of children's outcomes. Women with more schooling have children who obtain more schooling—a mechanism that transmits and multiplies the advantages of increased educational attainment across generations (Haveman and Wolfe 1994).

The intergenerational effects of increases in women's education are complex and multifaceted. Intergenerational effects involve a dynamic set of relationships that can operate at the individual, family, and population levels, may be offsetting or reinforcing, and differ in important ways for Americans of different race-ethnic backgrounds. Intergenerational effects accrue via two sets of pathways. The more familiar set of pathways, which has inspired much of the research in social stratification, describes associations at the family level between parents' statuses and children's statuses—for example, the partial correlations between parents' education and children's education (Blau and Duncan 1967; Jencks et al. 1972; Haveman and Wolfe 1994; Bowles, Gintis, and Groves 2005). The second set of intergenerational pathways, which is less studied but equally important, describes how the statuses of parents affect demographic processes such as marriage, assortative mating, fertility, and mortality that in turn create the very families within which statuses are transmitted (Duncan 1966; Preston 1974; Lam 1986; Mare 1996; Mare and Maralani 2006). Women with different levels of education have substantially different patterns of marriage and fertility (Ellwood and Jencks 2004; Martin 2004). Given that schooling is usually completed early in life, increases in women's education will likely change subsequent marriage and fertility choices as well. The intergenerational effects of increasing women's education include both family-level correlations in status and the effects that accrue via changes in patterns of family formation (Mare and Maralani 2006).

Although the demographic pathways of intergenerational effects are routinely ignored in the stratification literature, dramatic changes in patterns of family formation make it very clear that inequality and demography have become inextricably linked. In recent decades, American families have changed in important ways that are closely tied to women's education and race.[2] For both white and black college-educated women, the ages at which women marry and have children have increased across cohorts (Rindfuss, Morgan, and Offutt 1996). College-educated women in more recent cohorts do not forgo marriage and childbearing; rather, they delay it. Women with less schooling, on the other hand, who postpone marriage and childbearing have relatively lower rates of marriage and fertility at older ages (Martin 2004). There has also been substantial growth in single-parent families, primarily among women with less schooling and among African-Americans (Ellwood and Jencks 2004). These education and race-specific demographic trends have contributed to the creation of "diverging destinies," which have led to growing disparities in children's resources (McLanahan 2004; McLanahan and Perchesky 2008). Women with more education have embraced demographic patterns that increase the resources available to their children, while those with less education have patterns associated with lower family resources (McLanahan 2004). Thus, demography and social inequality have become even more closely intertwined, and demographic processes such as marriage and fertility have become important mechanisms in the reproduction of inequality.

The idea that demography and social mobility are closely tied is not new. Duncan (1966) described social mobility as part of a dynamic process of population renewal. He argued that the analysis of social mobility by necessity has to deal with the "component processes of 'social metabolism'" (1966:52), such as differential fertility, death, and migration. The links between demographic processes and social mobility are not simply methodological and empirical details to resolve or simplify but rather a central conceptual issue in understanding and describing social mobility. In addition to being important components of social mobility, demographic processes may also constrain social mobility. Wilson (1987), for example, identifies race differences in marriage markets as a mechanism that perpetuates poverty among black Americans. His hypothesis that black women face a shortage of black "marriageable men" posits that race differences in marriage markets create a macrolevel demographic constraint that explains race differences in social inequality and intergenerational mobility.

[2] Because data on multiple generations of the sort analyzed below are quite limited for groups other than white and black Americans, I limit the remainder of the discussion and the empirical analyses to differences between these groups only. This lack of data is unfortunate, however, because differences in educational mobility for ethnic and immigrant groups are an important area of research.

In his schema of the space of social positions, Bourdieu (1984, p. 128) also links social position and family statuses directly together. As one moves along the axes of economic and cultural capital, family size, education, and occupation move together systematically. Bourdieu argues that family processes are part of a multidimensional process of social mobility and that these mechanisms work in nonlinear ways along the social hierarchy (1984, pp. 331–32). One cannot explain the mechanisms underlying social inequality without recognizing that the process has multiple, interwoven dimensions. Similarly, in making a case for a new class map, Weeden and Grusky (2005) argue that social positions reflect clusters of statuses that encompass not just income, occupation, and job tenure but also marital status, number of children, and divorce. They propose that, to be effective, a given class schema must not only predict traditional measures of status such as education and income ("life chances") but also inextricably linked family statuses such as marital status, number of children, and divorce status ("lifestyles").

Although the links between social mobility and demographic processes are theoretically, conceptually, and empirically well established and compelling, most studies of social mobility ignore the demographic pathways of intergenerational effects. In the case of educational mobility, the demography of educational reproduction and the role it plays in explaining differences in stratification processes by race have been largely ignored in the existing literature. But as family processes and educational attainment have become, on the one hand, more closely tied and, on the other hand, more differentiated across subgroups, understanding race differences in educational reproduction requires considering both the direct transmission of family status and the family processes that transform one generation into the next. For example, in considering how a child's outcomes might change if her mother had more schooling, we would have to allow for that change in her mother's education to also change her father's education, the child's number of siblings, and her exposure to single parenthood, just as it might as one moves across Bourdieu's social space or a given class schema. It is this bundling or multidimensionality of status that explains the process of "diverging destinies" or changes in both "lifestyles" and "life chances."

Incorporating the demographic pathways of intergenerational effects advances our ability to describe social mobility in two other important ways. Demographic pathways such a marriage, assortative mating, and fertility operate at multiple levels. In addition to determining individual- and family-level characteristics (e.g., how many years a child lives in a two-parent household, how many siblings she has, or her father's level of education), demographic pathways have population-level effects. By creating the very families in which status is transmitted, demographic pathways link micro- and macrolevel processes. At the population level, for example, differential fertility informs the structure of inequality by reweighting different groups and thus the distribution of schooling in the next generation. At the same time, demographic pathways allow for dynamic interdependence across these levels. Moreover, because these relationships can differ by social group at the individual, family, and population levels, their joint dynamics can also differ by social group in important and unexpected ways.

The combination of these micro-macro processes allows for a conceptualization of mobility that includes not just the transmission of status but also the transformation of groups across generations. A dynamic, demographically informed view of social mobility allows us to study both the individual pathways of intergenerational effects and the combined implications of well-established and intertwined mechanisms. This allows for a more sophisticated and detailed accounting of the intrinsic multidimensionality of social status.

Very few studies of social mobility, however, espouse the idea of transformation. The reasons for this are threefold. First, this requires using an analytical model of social mobility that is dynamic rather than static and that allows for hypothetical changes in marriage and fertility choices, given a change in social status such as education (Mare and Maralani 2006). A standard regression model, path diagram, or cross-classified mobility table does not allow this, no matter how precisely estimated. Second, it requires counterfactuals not available in any observed data (the potential spouse or number of children a woman might have if her education were hypothetically increased). For a given change in social status, this requires a prospective forecast of changes in related statuses across the life course. Third, it requires a formal model of social reproduction that includes intergenerational pathways at both the micro- and macrolevel. Coleman (1987) describes this intellectual endeavor as the need to move from the individual level, which is our typical unit of observation, back to the population or macrolevel, which is the level at which inequality is conceptualized. This requires a model that links microprocesses to macrolevel distributions. Abbott (1988) similarly points to the need to move beyond the static, linear model to models and approaches that capture the complex nonlinearities and interactions inherent in social processes. The current analysis fills this gap in the literature on educational reproduction.

This study examines how increases in women's schooling combined with differences in patterns of marriage, assortative mating, and fertility create differences in the process of educational reproduction for black and white Americans. Specifically, the study addresses four related questions. What is the intergenerational effect of increases in women's schooling when we consider a more complete and complex set of family- and population-level pathways? Do these effects differ for black and white Americans? Do differences in demographic processes by race and education amplify or dampen family-level associations in educational status and, if so, by how much? Finally, how have these patterns changed across birth cohorts? To answer these questions, I combine a model of educational stratification with a demographic model of population renewal and use a series of simulations to examine differences in patterns of educational reproduction for black and white Americans. I assess the implications of demographic patterns such as differential fertility, assortative mating, delayed fertility and marriage, nonmarital fertility, and race and cohort differences in these demographic mechanisms on patterns of intergenerational effects.

THE DEMOGRAPHY OF EDUCATIONAL MOBILITY

The intergenerational ties between the schooling of parents and children have been a central concern in social stratification research. Much of this research shows that children of better educated parents get more schooling than the children of less-educated parents (Jencks et al. 1972; Featherman and Hauser 1978; Mare 1981). Although these studies highlight the importance of the intergenerational transmission of educational status, few include the effect of changes in education that accrue via marriage and fertility when estimating intergenerational effects (for exceptions, see Mare 1996, 1997; Mare and Maralani 2006; Kye and Mare 2012). Yet patterns of family formation and family structure can benefit or impinge on children via numerous pathways that operate simultaneously at different levels.

Individual- and Family-Level Demographic Pathways

At the individual level, couples' fertility choices about how many children to have determine the number of siblings with whom a child grows up. The time in life when couples bear children determines the spacing of their children, whether their children have older or younger parents, and part of children's exposure to single-parent households. At the family level, marriage decisions influence children's exposure to single-parent households as well and determine the education of children's fathers (for marital births). Thus, fertility and marriage patterns determine many individual- and family-level characteristics that research has shown predict children's educational outcomes. Children who live with both parents, for example, obtain more schooling than those living with single mothers (McLanahan and Sandefur 1994). Children with older parents also obtain more schooling (Mare and Tzeng 1989; Powell, Steelman, and Carini 2006), while children with more siblings, especially ones that are near in age, obtain less schooling on average (Blake 1989; Powell and Steelman 1993). Children of highly educated women are more likely to have a highly educated father, which amplifies the benefits to children (Mare and Maralani 2006).

These individual- and family-level characteristics, however, have different effects for black and white children. For example, relative to mother's schooling, father's schooling has a smaller effect on children's schooling for blacks, while for whites, father's schooling has a larger effect (Kane 1994). Similarly, the association between family size and children's schooling is weaker for blacks than for whites (Kuo and Hauser 1995), and the negative effect of nonintact families on children's schooling may be smaller for black children (Haurin 1992; Hauser and Phang 1993; Kuo and Hauser 1995; Dunifon and Kowaleski-Jones 2002). Thus, the relationship between marriage, assortative mating, fertility, and children's outcomes can differ for white and black Americans at both the individual and family levels, as well as in the combination of effects across these levels.

Population-Level Demographic Pathways

Differences in marriage and fertility by race operate at the population level as well. Education differences in total fertility, for example, are larger within race groups than across groups. Black women with 12 or fewer years of schooling have a higher total fertility rate than their white counterparts, whereas black and white women with some college completed have similar fertility rates (Johnson 1979; Yang and Morgan 2003). This means that increasing women's schooling across this educational threshold would predict a larger drop in total fertility for black women than white women. At the population level, this translates to a larger decline in the overall number of children born to college-educated black mothers. Education differences in marital status are also much larger for black women. Black women at the top of the education distribution are more likely to be married than black women with less schooling. In contrast, differences in marital status by education are much smaller for white women (Ellwood and Jencks 2004, fig. 1.18). These race differences in fertility and marriage reweight the population differentially for black and white Americans and are an important and often overlooked part of the process of educational mobility in the United States.

Black-White Differences in Social and Educational Mobility

Black-white differences in social mobility are a particularly important area of research because these differences represent a long-standing facet of racial inequality in the United States (Duncan 1967, 1968). Historically, black Americans have experienced higher levels of downward mobility and much lower rates of upward income mobility than white Americans (Duncan 1968; Hout 1984; Hertz 2005). On average, black Americans begin life with lower levels of parental socioeconomic status, have lower average occupational standing, and are less able to convert their educational attainment to higher occupational status (Duncan 1967, 1968; Featherman and Hauser 1976; Bielby, Hauser, and Featherman 1977; Hout 1984). Thus, differences in the process of intergenerational mobility by race are an important and enduring part of the landscape of social stratification in the United States.

Black-white differences in educational attainment have been described by numerous theories and factors (see Hallinan [2001] and Gamoran [2001] for reviews). Some scholars have emphasized the role of cultural explanations, both in the form of resistance to mainstream notions of academic success (Ogbu 1978) and in terms of a mismatch in the cultural resources children have at home versus those rewarded at school (Health 1983; Delpit 1996). Others have argued that negative stereotypes of academic competence may be self-fulfilling, causing black Americans to underachieve academically even when they know the stereotypes to be false (Steele 1997). By reflecting the biases of society, schools as institutions and the faculty they employ may also play a role in reproducing both class and race inequality (Bowles and Gintis 1976; Bourdieu and Passeron 1977; Giroux 1983; Furgeson 2003). Other scholars have emphasized the large role that differences in family background play in explaining racial gaps in educational achievement (Haveman and Wolfe 1994; Conley 1999). Much of the research points to disparities in family resources such as parent's education, income, wealth, and neighborhoods that leave black children at a considerable disadvantage. When background characteristics are held constant, the racial gap in educational attainment closes and is more favorable for black Americans (Hill and Duncan 1987; Hauser 1993; Hauser and Phang 1993; Conley 1999; Bennett and Lutz 2007).[3] These differences are an important part of the transmission of educational status and, thus, the process of educational mobility. But these family statuses are closely tied to other parts of the mobility process as well. Few studies have considered the implications of the massive changes in family formation by race and education in explaining black-white differences in educational mobility across cohorts.

Bridging Two Literatures

This effort to measure both the family-level effects of parents on children, as well as those effects that accrue through population processes that depend on parents' characteristics, builds on two literatures. It brings together

[3] It is important to distinguish between educational attainment and other measures of educational achievement such as educational quality or test scores. Black-white differences in test-scores, for example, are far more difficult to explain (Jencks and Philips 1998). Differences in family background explain only about one-third of the black-white gap in test scores (Hedges and Nowell 1999).

traditional status attainment research that focuses on intergenerational social mobility (Blau and Duncan 1967; Jencks et al. 1972; Featherman and Hauser 1978; Haveman and Wolfe 1994; Bowles et al. 2005) with formal demographic approaches of population projection that describe how groups sort and reproduce across generations (Mukherjee 1954; Matras 1961; Duncan 1966; Preston 1974; Lam 1986; Preston and Campbell 1993; Mare 1996; Mare and Maralani 2006). The current analysis extends the original model and approach described by Mare and Maralani (2006), which conceptualizes mobility as having both micro- and macrolevel pathways. The current study incorporates the complex demographic patterns present in the United States, including delayed marriage, never marrying, nonmarital fertility, and differences in these demographic patterns by race in assessing black-white differences in the intergenerational transmission of educational status. I also consider differences by birth cohort, address the concern that some mechanisms may be jointly determined, and check the robustness of the results to assumptions about the marriage market. A key methodological contribution of the current study is to use an individual-level model that accounts for correlations between different intergenerational pathways and unobserved heterogeneity at the individual and family level. As a whole, the approach models the transformation of educational status from one generation to the next.

RESEARCH DESIGN

The research design combines a demographic model of how a generation of women produces a generation of offspring with a stratification model that describes the association between children's schooling and parent's schooling. Because the formal model and simulations have many parts, it is crucial to keep the component parts as parsimonious as possible while still capturing the meaningful patterns in the data. This principle of parsimony guides the entire analysis so that, in interpreting the simulation results, one can understand clearly what went into the model and drives the results (Garson 2009). The results should be interpreted descriptively rather than causally. The results do not hinge on any specific point estimate but rather on the larger patterns observed by considering different alternatives (e.g., What if a woman marries a man with more schooling? What if a child is exposed to more years in a two-parent household?).

The model captures four mechanisms or pathways for intergenerational effects. Each pathway is summarized by a static statistical model. I use the parameter estimates from the statistical models in a set of simulations that allow for a dynamic and complex set of intergenerational effects. The first pathway is the direct association between parents' schooling and children's schooling (the transmission process). I also consider three additional mechanisms, which relate a woman's education to her marriage and fertility experiences: the probability that a woman will be married at each age from 15 to 62 years; the education of her husband if she marries; and the probability of having a birth at each age from 15 to 44 years. Taken together, these pathways relate the education distribution of women in one generation to the education distribution of the next generation. These pathways allow direct effects, family-level effects, and population-level effects in the number and types of families that are produced from one generation to the next.

The simulations draw out nonlinearities and interactions within and across the intergenerational pathways that would otherwise be difficult to describe using static approaches such as regressions or path diagrams. More importantly, simulations can describe counterfactuals not available in any observed data. Simulations allow for prospective forecasts of life courses. Simulation methods can be used to iterate forward one or many generations to draw out the implications of a set of intergenerational relationships in dynamic and complex ways. Simulations are a particularly effective way of determining the interdependence of demographic processes and socioeconomic inequalities (Preston and Campbell 1993; Mare 1997; Avery and Rendall 2002; Mare and Maralani 2006).

In the case of women's schooling, simulations allow one to assess what women's marriage and fertility choices and the subsequent attainment of their children might have been had the women had a different level of education than they did in the observed data (given the model specified). For example, given a hypothetical increase in her schooling, the simulations allow a woman to marry a man with a different level of education than her observed husband's education or have fewer or more children than in her observed family. The simulations accomplish this by generating predicted life courses that allow for changes both in the associations between parents' education and children's education and in women's marriage and fertility patterns for a given hypothetical increase in educational attainment. The demographic projection model aggregates these microlevel relationships up to the population level.

FORMAL MODEL

For women and children, completed schooling is specified in four discrete categories: 0–11, 12, 13–15, and 16 or more years. For husbands, completed schooling has three discrete categories: 0–11, 12, and 13 or more years.[4] Let C_j be the number of children in the offspring generation with education

[4] In the data used for this analysis there are too few African-American men with college education, especially in the older birth cohorts, to support the four-category version of schooling used for women and children.

level j and W_i be the number of women in the mother generation with education level i. Let $r_{jka|i}$ be the number of children who attain education level j, with a father with education level k, born at mother's age a, for a woman who has attained education level i. This can be thought of as an intergenerational transmission rate weighted by differential fertility and marriage. I set husbands'/fathers' education (k) equal to zero if a woman is not married. Thus, $i = 1, \ldots, 4$; $j = 1, \ldots, 4$; $k = 0, \ldots, 3$. Let age, a, range from 15 to 62 in single years. Then,

$$C_j = \sum_{i=1}^{4} \sum_{k=0}^{3} \sum_{a=15}^{62} r_{jka|i} W_i. \qquad (1)$$

Given the $r_{jka|i}$, one can compute the expected number of children of education level j born to a mother with education level i. If one knows the educational distribution of women at a given point in time, then this equation can project the educational distribution of children in the next generation. One can also simulate the change in C_j if the distribution of W_i were modified or if the distribution of W_i differed by cohort or race.

Marriage, fertility, and intergenerational transmission affect the $r_{jka|i}$ as follows:

$$r_{jka|i} = p^{H}_{k|ai} \, p^{F}_{kai} \, p^{T}_{j|kai}. \qquad (2)$$

The term $p^{H}_{k|ai}$ denotes the probability that a woman in the kth education category has a husband in the kth education category when she is age a. When k equals zero, this is the probability that she is unmarried. When k is greater than zero, this is the probability that she is married to a man in the given education category. The term p^{F}_{kai} denotes the probability that a woman in education category i who has a husband in category k (or who is unmarried if $k = 0$) has a birth at each age a. This probability is constrained to zero for ages 45–62 years. The model only allows singleton births. The term $p^{T}_{j|kai}$ denotes the probability that a child born to a woman in the ith education category at age a with a man in the kth education category (or unmarried if $k = 0$) achieves the jth level of schooling. In this model, only women's educational attainment is exogenous. The joint distribution of marital status, husband's schooling, fertility, and offspring's schooling is endogenously determined by women's schooling. I discuss this feature of the approach in more detail below.

The model specified above is extremely flexible. It allows women to delay or forgo marriage and/or fertility. Thus, a given change in women's schooling can change the relationships at the individual level as well as at the population level by changing the numbers and types of families that are produced. Specified in single years of age, the model allows age-specific variation in the likelihood of being married, as well as marital and nonmarital fertility. It also distinguishes between the ages at which children's parents are married and those in which the mother is unmarried as a result of never marrying, divorce, or widowhood. In this way, the model allows for an accounting of the number of years that children are expected to live in a two-parent household from birth through age 18, conditional on their mothers' schooling.

The model also makes some simplifications. In terms of demographic pathways, the model does not include a formal treatment of divorce or remarriage and does not distinguish between biological fathers and stepfathers. The analysis does, however, capture the education of a divorced man/father both in the marriage equation and the child's education equation. The model also captures differences in time spent in a two-parent family as a result of differential divorce by mother's education directly in the child's schooling equation.

The analysis ignores genetic ties between generations, maternal and child mortality, and cohabitation, and it uses a woman's completed education at all ages, rather than the education she actually had at each specific age.[5] In terms of educational transmission, the model does not include the direct effects of many of the detailed covariates that might be included if one were estimating a static regression of the predictors of race differences in children's schooling such as wealth, neighborhood, or regional differences (Massey and Denton 1993; Conley 1999). In the current approach, differences in wealth or spatial distributions do not affect educational mobility directly but affect it indirectly via the other family processes (marriage, assortative mating, fertility) included in the model.

The model is one of educational mobility rather than educational inequality at a given point in time. Anything that is specified as a determinant of children's schooling either has to be exogenous (such as women's schooling), randomly assigned (such as child's sex), or specified as a function of women's education within the model. The analyses focus only on educational attainment rather than addressing race differences in the quality of education, which are an important source of inequality between white and black Americans (Jencks and Philips 1998). While it is possible to include many of these extensions in the approach described above, these are omitted here for the sake of parsimony. The current model captures the

[5] Although race differences in infant mortality are an enduring dimension of inequality in the United States, previous work suggests that the intergenerational effects that accrue via differences in maternal and child survival are modest, even in a developing country where educational differences in mortality are moderately high (Maralani and Mare 2005).

mechanisms most sensitive to changes in women's schooling. Despite these simplifications, the current model goes far beyond conventional models of social mobility in specifying a complex set of pathways between the statuses of parents and those of their children.

The model allows education to affect fertility, but in the United States, the effect of fertility on schooling has also been of central concern. Although there is a continuing debate about whether or not fertility has a causal effect on completed schooling, there is nonetheless a large literature that focuses on the negative effects of early fertility on educational attainment (Rindfuss, Bumpass, and St. John 1980; Hofferth, Reid, and Mott 2001; see Hoffman [1998] for a review of the controversy). While the effect of fertility on schooling is important, this is not a major vein in the process of educational mobility and would require an even more complex model. For these reasons, the approach described here focuses only on the effect of changes in education on future fertility and marriage. The model assumes that women's completed education does not depend on their fertility and that women's education and fertility are not jointly determined.

In its simplest form, the model assumes a marriage market in which men's attainments are entirely endogenous to those of women, and women can marry men with whatever level of education they choose. This allows the men's education distribution to change freely in response to changes in the women's education distribution. This assumption may not hold, however, if men's education does not keep pace with changes in women's schooling. If women obtain more schooling than men, as is currently the case in the United States, then the marriage market may be constrained in ways not captured by the model. Theories of constrained marriage markets have been especially important in discussions of African-American family patterns and social position (Wilson 1987; see Ellwood and Jencks [2004] for a review of the empirical literature on this topic). To examine the sensitivity of the results to assumptions about the marriage market, I also consider a constrained marriage market in which gains in women's schooling are not matched by similar gains in men's schooling. In this hypothetical marriage market, the male education distributions are constrained to the observed sample distributions for white and black men. This implements a stylized version of Wilson's hypothesis and enforces a macrolevel demographic constraint on the process of educational mobility.

ESTIMATION METHOD

I estimate the components of equation (2) using three statistical models: one for marital status, one for assortative mating, and a joint model of fertility and educational transmission. The first two models estimate the first term in equation (2), $p^{H}_{k|ai}$, in two independent parts: a binary logit model predicting the probability of being married at each age, and conditional on being married, an ordered logit model predicting the probability of having a husband in each education category. The remaining two terms representing the fertility and transmission processes (p^F_{kai} and $p^T_{j|kai}$) are estimated jointly using a two-equation model with a woman-specific random intercept in each equation and an estimated covariance between the two random intercepts. The fertility equation is a binary logit model predicting the probability of a birth at each age (the birth may be marital or nonmarital). The children's schooling equation is an ordered logit model predicting the probability of having a child in each education category. Many sample women have observations in both the fertility and child schooling samples, and women with more than one eligible child have multiple observations in the child schooling sample. The fertility and child schooling equations are related as follows (a indexes age, w indexes women, m indexes different children of the same woman, and μ_1 and μ_2 are woman-specific random factors):

$$\text{fertility}_{aw} = f(X'_{aw}\beta + \mu_{1w} + \omega_{aw}), \tag{3}$$

$$\text{child's education}_{mw} = g(Z'_{mw}\gamma + \mu_{2w} + \eta_{mw}), \tag{4}$$

where $\mu_{1w} \sim N(0, \sigma_1^2), \mu_{2w} \sim N(0, \sigma_2^2)$, with estimated correlation ρ; $\omega_{aw} \perp \eta_{mw} \perp \mu_{1w} \perp \mu_{2w}$; and $E(\omega_{aw}) = E(\eta_{mw}) = 0$. The terms β and γ, which are vectors, and σ_1^2, σ_2^2, and ρ, which are the variances of the random factors and their correlation, are parameters to be estimated. Equations (3) and (4) are estimated simultaneously using maximum likelihood.

The concern that family size and children's outcomes may be correlated is well documented in the literature and thus an important issue to address in the estimation (Rosenzweig and Wolpin 1980; Becker 1991; Guo and Van Whey 1999). The joint random effects structure specified above allows for separate woman-specific unobserved factors in the fertility and transmission processes and allows these to be correlated within individual women. This specification addresses two concerns. The first is that each woman may have constant but unobserved characteristics, for example, her temperament or motivation, which influence her family size and her children's outcomes. The second is that these characteristics may be correlated such that her fertility and children's outcomes are also correlated.[6]

[6] With more assumptions and structure, one could also estimate a more complicated system that allows marriage to be correlated with fertility or children's schooling as well.

Table 1 presents a summary of the statistical models used to compute the components of equation (2). I control for birth cohort in all models and allow the levels and age patterns of marriage and fertility to differ for each cohort. These cohort terms adjust for both the dramatic changes in marriage and fertility patterns and cohort-specific characteristics such as differences in gender-role expectations. All models are estimated separately by race to allow full flexibility in the race-specific intergenerational patterns. These statistical models describe the relationship between women's schooling and various intergenerational mechanisms, and how these differ for black and white Americans. The goal is not to build a complete behavioral model for each mechanism. Rather, for each model, I use specifications that capture important interactions or nonlinearities and that reproduce the meaningful patterns present in the observed data.

I use predicted probabilities from these statistical models and actual or hypothetical values of observed characteristics of women and their husbands to compute an estimate of $r_{jka|i}$ in equation (2). Given this estimate, the expected number of individuals in the offspring generation who attain education level j is the sum over all women's and husbands' education categories and women's ages, or $\hat{C}_j = \sum_i \sum_k \sum_a \hat{r}_{jka|i} W_i$. As discussed in further detail below, I compute the $\hat{C}_j$ under several scenarios that vary given a hypothetical increase in women's schooling in the parent generation and which of the effects of women's education on marriage, fertility, and child's schooling (specified in the $\hat{r}_{jka|i}$) are allowed to operate in the simulation.

Overall, the simulations produce stable results. The simulations have many moving parts but these parts come together in fairly simple ways. One key feature of this stability is that the simulations iterate forward only one generation. Moreover, the analyses directly assess the sensitivity of the results to holding different pathways fixed in the simulations. The results are fairly consistent across the two race groups and three cohorts. The race-cohort groups have quite different parameters so the range of results produced gives a good sense of how much predictions change (and where in the system) when parameters have opposite signs or quite different magnitudes as they often do for white and black Americans.

DATA

The analysis uses the 1968–2003 public use waves of the Panel Study of Income Dynamics (PSID). The PSID is a longitudinal survey with a representative sample of U.S. individuals and their families. Since 1968, the PSID has followed original sample members and all new family members, tracking children from their families of origin to their new households. The survey includes extensive socioeconomic and demographic information and has a multigenerational structure. I exclude the Latino and immigrant samples

TABLE 1
SUMMARY OF STATISTICAL MODELS USED IN ANALYSES, PSID 1968–2003

Mechanism	Model	Dependent Variable	Specification
Marital status.	Binary logit	Married (yes/no) in single years, ages 15–62	Woman's education Age in four-piece spline Birth cohort Woman's education × age Cohort × age
Assortative mating	Ordered logit	Husband's education in categories: 0–11, 12, ≥13 years	Woman's education Birth cohort
Fertility	Binary logit estimated jointly with Transmission	Probability of giving birth at each age from 15 to 44 years	Woman's education Age in four-piece spline Birth cohort Husband's education Women's education × age Cohort × age Random intercept with variance σ_1^2
Transmission	Ordered logit estimated jointly with Fertility	Child's education in categories: 0–11, 12, 13–15, ≥16 years	Woman's education Birth cohort Husband's education No. of siblings Child's sex No. of years lived in two-parent family ages 0–18 Random intercept with variance σ_2^2 Correlation ρ (σ_1^2, σ_2^2)

NOTE.—The Fertility and Transmission models are estimated jointly using a two-equation model with random intercepts in each equation that may be correlated. See the text for details. All models are estimated separately for whites and blacks. Birth cohorts are 1919–38, 1939–53, and 1954–68.

from the analyses because these subsamples were observed for substantially fewer years than the original 1968 sample. Several studies confirm that differential attrition in the PSID is small and that response rates are largely invariant across individual characteristics (Hill 1992). Once weighted, the data are generally representative of the original 1968 sampling population.

The analyses use observations from women ages 0–49 years in the 1968 PSID household and their children. I divide women into three birth cohorts and control for cohort in all models. These cohorts include women born 1919–38, 1939–53, and 1954–68, or alternatively, women ages 30–49, 15–29, and 0–14 years, respectively, in the first survey wave. Appendix table A1 describes these cohorts in more detail. As expected, women's education has been increasing across cohorts for both whites and blacks and marriage and fertility levels have been declining.

I form four overlapping samples for estimating the statistical models. Many women contribute information to all four samples, and women observed in only some years or samples are included for the ages they are observed. To minimize the censoring of educational attainment, education is measured at age 25, and women who leave the survey before age 25 are excluded from the sample (Aud et al. 2012). Table 2 describes the educational attainment distributions and sample sizes of the women (and their husbands and children) used in estimating each statistical model. The most comprehensive sample is the one used for estimating the probability of being married from ages 15 to 62 years (marital status sample). This sample includes 3,322 white and 2,734 black women. A woman is considered married at a given age if she reports being married at any point during the specified age. The assortative mating sample is a subset of the marital status sample, namely those women who ever married and for whom the PSID recorded husband's education.[7] The fertility sample is a subset of the marital status sample with valid fertility histories. The children's education (transmission) sample is a sample of children who ever resided in a PSID household and who were observed until at least age 25 to capture completed schooling. Because few women in the youngest cohort are old enough to have children who

[7] For women with multiple marriages (about 18% of women in the marriage sample), I use the education of the man to whom a woman was married for the longest time between ages 15 and 44 (inclusive). If that man's education is missing, I use the education of the man from her next longest marriage. If an ever-married woman has no husbands who have ever resided in a PSID family, then husband's education is missing for that woman (8% of women who were sampled). Each woman is assigned only one husband, and this husband is the same in both the fertility and transmission sample. The husband does not have to be the biological father of the woman's children; nor does he have to be present when the child is born. If, for example, a woman was married twice between ages 15 and 44, first for 3 years and then for 15, she is recorded as being married for 18 years but has only one husband's education for all married ages, that of the man from the 15-year marriage.

TABLE 2

Educational Attainment Distributions of Samples Used in Estimation of Statistical Models (%), PSID 1968–2003

		Assortative Mating		Fertility		Transmission (Child's Education)		
Educational Attainment	Marital Status	Woman	Husband	Woman	Husband	Woman	Husband	Children
Whites:								
Less than high school (0–11 years)	17.0	16.6	21.7	16.3	20.0	18.7	25.2	8.7
High school only (12 years)	41.5	42.7	33.9	41.5	31.2	48.1	35.1	34.2
Some college (13–15 years)	20.3	20.4	18.6	20.4	17.1	18.8	15.6	25.5
Completed college (≥16 years)	21.1	20.4	25.8	21.7	23.8	14.4	23.6	31.6
No husband					7.9		.60	
Total	99.9	100.1	100.0	99.9	100.0	100.0	100.1	100.0
No. of observations	3,322	2,941		3,175		1,138		2,937
Blacks:								
Less than high school (0–11 years)	32.7	31.6	37.3	30.1	25.5	38.2	44.7	13.7
High school only (12 years)	38.1	34.8	37.9	38.4	26.4	41.9	28.4	42.9
Some college (13–15 years)	20.9	23.6	17.7	22.4	12.5	12.4	9.8	30.5
Completed college (≥16 years)	8.3	10.0	7.2	9.1	5.1	7.5	4.9	12.9
No husband					30.4		12.3	
Total	100.0	100.0	100.1	100.0	99.9	100.0	100.1	100.0
No. of observations	2,734	1,588		2,297		607		1,844

Note.—Totals do not sum to 100 due to rounding. Data are weighted to adjust for sample design.

are age 25 and older, I restrict the transmission sample to the children of women from the two older birth cohorts. Table 3 summarizes the observed distributions of the four outcome variables by women's education.

EMPIRICAL RESULTS

Education and Race Differences in Intergenerational Pathways

Appendix tables A2–A4 present parameter estimates from the multivariate statistical models described above, corresponding to the different pathways of intergenerational effects (marital status, assortative mating, fertility and transmission). I report robust standard errors for all models and correct for the clustering of multiple observations for the same woman. Figures 1–5 summarize the results and show the key patterns in the observed data. For each mechanism, I show results separately for the two oldest cohorts (1919–38 and 1939–53) to highlight changing patterns over time. The simulations use these two birth cohorts. For simplicity, I describe results only for daughters. There are no meaningful differences in the effects of women's schooling on children's schooling by sex of child.

Figure 1 shows the probability of being married at each age by women's education and race for the highest and lowest education categories. The predicted values for the other education groups fall within these bounds. The figure shows well-known differences in marriage levels by education and race. In both birth cohorts, white women with less than high school completed are more likely to be married at each age than their black counterparts. For

TABLE 3
DISTRIBUTION OF OUTCOMES BY WOMEN'S EDUCATIONAL ATTAINMENT, PSID 1968–2003

Woman's Education (Years)	Married at		Husband's Education (%)			Children Born	Children's Education (%)			
	Age 20	Age 30	0–11	12	≥13		0–11	12	13–15	≥16
Whites:										
0–11	64.5	87.2	58.7	31.5	9.8	2.9	24.0	46.9	19.5	9.7
12	54.5	87.9	22.5	48.2	29.3	2.5	5.8	38.4	27.5	28.4
13–15	40.2	84.1	8.9	25.9	65.2	2.3	3.1	23.2	30.1	43.6
≥16	17.1	77.6	2.7	13.9	83.5	1.8	1.0	12.0	21.9	65.1
Blacks:										
0–11	43.7	62.5	68.3	23.7	8.0	3.3	20.3	47.1	24.9	7.7
12	36.3	59.1	29.1	49.3	21.6	2.4	8.1	44.0	38.4	9.5
13–15	33.5	63.4	18.0	39.9	42.1	2.2	5.7	30.5	40.6	23.2
≥16	16.6	62.4	13.2	38.0	48.9	1.7	1.6	18.4	14.6	65.4

NOTE.—Data are weighted to adjust for sample design. Marriage and fertility estimates are based on women observed at age 40 or older.

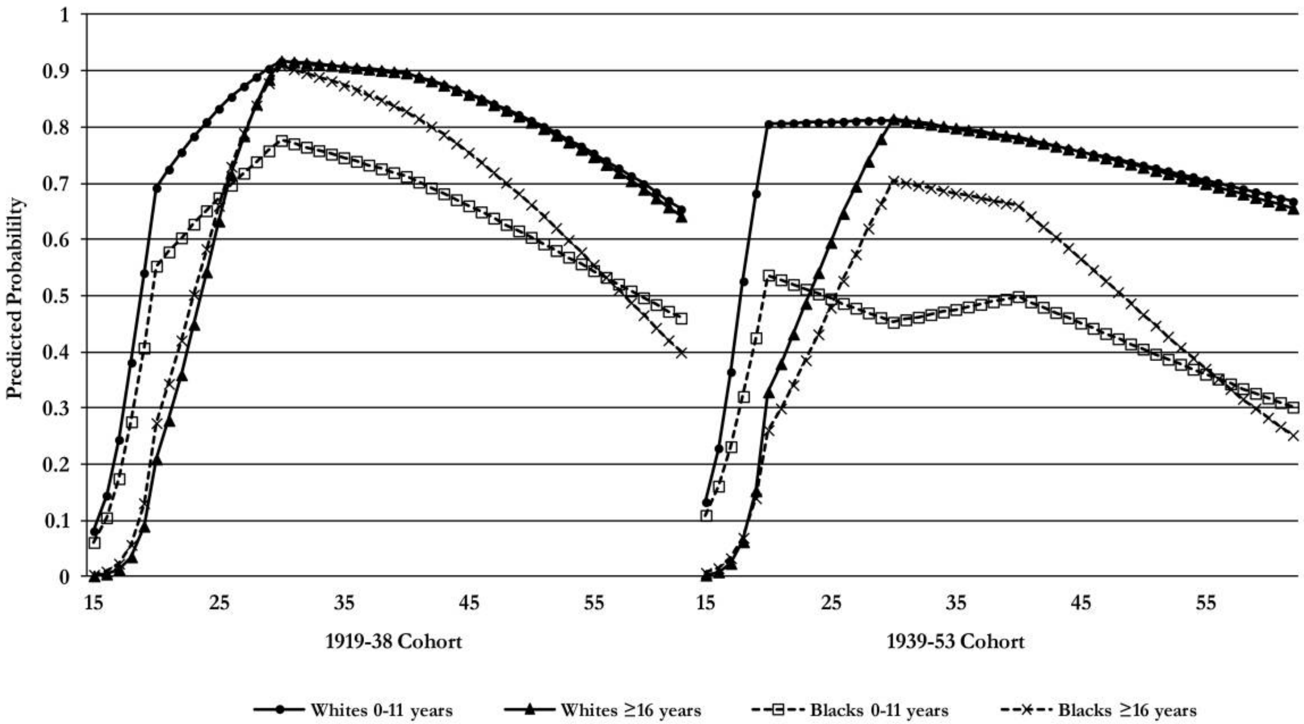

FIG. 1.—Predicted probability of being married by age, women's education, race, and birth cohort based on model shown in appendix table A2, Panel Study of Income Dynamics 1968–2003.

women with a college degree in the 1919–38 birth cohort, levels of marriage by race are similar until the mid-30s but higher for whites from age 35 onward. By the 1939 birth cohort, marriage levels have declined for both groups but more sharply for black women such that black college-educated women have lower predicted probabilities of being married at each age relative to their white counterparts. But highly educated black women continue to have higher likelihoods of being married between ages 25 and 55 than black women with less than high school completed.[8] Age patterns of marriage are similar across groups.

Figure 2 shows patterns of assortative mating by educational attainment. In both cohorts and for both groups, women with more schooling are more likely to be married to men who have more schooling. White women are more likely to marry a man with more schooling than black women, and white women with college degrees are much more likely to be married to a man with at least some college than are black women. Husbands in the black sample have a more disadvantaged education distribution than wives, which means that opportunities for marrying men with high levels of schooling are more limited for black women in these cohorts. These differences are particularly sharp in the 1919–38 birth cohort where white women with a college degree have a predicted probability of having a husband with at least some college of about 0.77 compared to 0.26 for black women. Differences narrow in the 1939–53 birth cohort but are still substantial (.84 versus 0.50). These patterns are similar for women with 13–15 years of schooling as well.

Figure 3 shows age-specific patterns of marital fertility by education for white and black women. Figure 4 shows corresponding patterns for nonmarital fertility. Predicted probabilities of having a marital birth are moderately higher for whites than for blacks across each education group.[9] Age patterns of fertility are similar across groups. For women with 0–11 years of schooling, the likelihood of having a marital birth peaks in the early 20s and declines steadily thereafter. For women with 16 or more years of schooling, the likelihood of having a marital birth peaks at later ages. In the 1919–38 cohort, white women who complete some college have the highest predicted probability of having a marital birth at age 25 and those with college degrees have the highest likelihood around age 30. Across both cohorts from age 29 to 44 years, college-educated white women have the

[8] Black-white differences in cohabitation are smaller than those for marriage; thus, the gaps shown here would be smaller if one considered both marital and cohabiting unions (Raley 1996). The current study omits cohabitation because the data do not include complete cohabitation histories for all women who were sampled.

[9] Although fig. 3 shows predicted probabilities of marital fertility for the full age range, very few women with a college degree are actually married or give birth between ages 15 and 20. These estimates are out of sample predictions that should be interpreted with caution.

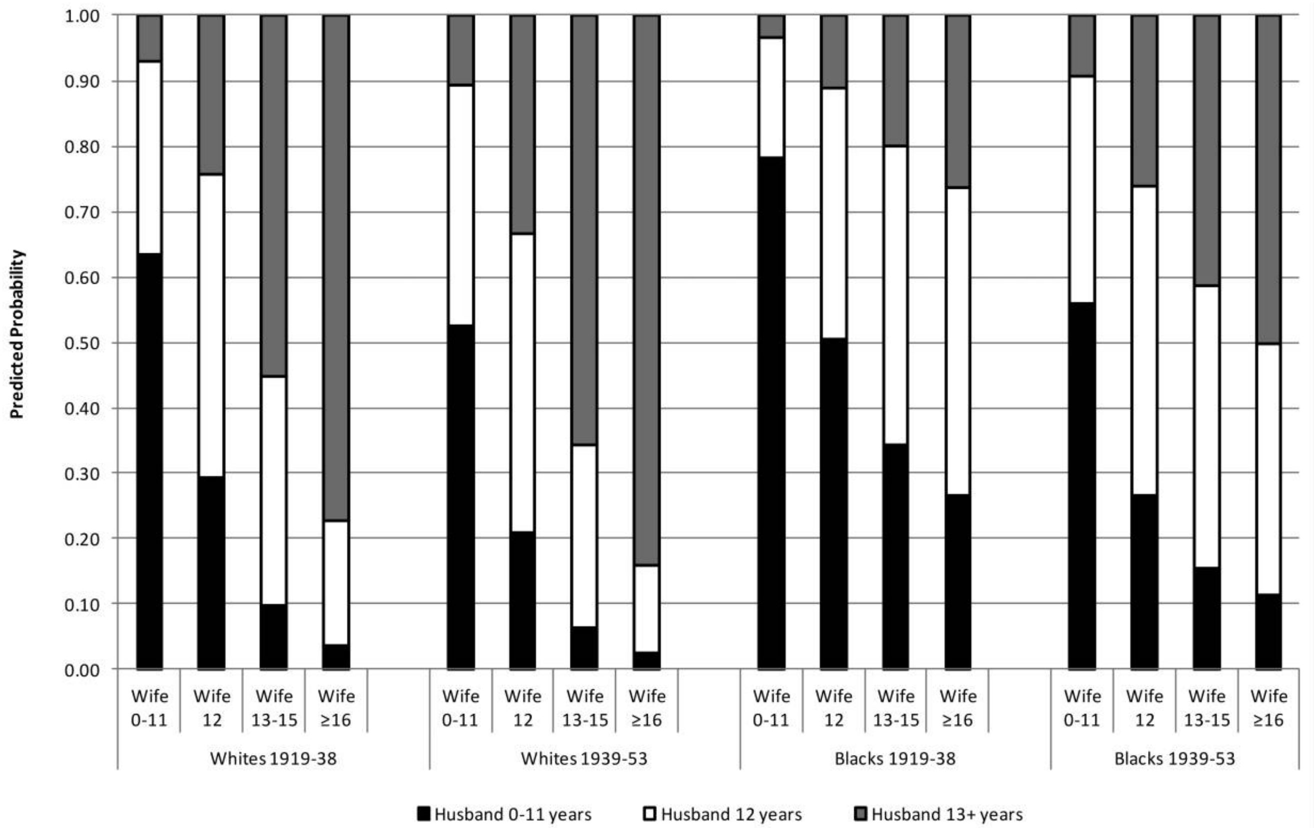

FIG. 2.—Husband's predicted education given wife's education by race and birth cohort based on model shown in appendix table A3, Panel Study of Income Dynamics 1968–2003.

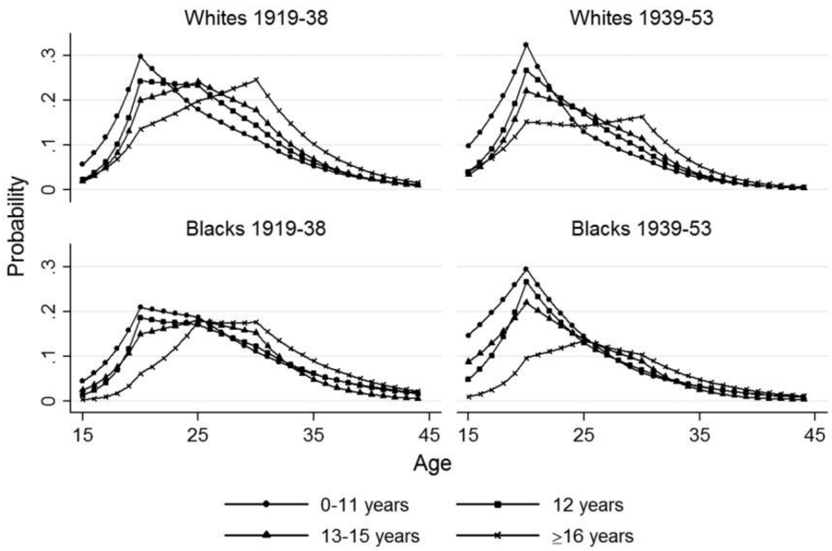

FIG. 3.—Predicted probability of having a marital birth by age, women's education, race, and birth cohort based on a joint model of fertility and children's education shown in appendix table A4 (husband's education = 12 years), Panel Study of Income Dynamics 1968–2003.

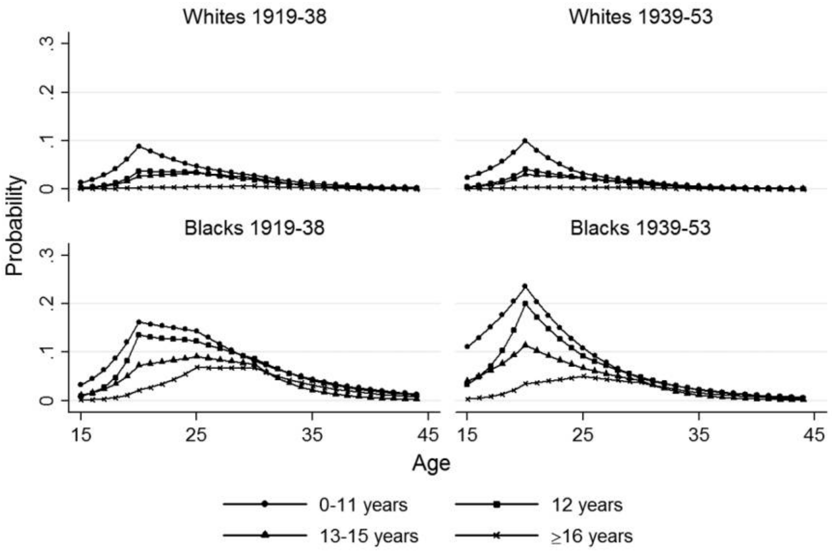

FIG. 4.—Predicted probability of having a nonmarital birth by age, women's education, race, and birth cohort based on a joint model of fertility and children's education shown in appendix table A4, Panel Study of Income Dynamics 1968–2003.

highest predicted probabilities of having a birth at each age. Black women show similar patterns except that the probability of having a birth peaks earlier for college-educated women and education differences in the probability of having a birth after age 30 are less pronounced. Also, black women with some college have lower predicted probabilities of marital fertility in their 30s than their white counterparts. For both whites and blacks, the overall likelihood of having a marital birth at each age declines for college-educated women across birth cohorts. For women who do not finish high school, the likelihood of having a marital birth increases across birth cohorts before age 21 but decreases from ages 21 onward.

In contrast to marital fertility, black women have substantially higher predicted probabilities of nonmarital fertility than white women. Age patterns of nonmarital fertility differ across education groups in roughly the same ways as age patterns of marital fertility. Cohort changes in nonmarital fertility are small for whites and moderately large for blacks. Relative to the 1919 cohort, black women in the 1939–53 cohort have higher predicted probabilities of having a nomarital birth at earlier ages and lower likelihoods at ages 25 and older.

Figure 5 shows the relationship between mother's and daughter's education. For both black and white Americans, women with more schooling are more likely to have daughters who complete more schooling. This is especially true for college-educated black women whose daughters are more likely than daughters of similarly educated white women to complete college themselves. This is consistent with research that shows that, once family background is controlled, blacks are more likely to go to college (Bennett and Lutz 2007; Hauser 1993). Black women with some college completed also have higher likelihoods of having daughters with more schooling relative to their white counterparts. But the patterns are reversed at the lowest levels of schooling. Among women with 12 or fewer years of schooling, white women are more likely to have daughters who complete college than similarly educated black women. For black women, these relationships are stable across cohorts. For white women, conditional on mother's education, daughters have lower predicted probabilities of completing at least some college in the 1939 cohort relative to the 1919 cohort. For whites, women's education increased across cohorts but children's schooling did not increase as fast as these gains in mother's schooling would have predicted. This translates to a negative coefficient of cohort for whites once mother's schooling is controlled.[10]

[10] The model does not specify an interaction between women's schooling and birth cohort, and this interaction term is not significant if included. However, the model's nonlinear form means that, when transformed, predicted probabilities within categories of women's education differ across cohorts.

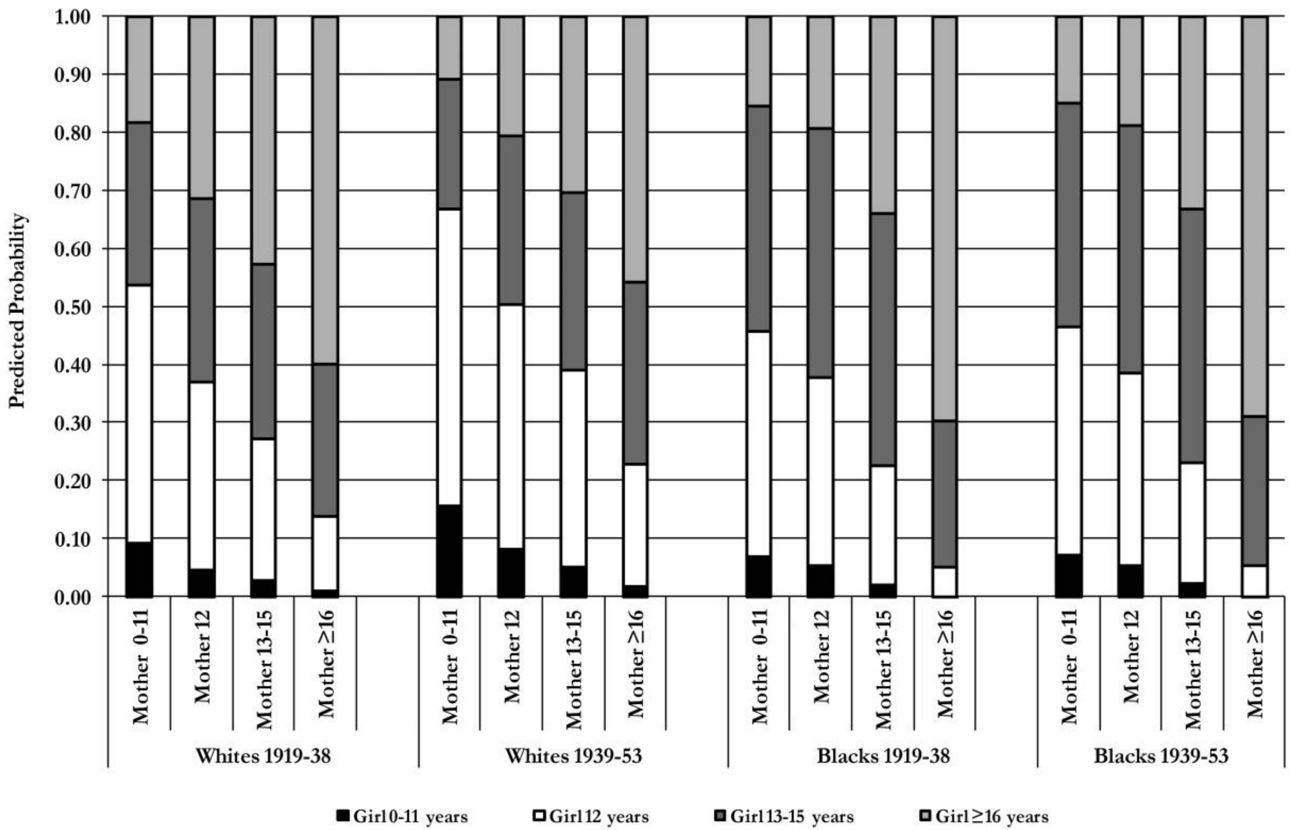

FIG. 5.—Daughter's predicted education given mother's education by race and birth cohort based on a joint model of fertility and children's education shown in appendix table A4 (father's ed. = 12 years; siblings = 2; no. of years lived with two parents = 19 years; mother's age at birth = 25), Panel Study of Income Dynamics 1968–2003.

Figure 5 holds father's schooling fixed at high school completed. The regression results show, however, that having a father with more schooling is associated with a higher probability of having children with more schooling for white families. Among whites, having a father with high school completed versus less than high school increases the predicted probability of having a daughter who completes college by about 0.11. Having a father with some college versus high school completed increases daughters' predicted probabilities of completing college by 0.24. For black families, in contrast, the corresponding changes are 0.04 and 0.08. Highly educated fathers benefit both white and black children but the associations are much stronger in white families. This finding might be explained by differences in exposure to father absence, which is larger for black than for white children (Krein and Beller 1988).

Two additional aspects of the joint fertility and transmission model that deserve explanation are the estimated variances of the latent factors and their correlations (shown at the end of app. table A4). All the estimated variances are statistically significant. Although the estimated covariances of the latent factors are not estimated precisely for either whites or blacks, the point estimates are quite different from each other. For blacks, the estimated covariance is nearly zero. This suggests that once the appropriate set of covariates is controlled in the model, the women-specific random errors of the fertility and transmission processes are uncorrelated. The point estimate for whites, in contrast, is fairly large and corresponds to a correlation between the women-specific errors in fertility and transmission of about 0.5. These estimated correlations depend greatly on the covariates included in the models, especially ones related to family processes. The correlation changes, for example, if number of years lived in a two parent family or number of siblings is omitted from the transmission model.

Taken together, these results show that key components of the intergenerational process differ substantially by women's education and race. At the family level, these relationships might suggest higher direct transmission of educational status for highly educated black women relative to their white counterparts. Indeed, if the analysis had no demographic component, we might conclude that having a college-educated mother was associated with larger intergenerational gains for black Americans. But as the simulations below show, the correlations between parent's schooling and children's schooling are just one component of a complex set of intergenerational pathways at both the micro and macro level. Conventional estimates of educational mobility ignore the demographic pathways of intergenerational effects and how they differ across groups. The analyses below incorporate all these pathways in estimating the intergenerational effect of increasing women's schooling for white and black Americans.

Combining Pathways of Intergenerational Effects

I assess the hypothetical effect of increasing women's education on the education of the next generation through a series of micro simulations. Each simulation has two parts: (i) a hypothetical change in women's schooling, and (ii) a particular set of pathways that are included in assessing intergenerational effects. Each simulation is carried out separately for whites and blacks and for each of the two older birth cohorts (1919–38 and 1939–53) using the women from the marriage sample. For each simulation, I impose a hypothetical change to the women's education distribution by drawing at random without replacement a subsample equal to 5% of the women and increasing their education to a higher level. The other 95% of the women retain all their original values. The choice of moving 5% of sample women is somewhat arbitrary. The goal is to choose a level that is large enough to see population-level results but still realistic in its scale.

The simulations are conducted at the individual level. For each woman, I use predicted probabilities from the statistical models to draw marriage, fertility, and transmission statuses at each age. The simulations account for the unobserved heterogeneity component predicted by the joint model of fertility and transmission by drawing an individual random component for each sample woman. This draw is held fixed even when a woman's education and the other endogenous processes are allowed to change. This component allows for correlation between a woman's predicted fertility probabilities and her children's predicted education. I combine these estimates to simulate a prospective life course for each woman and then aggregate across women and children and compute the number of children born in each educational category in the subsequent generation. I use the ratio of the simulated children's educational distribution to the baseline distribution predicted by the sample women's observed education to assess how a given hypothetical change in women's education increases or decreases the proportion of children at each education level, relative to making no changes in women's education. Although the simulations alter the education of exactly 5% of sample women, the size of the proportional changes in each education category varies greatly depending on the starting number of women and daughters in each category.[11]

Changes in women's education distribution.—I simulate the effect of increases in women's schooling by computing the expected children's education distribution for each of five actual or hypothetical distributions of women's educational attainment: (i) the education distribution of the sam-

[11] Moving 5% of the total sample is not the same as moving 5% of women in a given educational category. At the top of the educational distribution, upgrading the schooling of a number equal to 5% of the sample is a near doubling of the number of women in that education category, especially for the 1919–38 cohort.

ple women, as observed; (ii) move 5% of sample women from 0–11 years to 12 years completed; (iii) move 5% of sample women from 12 years to 13–15 years completed; (iv) move 5% of sample women from 13–15 years to 16 or more years completed; and (v) move 5% of sample women from 0–11 years to 16 or more years completed. I then compare the distribution of children's schooling predicted by each hypothetically altered women's education distribution (ii–v) to the distribution of children's schooling predicted by the observed women's education distribution (i). These hypothetical changes in women's schooling map conceptually to the common school transitions where education often expands, such as reductions in high school dropout (ii), increases in college entry (iii), improvements in college completion (iv), and finally, an upward shift throughout the entire education distribution (v). These hypothetical changes assess not only the race-specific effects of different changes to women's schooling but also how patterns of social mobility change depending on where in the women's education distribution expansions occur. In the United States, women have made large gains in college entry and completion, but expansions at the lower levels of the distribution (i.e., from less than high school to 12 years completed) have been important educational policy initiatives as well.

Combinations of mechanisms.—In much of the existing stratification literature, estimates of the intergenerational effect of mothers' education on children's education are based on the observed conditional joint distribution of parents' and offspring's schooling. This does not allow changes in women's education to alter their marriage or fertility experiences. In terms of the components of equation (2), this suggests that changes in women's schooling will only affect children's schooling through the transmission process—or the direct individual level effect of mother's schooling on child's schooling. Given an increase in women's education, children gain the benefit of having more educated mothers, but they retain their observed values for father's schooling, number of siblings, and the number of years spent living with two parents between birth and age 18. These characteristics are not allowed to change despite the upgrading of women's education. The population-level effects are also ignored. This is the limitation of "holding all else constant." Women cannot change when or whom they marry, forgo marriage or fertility, or change how many children they have. As a point of comparison, I report these results in the combination labeled "Transmission Only." I report two versions of the "Transmission Only" combination: one using parameters from an independent model of transmission (this most closely resembles the conventional approach in the literature) and another from the joint random effects model with fertility shown in equations (3) and (4).

The other mechanisms in equation (2) modify conventional estimates by taking account of the fertility or marriage processes. For example, the "Transmission, Fertility, Marriage" combination allows for family-level changes in mother's education, father's education, number of siblings, and the number of years a child lives with two parents from age zero to 18, women's and husband's education in fertility, plus population-level effects of differential fertility, childlessness, and never marrying. In contrast, the "Transmission, Marriage" combination allows pathways through marriage but not fertility. This allows for changes in mother's and father's education in transmission but no changes through fertility levels or timing at either family level or the population level. The "Transmission-Fertility" combination allows for changes in mother's education in transmission and fertility, number of siblings, the part that fertility timing that contributes to number of years lived with two parents, plus population-level effects of differential fertility and childlessness. This combination holds husband's/father's education fixed at the observed levels.[12]

Assumptions about marriage markets.—The model described in equations (1) and (2) assumes a simple marriage market. Men's education can increase along with women's education, such that there is no shortage of educated men to marry. To check the sensitivity of the results to these assumptions, I estimate a set of simulations in which men's schooling is constrained to the observed sample men's schooling distribution, and this distribution is not allowed to change when women's schooling increases. This creates a relative shortage of highly educated men in the marriage market. In this case, the simulation implements a stylized and simple "queue." Women with the highest education level get "first pick" of the highly educated men, and these husbands are distributed without replacement. Once all of the highly educated men are matched, the remaining women who would otherwise marry a highly educated man must instead take a husband from the next lower education level. If no men remain available at that level either, women must draw from the next lower education category. This queue proceeds from the highest education level to the lowest until all the women who desire husbands are matched.[13] Although this constrained market is an extreme case, it provides a lower bound for the effect of marriage in the presence of highly unmatched educational marriage markets and high educational assortative mating.

[12] Many other combinations are possible; e.g., one could allow husband's education to change but not marital status, or fertility timing to change but not fertility levels. In different settings or for different social groups, these combinations may be of substantive interest. Below, I report on the four combinations that are the most relevant substantively for comparing white and black women based on the differences in family processes observed in the United States.

[13] One could also implement a stopping rule such that women who would otherwise draw a husband choose instead to forgo marriage if the constrained market forces them to match with a man who is across a below threshold (e.g., women with some college requiring a man with at least some college).

Disentangling differences in composition from differences in effects.—Black-white differences in the intergenerational effects of improvements to women's education occur for two reasons. First, because white and black women have different baseline educational distributions, a given hypothetical change in education results in different proportional changes by race in the relative numbers of women in the different education categories. Second, the relationship between women's schooling and the various intergenerational pathways differs by race. Black Americans have much higher rates of nonmarriage and nonmarital fertility and lower levels of predicted marital fertility by women's schooling. They also have higher predicted probabilities of having college-educated children, given highly educated mothers.

In order to assess the relative contribution of each of these parts to the overall pattern of racial differences in intergenerational effects, I also estimate simulation results for a third sample of women: the sample of black women with their education standardized to the education distribution of white women. Standardizing the black women's education distribution produces a more favorable baseline education distribution for husbands as well. In simulations where the marriage market is constrained, the husbands' schooling distribution is constrained to this more favorable baseline. Although this does not provide a full formal decomposition of the relative contributions of levels versus effects, it begins to disentangle differences between blacks and whites in the effects of women's schooling on the marriage, fertility, and transmission processes from differences in the relative distribution of women in the different education categories.

Results.—Appendix tables A5–A7 show the simulation results for daughters for the two older birth cohorts. Tables A5 and A6 show results for white and black women using their observed starting education distributions. Table A7 shows results for the black sample with each cohort's education distribution standardized to the corresponding white distribution. Table 4 summarizes the main findings for two hypothetical changes to women's schooling: one that moves 5% of the women from less than high school to high school completed, and one that shifts up the whole education distribution by moving 5% of the women with less than high school to having 16 or more years completed. Table 4 shows the results for only the lowest and highest categories of daughter's education (<12 years and ≥16 years). The top panel shows results for the 1939–53 birth cohort, and the bottom panel shows the 1919–38 cohort. The combinations of pathways shown in rows 1–6 are identical to those described in rows 7–12. The results shown in rows 1 and 7 include the full set of pathways (the most complex model). The results in rows 2 and 8 ignore the effects that accrue via changes in levels and timing of fertility. The results in rows 3 and 9 ignore the effects that accrue via changes in marriage timing and assortative mating. The results in rows 4 and 10 ignore the effects that accrue via both marriage and

TABLE 4

RATIO OF SIMULATED TO BASELINE DAUGHTERS' EDUCATION FOR SELECTED CHANGES IN WOMEN'S EDUCATION AND COMBINATIONS OF MECHANISMS, PSID 1968–2003

	Daughter's Education											
	White Women				Black Women				Black Women Standardized to White Education Distribution			
	$<12 \rightarrow 12$		$<12 \rightarrow \geq 16$		$<12 \rightarrow 12$		$<12 \rightarrow \geq 16$		$<12 \rightarrow 12$		$<12 \rightarrow \geq 16$	
Combinations	<12	$\rightarrow \geq 16+$	<12	$\rightarrow \geq 16+$	<12	$\rightarrow \geq 16+$	<12	$\rightarrow \geq 16+$	<12	$\rightarrow \geq 16+$	<12	$\rightarrow \geq 16+$
Women born 1939–53:												
1. Transmission, fertility, and marriage	.90	1.04	.85	1.10	.96	1.02	.92	1.11	.92	1.01	.87	1.10
2. Transmission and marriage	.90	1.02	.83	1.10	.94	1.02	.87	1.20	.94	1.02	.86	1.15
3. Transmission and fertility	.92	1.03	.85	1.06	.94	1.01	.90	1.07	.97	1.02	.90	1.07
4. Transmission, joint model	.92	1.01	.86	1.05	.96	1.01	.88	1.16	.95	1.01	.86	1.12
5. Transmission, independent model	.93	1.02	.88	1.06	.96	1.01	.89	1.18	.96	1.01	.87	1.14
6. Transmission, fertility, and marriage (constrained marriage market)	.91	1.04	.91	1.08	.94	1.02	.93	1.09	.92	1.01	.94	1.11
Women born 1919–38:												
7. Transmission, fertility, and marriage	.92	1.03	.94	1.10	1.02	1.06	.99	1.17	.98	1.02	.93	1.14
8. Transmission and marriage	.93	1.03	.89	1.10	.97	1.03	.94	1.21	.96	1.02	.91	1.18
9. Transmission and fertility	.93	1.04	.91	1.07	1.01	1.04	.97	1.14	.98	1.05	.92	1.14
10. Transmission, joint model	.95	1.02	.90	1.05	.98	1.02	.94	1.20	.97	1.01	.91	1.16
11. Transmission, independent model	.95	1.02	.91	1.06	.98	1.02	.94	1.22	.97	1.01	.92	1.20
12. Transmission, fertility, and marriage (constrained marriage market)	.93	1.04	.97	1.07	.99	1.03	.96	1.18	.94	1.04	.96	1.13

NOTE.—Simulations move a number equal to 5% of sample women from one education category to another one. See text for description of different combinations and specifics of the constrained marriage market. The top set of numbers represent the simulation, and the bottom set, daughter's education.

fertility but use parameters from the joint model of transmission and fertility. The results in rows 5 and 11 ignore all demographic mechanisms and use parameters from an independent model of transmission not estimated jointly with fertility. This replicates a conventional stratification model that ignores any correlated demographic mechanisms.[14] The results shown in rows 6 and 12 include all pathways but under the assumption that women face a constrained marriage market. For ease of exposition, I first discuss the results for the 1939–53 cohort and then highlight key differences between the cohorts.

Columns 1 and 2 show results for whites for a simulation that moves 5% of the women from less than high school to high school completed. In the 1939–53 birth cohort, this shift in white women's schooling predicts a 10% decrease in the proportion of girls with less than high school completed and about a 4% increase in the proportion of girls with college completed (row 1). This change to women's schooling represents a moderate shift in this cohort's education distribution. It reduces the number of white women at the very bottom of the education distribution and therefore the proportion of daughters produced with low levels of schooling, but it does not move women into educational categories that contribute many daughters to the top of the children's education distribution. The different combinations of pathways (rows 2–5) suggest that differences in fertility and marriage patterns between these women's education groups (less than high school and high school completed) do not play a large role in estimates of intergenerational effects. Ignoring the effects that accrue through marriage and fertility would understate the expected intergenerational results by a small amount. Constraining the marriage market does not change the results of the full model (row 6).

Columns 3 and 4 of table 4 show results for a more drastic change to white women's schooling. In this simulation, 5% of white women are moved from the lowest education category into the highest education category. In the 1939–53 cohort, this represents a 21% increase in the number of women with college degrees and a 37% decrease in the number of women with less than 12 years completed. Not surprisingly, improvements are larger at both the bottom and top of the daughters' schooling distribution. Every combination of mechanisms leads to larger reductions in the proportion of daughters with 0–11 years of schooling. The reduction is largest for the combination that allows changes through both transmission and marriage but omits the effects that accrue through reductions in fertility levels (17% reduction, row 2). In this combination, women continue to produce as many children as predicted by their observed rather than upgraded educational

[14] This reference model is an independent ordered logit with the covariates shown in table 1 under "Transmission" (model parameters not shown).

level. This creates more children who go on to gain the benefits of parents with more schooling compared to the full model, which allows for reductions in fertility levels. These positive effects at the population level of higher fertility are offset at the family level by having more siblings, which for white children predicts less schooling. But the population-level effects swamp these family-level effects, and the predicted intergenerational effects are quite large. Ignoring all demographic pathways (row 5) predicts a 12% reduction in daughters at the bottom of the education distribution. Allowing effects via all pathways (row 1) predicts a 15% reduction in daughters with 0–11 years of schooling.

This shift in women's schooling also has larger effects for daughters with college completed (col. 4). Women with college completed are very likely to produce daughters who complete college, and this simulation moves women into that education category. Combinations that ignore the benefits that accrue to children through marriage processes produce the smallest effects (rows 3, 4, and 5). For white women, positive assortative mating is an important pathway through which marriage benefits children's schooling. This simulation moves women into an education category that greatly improves their husband's predicted schooling and predicts the most favorable expected distribution of father's schooling. As expected, constraining the marriage market attenuates the results in this simulation, especially for girls at the bottom of the education distribution. But the results of the full model are still substantial even when the men's education distribution is held fixed at the observed level.

Overall, these patterns are similar for both cohorts of white women. The main substantive difference is that intergenerational effects increase across cohorts for daughters with less than high school completed (row 7). Differences across these white cohorts are produced by widening gaps in differential fertility, upward shifts in the women's baseline education distribution, and changing transmission probabilities within women's education categories (shown in fig. 5). Constraining the marriage market attenuates results less for the older cohort because men still have quite a bit more schooling than women in this cohort. As the men's and women's education distributions converge in more recent cohorts, assumptions about the marriage market become more relevant. For both cohorts of white women, ignoring the demographic pathways would result in an underestimate of intergenerational effects, primarily because positive assortative mating amplifies the intergenerational effects of increasing women's schooling. This general finding is robust to assumptions about the marriage market.

Columns 5 and 6 show results for black women. For these women, moving 5% of the 1939–53 cohort from less than high school to high school completed produces modest effects for girls at the bottom of the education distribution and very small effects for those at the top of the distribution. The contribution of the different demographic mechanisms is also quite small. This shift in women's schooling represents a modest improvement to this cohort's education distribution. Many black women remain in the lower education categories despite the shift. Moreover, unlike white women, black women with high school completed have similar predicted probabilities of having daughters in the lower education categories as women with only 0–11 years completed (see fig. 5). Taken together, this means that this particular hypothetical change to black women' schooling does not translate to meaningful improvements for the daughter's education distribution for this cohort.

In contrast, moving women from the bottom of the education distribution to the very top predicts much larger improvements to the education distribution of daughters (cols. 7 and 8). The full model (row 1) predicts an 8% reduction in the proportion of daughters with less than high school completed and an 11% increase in the proportion that complete college. Ignoring positive assortative mating and changes in marital status would understate the intergenerational effects (row 3). Ignoring the offsetting effects of differential fertility levels, however, would overstate the intergenerational effects by 5 percentage points at the bottom and 9 percentage points at the top of the daughters' education distribution (row 2). Recall the patterns shown in figures 3 and 4. In this cohort, college-educated black women had lower levels of predicted fertility than did women in the lowest education category. That relationship is ignored here, and these women are predicted to bear more children than they probably would. A conventional model that ignores any endogenous or correlated demographic mechanisms (row 5) would overestimate the intergenerational effects of increases to women's schooling for black women for this cohort by about 7 percentage points. For this cohort of black women, the amplifying effects of changes in marital patterns are offset by the dampening effects of differential fertility. This occurs for three reasons. First, father's education has a weaker effect for blacks than whites. Second, the benefits that come from the increased likelihood of being married and, therefore, the number of years children live with both parents or from having fewer siblings (positive family-level effects) do not make up for the population-level differences in fertility. Third, differential fertility by education is larger for black women than for white women. Because assortative mating has a smaller effect for black women, constraining the marriage market has only a small effect on the results for this group (row 6).

As was the case for whites, intergenerational effects for black families increase across cohorts for daughters with less than high school completed. For daughters with college completed, in contrast, intergenerational effects for blacks decrease across cohorts, whereas these remained constant for whites. These cohort differences are produced by changing fertility patterns by education status and upward shifts in the black women's education distribution. Unlike for whites, the family-level relationships between women's schooling and children's schooling (shown in fig. 5) do not differ across cohorts for blacks. Instead, changes in marriage and fertility patterns by education and population composition account for most of the cohort differences in the intergenerational effects for black Americans.

Columns 9–12 show the results for black women, but with their education standardized to the white women's education distribution. This begins to disentangle the relative contribution of differences in baseline education distributions versus differences in the effects of women's schooling on the different intergenerational pathways for explaining black-white differences in intergenerational effects. Once standardized, the proportion of black women in the bottom education category of the 1939–53 cohort is nearly halved (13.8% vs. 25.1%), and the proportion in the highest category more than doubles (24.5% vs. 11.1%). In the full model (row 1), standardizing the black women's education distribution produces larger reductions in the proportion of daughters with less than 12 years completed than those predicted for the observed black sample. This estimate is much closer to that for whites than the observed black sample. This result appears in both hypothetical changes to women's schooling (cols. 9 and 11). Thus, black-white differences in patterns of intergenerational effects for daughters at the bottom of the education distribution are largely driven by the fact that the black women in this cohort have a more disadvantaged baseline education distribution than their white counterparts. As black and white women's educational distributions continue to converge, patterns of educational reproduction at the bottom of the education distribution should also converge.

Standardization does not have much of an effect for the proportion of daughters in the highest education category (cols. 10 and 12). These estimated effects are quite similar for white and black women, regardless of black women's baseline education distribution. The pattern of the results across combinations, however, is similar to that for the observed black sample, suggesting that these depend on the associations of women's schooling and the various intergenerational pathways rather than the underlying education distributions. Assumptions about the marriage market do not change the pattern of results for this standardized sample. Differences across birth cohorts are similar to the patterns for the observed black sample, suggesting that intergenerational pathways rather than underlying differences in educational distributions drive the cohort patterns for black women.

DISCUSSION

Although the correlation between parents' education and children's education is a simple statistic to compute, it is far more difficult to describe the processes that produce this association. The mechanisms that link generations are complex and dynamic. In the existing quantitative literature on social stratification and mobility, this complexity is routinely ignored when relationships between generations are described. But the processes that transform one generation into the next, and the implications of changing patterns within these processes, are a substantively interesting and important part of social reproduction. These components are the real-life mechanisms that tie the statuses of parents to those of children and produce the observed associations in status. Intergenerational effects are not simply about the transmission of status; rather, these include the process of transformation from one generation to the next.

This study combines microlevel data analysis with a demographic model that accounts for the ways that groups sort and reproduce. This micro-macro blended approach specifies complicated relationships at the individual and family level in a demographically informed way. In those cases where family processes and social status are interrelated, as is the case with patterns of family formation, race, and educational attainment, ignoring demographic pathways can seriously bias our assessment of intergenerational effects. This is particularly true for understanding black-white differences in educational reproduction. This micro-macro approach therefore is an important extension to standard approaches for studying race differences in educational mobility. The analyses above quantify how much estimates of intergenerational effects can change when we include the role of marriage and fertility at the individual, family, and population level in the process of educational reproduction. By specifying both micro and macro level pathways, the analytical approach also considers potential macrolevel constraints on social mobility such as constrained marriage markets or hypothetical distributional shifts in black women's schooling.

The results show that the intergenerational effects of increases in women's education accrue through several mechanisms. In addition to the direct benefits to children of having a mother with more schooling, increasing women's education changes patterns of family formation in ways that also influence children's education. Some of these effects are at the individual and family levels, including changes in the number of siblings a child has, the education of her father, or the number of years she lives in a two-parent family. Other effects are at the population level. Given an increase in education, some women will change their timing and levels of marriage and fertility, while others may forgo marriage or fertility altogether. These changes alter the numbers and types of children that are created at the population level and inform the distribution of education across generations. The analyses above capture all of these mechanisms and provide a richer and more complete assessment of the intergenerational effects of increasing women's education for white and black Americans.

In the United States, patterns of family formation and structure differ greatly by women's education and race. Moreover, the effects of family characteristics on children's schooling differ for white and black children. The results show that a conventional model of social mobility that ignores demographic processes underestimates the predicted intergenerational effects of increasing women's schooling for white Americans and overestimates these for black Americans. Ignoring demographic pathways produces estimated intergenerational effects for daughters at the top of education distribution that are three times larger for black families than white families. A model that includes a more complete set of intergenerational pathways shows that the gap in predicted effects is in fact smaller, and that race differences are converging across birth cohorts. For both white and black Americans, the intergenerational benefits of increasing women's schooling increase across birth cohorts for daughters with less than high school completed. In contrast, for daughters with college completed, the benefits of increasing women's schooling are constant across cohorts for whites and decrease across cohorts for blacks. Patterns across cohorts are converging because black and white women's educational distributions are converging, and the offsetting effects of differential fertility have increased for black women.

For white women, assortative mating amplifies the benefits of increases in women's educational attainment. Increases in fathers' schooling provide substantial gains in children's schooling above and beyond those predicted by increases in mothers' schooling. The effects of fathers' education are not as large for black children. Instead, black children with college-educated mothers get a large boost to their predicted schooling at the family level. Highly educated black women, however, have lower fertility than black women with less schooling. At the family level, reductions in fertility translate to fewer siblings (which, especially for whites, is a positive family-level effect), but at the population level, reductions in fertility reduce the number of children produced overall who go on to benefit from having highly educated mothers. These population-level effects of differential fertility attenuate the benefits accrued at the family level. This offset produced by differential fertility is larger for black Americans because differences in fertility by education are larger for black versus white women. Overall, these findings show that demographic patterns are an important part of race differences in educational mobility. A narrow focus on only the family-level associations in status misses the important insights that emerge by considering the combined implication of a set of intertwined mechanisms in a unified analytical model of educational mobility.

Why do the demographic pathways have reinforcing patterns in some cases but offsetting ones in others? These differences reflect the net effect of numerous component parts, many of which have associations that differ by race. No one explanation determines the overall pattern by race, and race differences in these components have numerous explanations. The individual associations are difficult to generalize by race, and many—such as why children of highly educated black women get more schooling than children of similarly educated white women—have a complex set of explanations. The key insight is that educational mobility is a process that includes many components closely tied to demographic processes such as marriage, assortative mating, and differential fertility. These demographic components are in turn closely related to women's education and race and operate simultaneously at multiple levels. Moreover, the changes observed in patterns of marriage and fertility in the United States show that these relationships can change dramatically over time. Incorporating the demography of social mobility broadens our understanding of the sources and nature of race differences in educational mobility.

Understanding these component parts of race differences in educational reproduction not only provides a better estimate of intergenerational effects but also a much richer and broader understanding of the social world. Models and methods that gain precision or causal interpretation by ignoring underlying demographic processes serve an important role in sociological research, but these also come at a cost. Such approaches trade complexity in the social processes examined for complexity in statistical estimation. In comparing race differences in educational mobility, even the best causal estimate cannot provide the right answer to the question of how children's schooling will change given changes in mothers' schooling. This is because static regressions "hold all else constant," while the answer to the question depends on the dynamics of intervening demographic mechanisms at both the micro- and macrolevel.

The analyses described above use a complex model of intergenerational effects, but the model also makes important simplifications that should temper our interpretation of the results. These simplifications include ignoring genetic ties between parents and children, ignoring differential mortality, and assuming that the marriage process is independent of the fertility and transmission processes. Ignoring genetic ties between parents and children is likely to overstate the estimated family-level effect of mother's education on child's education (transmission process). The results above, however, suggest that even in the absence of any direct effect of women's schooling on children's schooling, the intergenerational effects of increasing women's schooling are unlikely to be zero because these accrue through many different pathways. Ignoring differential mortality is likely to underestimate the benefits of increasing women's schooling. If differential mortality differs by race, as is the case with infant mortality, then this omission misses another way in which intergenerational pathways differ for white and black Americans. If the random effects structure used to relate the fertility and transmission processes is incorrectly specified, then the model may not adequately account for the correlated nature of these mechanisms. Finally, all simulation studies ultimately assume that the parameters used are correct and causal, despite judicious caution in the language used to interpret the results. Simulations offer a way to consider counterfactuals not available in the observed data at the risk of using parameters that might be incorrect. The estimated parameters used above reproduce the patterns present in the observed data. Nonetheless, they are potentially biased estimates of the "true" causal parameters and should be interpreted with that in mind.

Despite these simplifications, the analyses show important features of educational reproduction across generations, the intervening role of demographic processes, and how these processes differ for black and white Americans. The approach assesses the effects of recent demographic shifts such as delayed fertility timing, nonmarital fertility, and delayed and/or forgone marriage on intergenerational effects. The analyses tease out relationships that many studies either bundle or omit altogether. Theories of social reproduction incorporate these family processes at both the micro- and macrolevel, and the massive historical changes observed in the United States by race and education in patterns of family formation serve as an important signal that component parts of intergenerational relationships may have changed. The analyses reported above measure the effects of these processes on black-white differences in educational mobility. The results highlight not only how individual, family, and population pathways in the process of educational mobility differ by race but also how their joint dynamics differ by race. Taking these demographic components into account changes our estimates of educational mobility in opposite directions for white and black Americans.

APPENDIX

TABLE A1
COHORT SUMMARIES, PSID 1968–2003

	Cohort 1	Cohort 2	Cohort 3
Birth Year:	1919–38	1939–53	1954–68
Age in 1968	30–49	15–29	0–14
Age in 2003	65–84	50–64	35–49
Whites:			
Education (%)			
0–11 years	28.0	13.8	8.7
12 years	47.8	40.5	35.9
13–15 years	12.6	21.2	27.7
≥16 years	11.7	24.5	27.8
No. of women in marriage sample	1,126	1,111	1,085
No. of children born	2.8	2.2	1.9
Blacks:			
Education (%)			
0–11 years	55.4	25.1	21.1
12 years	29.8	44.0	39.9
13–15 years	9.9	19.8	30.2
≥16 years	4.8	11.1	8.8
No. of women in marriage sample	727	816	1191
No. of children born	3.1	2.5	2.2

NOTE.—Data are weighted to adjust for oversampling and attrition.

TABLE A2
PARAMETER ESTIMATES FOR BINARY LOGIT MODEL PREDICTING MARITAL STATUS, PSID 1968–2003

DEPENDENT VARIABLE: MARRIED (0/1)	WHITES			BLACKS		
	β	SE	z	β	SE	z
Age, years (spline):						
15–20	1.012	.04	26.4	.744	.08	9.2
20–30	.249	.02	15.3	.163	.03	6.4
30–40	−.057	.01	−3.8	−.113	.02	−4.8
≥40	−.054	.01	−7.0	−.032	.02	−1.9
Woman's education (ref. = 12 years):						
0–11 years	7.696	.76	10.1	3.245	1.51	2.1
13–15 years	−1.390	1.11	−1.3	−3.720	1.97	−1.9
≥16 years	−1.201	1.76	−.70	−4.482	3.14	−1.4
Woman's ed 1 × age (spline):						
Woman's ed 1 × age 1	−.365	.04	−8.9	−.156	.08	−2.0
Woman's ed 1 × age 2	−.089	.02	−5.0	−.060	.02	−2.5
Woman's ed 1 × age 3	.032	.02	1.7	.079	.02	3.6
Woman's ed 1 × age 4	−.015	.01	−1.3	−.016	.02	−.9
Woman's ed 3 × age (spline):						
Woman's ed 3 × age 1	.039	.06	.70	.206	.10	2.0
Woman's ed 3 × age 2	.057	.02	3.3	.013	.03	.50
Woman's ed 3 × age 3	−.024	.02	−1.3	.023	.03	.80
Woman's ed 3 × age 4	−.001	.01	−.1	−.017	.03	−.70

TABLE A2 (*Continued*)

Dependent Variable: Married (0/1)	Whites			Blacks		
	β	SE	z	β	SE	z
Woman's ed 4 × age (spline):						
Woman's ed 4 × age 1 . . .	−.027	.09	−.3	.171	.16	1.1
Woman's ed 4 × age 2 . . .	.125	.02	7.5	.165	.04	4.0
Woman's ed 4 × age 3 . . .	.032	.02	2.0	.039	.04	1.0
Woman's ed 4 × age 4 . . .	−.018	.01	−1.5	−.058	.04	−1.6
Cohort (ref. = 1919–38):						
1939–53	.360	.81	.5	2.720	1.57	1.7
1954–68	2.082	.83	2.5	.987	1.54	.60
Cohort 2 × age (spline):						
Cohort 2 × age 1	.013	.04	.30	−.139	.08	−1.7
Cohort 2 × age 2	−.155	.02	−8.7	−.137	.03	−5.1
Cohort 2 × age 3	.005	.02	.3	.052	.02	2.1
Cohort 2 × age 4	.043	.01	4.4	.011	.02	.60
Cohort 3 × age (spline):						
Cohort 3 × age 1	−.122	.04	−2.8	−.119	.08	−1.5
Cohort 3 × age 2	−.112	.02	−6.3	−.090	.03	−3.2
Cohort 3 × age 3	.059	.02	3.4	.057	.03	2.2
Cohort 3 × age 4	.048	.03	1.8	.096	.03	2.8
Constant	−19.822	.74	−26.9	−14.793	1.57	−9.4
No. of observations (person-years)		112,881			82,181	
Log likelihood		−51,776			−47,805	

NOTE.—Data are weighted to adjust for sample design. Standard errors are adjusted for clustering.

TABLE A3

PARAMETER ESTIMATES FOR MODEL PREDICTING HUSBAND'S EDUCATION (ORDERED LOGIT), PSID 1968–2003

Dependent Variable: Husband's Education (0–11, 12, ≥13 years)	Whites			Blacks		
	β	SE	z	β	SE	z
Woman's education (ref. = 12 years):						
0–11	−1.434	.11	−13.0	−1.252	.24	−5.1
13–15	1.346	.11	12.3	.684	.23	3.0
≥16.	2.369	.13	18.3	1.044	.34	3.1
Cohort (ref. = 1919–38):						
Born 1939–53	.449	.09	4.7	1.040	.29	3.6
Born 1954–68	.546	.10	5.6	1.226	.29	4.2
Cut points:						
Cut 1	−.884	.08		.027	.28	
Cut 2	1.144	.08		2.077	.32	
No. of observations. . . .	2,941			1,588		
Log likelihood		−2,558			−1,481	

NOTE.—Data are weighted to adjust for sample design. Standard errors are adjusted for clustering.

TABLE A4
Parameter Estimates From Jointly Estimated Random Effects Model of Fertility (Binary Logit) and Children's Schooling (Ordered Logit), PSID 1968–2003

Parameter	Whites β	Whites SE	Whites z	Blacks β	Blacks SE	Blacks z
Dependent Variable: Birth (0/1)						
Age, years (spline):						
1. 15–20	.532	.05	9.8	.586	.09	6.4
2. 20–25	−.014	.02	−.70	−.029	.07	−.50
3. 25–30	−.123	.02	−6.9	−.090	.05	−1.7
4. ≥30	−.193	.01	−15.1	−.158	.03	−5.2
Woman's education (ref. = 12 years):						
0–11	3.121	1.06	2.9	4.630	1.25	3.7
13–15	.058	1.51	0	3.405	1.75	1.9
≥16	2.278	2.25	1.0	−3.017	2.77	−1.1
Woman's ed 1 × age (spline):						
Woman's ed 1 × age 1	−.133	.05	−2.5	−.219	.07	−3.3
Woman's ed 1 × age 2	−.127	.03	−4.7	−.005	.06	−.10
Woman's ed 1 × age 3	.010	.03	.30	−.049	.05	−1.0
Woman's ed 1 × age 4	.021	.02	1.0	.015	.03	.50
Woman's ed 3 × age (spline):						
Woman's ed 3 × age 1	−.018	.08	−.20	−.185	.09	−2.1
Woman's ed 3 × age 2	.060	.03	2.0	.075	.06	1.3
Woman's ed 3 × age 3	.042	.03	1.6	.040	.06	.70
Woman's ed 3 × age 4	−.028	.02	−1.3	−.107	.04	−2.5
Woman's ed 4 × age (spline):						
Woman's ed 4 × age 1	−.153	.11	−1.3	.081	.14	.6
Woman's ed 4 × age 2	.104	.04	2.4	.277	.10	2.8
Woman's ed 4 × age 3	.177	.03	6.2	.082	.09	.90
Woman's ed 4 × age 4	−.021	.02	−1.2	−.012	.04	−.30
Husband's education (ref. = 12 years):						
No husband	−2.160	.12	−17.5	−.401	.13	−3.1
0–11	.090	.04	2.0	.273	.12	2.3
≥13	.083	.04	2.2	.161	.11	1.4
Cohort (ref. = 1919–38):						
Born 1939–53	1.984	.98	2.0	3.962	1.58	2.5
Born 1954–68	4.649	1.01	4.6	5.693	1.48	3.8
Cohort 2 × age (spline):						
Cohort 2 × age 1	−.093	.05	−1.8	−.173	.08	−2.0
Cohort 2 × age 2	−.106	.02	−4.3	−.169	.06	−2.7
Cohort 2 × age 3	−.024	.02	−1.0	−.059	.06	−1.0
Cohort 2 × age 4	−.035	.02	−1.9	−.009	.03	−.30
Cohort 3 × age (spline):						
Cohort 3 × age 1	−.239	.05	−4.5	−.279	.08	−3.5
Cohort 3 × age 2	−.071	.03	−2.5	−.075	.06	−1.2
Cohort 3 × age 3	.036	.02	1.5	−.031	.05	−.60
Cohort 3 × age 4	−.010	.02	−.60	−.036	.04	−1.0
Data source (binary):	−1.078	.07	−14.6	−1.396	.14	−10.0
Woman's ed × no husband						
Woman's ed 1 × no husband	.639	.18	3.5	.060	.18	.30

TABLE A4 (*Continued*)

Parameter	Whites β	Whites SE	Whites z	Blacks β	Blacks SE	Blacks z
Woman's ed 3 × no husband	−.056	.20	−.30	−.429	.22	−2.0
Woman's ed 4 × no husband	−1.829	.31	−5.9	−.715	.43	−1.7
Constant (fertility equation)	−11.679	1.06	−11.0	−13.125	1.74	−7.5
Dependent variable: child's education (0–11, 12, 13–15, ≥16 years)						
Woman's education (ref. = 12 years):						
0–11	−.923	.18	−5.2	−.548	.29	−1.9
13–15	.605	.17	3.6	.816	.42	2.0
≥16	1.356	.20	6.9	2.765	.97	2.9
Husband's education (ref. = 12 years):						
No husband	−1.241	.74	−1.7	−.239	.39	−.60
0–11	−.572	.16	−3.7	−.236	.34	−.70
≥13	1.259	.16	8.1	.503	.45	1.1
No. of siblings	−.379	.09	−4.1	−.102	.15	−.70
No. of years lived with 2 parents ages 0–18 (ref. = 19 years):						
0–10	−.595	.29	−2.1	−.944	.30	−3.1
11–18	−.499	.17	−3.0	−.264	.25	−1.1
Child is female	.160	.09	1.8	.598	.17	3.6
Mother's cohort (ref. = 1919–38):						
Born 1919–38 (ref.)						
Born 1939–53	−.727	.14	−5.3	−.036	.26	−.10
Cut points:						
Cut 1	−4.426	.27	−16.6	−3.093	.42	−7.3
Cut 2	−1.327	.24	−5.5	−.252	.41	−.60
Cut 3	.413	.24	1.7	2.063	.44	4.7
σ_1^2 (variance of random intercept, fertility)	.047	.02		.339	.06	
σ_2^2 (variance of random intercept, child's education)	1.760	.22		1.194	.32	
Covariance σ_1^2, σ_2^2	.148	.10		−.038	.29	
ρ (correlation of intercepts)	.514			−.059		
No. of level-one units		87,896			58,686	
No. of level-two units (women)		3,178			2,305	
Joint log likelihood		−482,904			−67,469	

NOTE.—Fertility observations are person years. Data are weighted to adjust for sample design. SEs are adjusted for clustering.

TABLE A5

Ratios of Simulated to Observed Daughters' Education Distributions for a Given Change in Women's Schooling for White Women by Birth Cohort, PSID 1968–2003

	Daughters' Education (Years)							
	Whites 1919–38				Whites 1939–53			
Woman's Education (Years)	0–11	12	13–15	≥16	0–11	12	13–15	≥16
Transmission, fertility, and marriage:								
0–11 to 12	.92	.99	1.01	1.03	.90	.98	1.02	1.04
12 to 13–15	.99	.98	1.01	1.02	.94	.99	1.01	1.02
13–15 to ≥16	.98	1.00	1.00	1.01	.97	.98	1.01	1.03
0–11 to ≥16	.94	.95	1.00	1.10	.85	.95	1.03	1.10
Transmission and marriage:								
0–11 to 12	.93	.99	1.02	1.03	.90	.99	1.03	1.02
12 to 13–15	.98	.99	.99	1.03	.97	.98	1.02	1.02
13–15 to ≥16	.99	.99	.99	1.04	.99	.98	.99	1.03
0–11 to ≥16	.89	.96	1.02	1.10	.83	.95	1.03	1.10
Transmission and fertility:								
0–11 to 12	.93	1.00	.99	1.04	.92	.99	1.02	1.03
12 to 13–15	.98	.99	.99	1.03	.97	.98	1.03	1.01
13–15 to ≥16	1.00	1.00	.96	1.04	.99	.98	1.02	1.01
0–11 to ≥16	.91	.97	1.01	1.07	.85	.95	1.07	1.06
Transmission only (joint model):								
0–11 to 12	.95	1.00	1.01	1.02	.92	1.00	1.02	1.01
12 to 13–15	.98	.99	1.00	1.02	.98	.99	1.01	1.01
13–15 to ≥16	.99	.99	.99	1.03	.99	.99	.99	1.02
0–11 to ≥16	.90	.98	1.02	1.05	.86	.98	1.03	1.05
Transmission only (independent model):								
0–11 to 12	.95	.99	1.02	1.02	.93	.99	1.02	1.02
12 to 13–15	.99	.99	1.00	1.02	.99	.99	1.00	1.01
13–15 to ≥16	1.00	.99	.99	1.03	.99	.98	1.00	1.03
0–11 to ≥16	.91	.97	1.03	1.06	.88	.96	1.04	1.06
Transmission, fertility, and marriage (constrained market):								
0–11 to 12	.93	1.00	.99	1.04	.91	.98	1.02	1.04
12 to 13–15	1.00	.98	.98	1.04	.98	.99	.99	1.03
13–15 to ≥16	1.02	.99	.98	1.02	1.02	.97	.99	1.04
0–11 to ≥16	.97	.97	.98	1.07	.91	.97	.99	1.08

TABLE A6
RATIOS OF SIMULATED TO OBSERVED DAUGHTERS' EDUCATION DISTRIBUTIONS FOR A GIVEN CHANGE IN WOMEN'S SCHOOLING FOR BLACK WOMEN BY BIRTH COHORT, PSID 1968–2003

	DAUGHTERS' EDUCATION							
	Blacks 1919–38				Blacks 1939–53			
WOMAN'S EDUCATION (Years)	0–11	12	13–15	≥16	0–11	12	13–15	≥16
Transmission, fertility, and marriage:								
0–11 to 12	1.02	.99	.98	1.06	.96	.98	1.03	1.02
12 to 13–15	1.01	.98	1.00	1.06	.96	.99	1.01	1.02
13–15 to ≥16	.99	.99	.97	1.11	.98	1.00	.97	1.07
0–11 years to ≥16	.99	.96	.99	1.17	.92	.95	1.04	1.11
Transmission and marriage:								
0–11 to 12	.97	.99	1.01	1.03	.94	.99	1.02	1.02
12 years to 13–15	.99	.98	1.01	1.04	.97	.98	1.02	1.03
13–15 years to ≥16	.99	.98	.97	1.13	.99	.97	.98	1.11
0–11 years to ≥16	.94	.95	1.00	1.21	.87	.93	1.02	1.20
Transmission and fertility:								
0–11 to 12	1.01	.99	.99	1.04	.94	1.00	1.02	1.01
12 years to 13–15	1.02	.98	1.00	1.05	.97	.99	1.02	.99
13–15 years to ≥16	1.00	.99	.98	1.10	.98	.99	.99	1.05
0–11 years to ≥16	.97	.96	1.00	1.14	.90	.96	1.04	1.07
Transmission only (joint model):								
0–11	.98	1.00	1.00	1.02	.96	.99	1.01	1.01
12 to 13–15	.99	.99	1.01	1.04	.97	.99	1.02	1.02
13–15 years to ≥16	.99	.98	.97	1.13	.99	.97	.98	1.11
0–11 to ≥16	.94	.95	1.00	1.20	.88	.94	1.03	1.16
Transmission only (independent model):								
0–11 to 12	.98	1.00	1.01	1.02	.96	.99	1.01	1.01
12 years to 13–15	.98	.99	1.01	1.03	.98	.99	1.01	1.02
13–15 years to ≥16	.98	.98	.99	1.11	.99	.98	.99	1.09
0–11 years to ≥16	.94	.96	1.01	1.22	.89	.94	1.03	1.18
Transmission, fertility, and marriage (constrained market):								
0–11 to 12	.99	1.00	1.00	1.03	.94	1.00	1.01	1.02
12 to 13–15	1.00	.98	1.00	1.06	.99	.98	1.02	1.00
13–15 to ≥16	.98	.99	.98	1.11	.99	1.00	.98	1.05
0–11 to ≥16	.96	.98	.97	1.18	.93	.96	1.02	1.09

TABLE A7
RATIOS OF SIMULATED TO OBSERVED DAUGHTERS' EDUCATION DISTRIBUTIONS FOR A GIVEN CHANGE IN WOMEN'S SCHOOLING FOR BLACK WOMEN WITH EDUCATION STANDARDIZED TO WHITE WOMEN'S EDUCATION DISTRIBUTION BY BIRTH COHORT, PSID 1968–2003

	DAUGHTERS' EDUCATION (Years)							
	Blacks 1919–38				Blacks 1939–53			
WOMAN'S EDUCATION (Years)	0–11	12	13–15	≥16	0–11	12	13–15	≥16
Transmission, fertility, and marriage:								
0–11 to 12	.98	.97	1.03	1.02	.92	.99	1.03	1.01
12 to 13–15	1.01	.97	1.00	1.04	.96	.98	1.02	1.03
13–15 to ≥16	.99	.99	.97	1.08	1.01	.98	.99	1.04
0–11 to ≥16	.93	.93	1.03	1.14	.87	.95	1.02	1.10
Transmission and marriage:								
0–11 to 12	.96	.99	1.01	1.02	.94	.99	1.01	1.02
12 to 13–15	.98	.99	1.00	1.03	.96	.98	1.02	1.03
13–15 to ≥16	.99	.98	.98	1.09	.98	.97	.98	1.07
0–11 to ≥16	.91	.94	1.00	1.18	.86	.92	1.01	1.15
Transmission and fertility:								
0–11 to 12	.98	.98	1.00	1.05	.97	.96	1.04	1.02
12 to 13–15	.98	.99	.99	1.04	.99	.96	1.05	.99
13–15 to ≥16	1.02	.96	.99	1.09	.99	.98	1.00	1.04
0–11 to ≥16	.92	.95	1.00	1.14	.90	.93	1.05	1.07
Transmission only (joint model):								
0–11 to 12	.97	.99	1.01	1.01	.95	1.00	1.01	1.01
12 to 13–15	.99	.99	1.00	1.03	.97	.98	1.02	1.02
13–15 to ≥16	.99	.98	.99	1.09	.98	.97	.99	1.07
0–11 to ≥16	.91	.94	1.00	1.16	.86	.93	1.03	1.12
Transmission only (independent model):								
0–11 to 12	.97	.99	1.02	1.01	.96	.99	1.01	1.01
12 to 13–15	.98	.99	1.01	1.03	.97	.98	1.01	1.03
13–15 to ≥16	.98	.98	.98	1.10	.98	.98	.98	1.08
0–11 to ≥16	.92	.93	1.01	1.20	.87	.93	1.02	1.14
Transmission, fertility, and marriage (constrained market):								
0–11 to 12 years	.94	1.01	.98	1.04	.92	.98	1.03	1.01
12 to 13–15 years	1.06	.96	1.01	1.04	.93	.98	1.02	1.01
13–15 to ≥16 years	1.04	.98	.97	1.08	1.02	.99	.98	1.04
0–11 to ≥16 years	.96	.96	.99	1.13	.94	.96	.99	1.11

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