DIVERGING FERTILITY AMONG U.S. WOMEN WHO DELAY CHILDBEARING PAST AGE 30*

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In this paper I examine the evolving association between educational attainment and the timing of births. In the late 1970s, women with four-year college degrees had lower first birth rates before age 30 than women with less education, but rates of first births were similar for the two groups after age 30. From the 1970s to the 1990s, first birth rates decreased before age 30 for all women, but increased after age 30 only for women with four-year college degrees. Parity 2 birth rates also increased for college graduates with a first birth after age 30. These results document widening educational differences in fertility timing between 1975 and 1995, which may reflect period changes at later ages in women's work and family lives.

In this paper I examine trends in U.S. women's birth rates in their later reproductive years for the period 1975 to 1995. I pose several questions concerning this two-decade span. First, what are the chances that women who delay childbearing to age 30 will eventually have children? Second, how many children will they have? Third, what is the association between education and fertility during these ages?

For answers to these questions, I examine data from the June 1990 and June 1995 Current Population Surveys to estimate trends in birth rates from 1975 to 1995. Then I reconstitute the birth rates into synthetic estimates of total births for the late 1970s and early 1990s. Results are consistent with a standard interpretation: Conflicts between women's work and family lives reduce fertility in early adulthood for all women, and especially for college-educated women. Yet I find a compensating increase in family formation rates after age 30 only for women with four-year college degrees.

Theoretical interest in birth timing derives partly from the link between delayed fertility and recent transformations of women's work lives. Working women commonly postpone childbearing as a way to coordinate their work and domestic roles (see Bianchi and Spain 1986; Van Horn 1988); this would imply that successive cohorts of women increasingly will postpone childbearing as their labor force involvement increases. Cross-sectionally we would also expect women with high labor force involvement, such as college graduates, to be the most likely to postpone childbearing. Indeed, Rindfuss, Morgan, and Offutt (1996) have documented declining birth rates for women in their early-middle reproductive years, especially women with college degrees.

Although it is widely agreed that women's work leads to postponement of fertility, it is less clear whether postponement leads to later births or to childlessness. As a step toward resolving this issue, I make an explicit distinction between decreasing birth rates before age 30 and rising birth rates after age 30. In addition, I argue that parity-specific birth rates after age 30, although affected strongly by birth rates before age 30, are also subject to distinct social and economic influences on women's lives.

Decreasing birth rates before age 30 have been well documented in the United States. Because fewer women enter their later reproductive years with their childbearing already completed, recent increases in births at later ages may be considered a direct consequence of delayed family formation at younger ages. Many current arguments on fertility timing proceed as follows: The reason why women (especially college-educated women) are having births at later ages is that they are not having births at younger ages, and the reason why they are not having births at younger ages is that their career orientations and demands for high-quality (and costly) childcare do not permit them to start families early in their careers. Hence, especially for college-educated women, the competition between work and family roles in the early adult years causes births to be consigned to the later adult years.

This argument thus predicts that *total* birth rates after age 30 are rising, but it makes no explicit predictions about birth rates after age 30, conditional on childlessness at age 30. Total birth rates after age 30 pool across birth order; thus period change in total birth rates could reflect differences in fertility behavior of women who have postponed childbearing, but also could reflect period change in the proportion of women over 30 who have already completed childbearing. Thus, even if there were no changes in conditional birth rates after age 30, one would expect rates of delayed birth to increase over time and to be highest among college graduates. Demographic evidence to date suggests that this is indeed the case (Rindfuss et al. 1996).

Women with college degrees, however, are also the most likely to remain childless, and childlessness is increasing over time for women at all educational levels (Bachu 1999). These patterns reflect the biological and especially the social effects of age, whereby fertility is limited for women who postpone childbearing, even those who express desires

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and intentions to bear children (Rindfuss and Bumpass 1978; also see McFalls 1990; Menken 1985). Some evidence suggests that first birth rates after age 30 are increasing (Chen and Morgan 1991). Even so, information about educational patterns and higher-order births is lacking, and most discussions of the competition between work and family do not address circumstances in women's later reproductive years.

For women over 30, work and family considerations compete strongly for time, energy, and commitment. Most women who are childless at age 30 can be assumed to be in the labor force; thus first birth rates after age 30 may reflect their ability or willingness to integrate childbearing into their work lives. In this context, recent changes in women's income are noteworthy. Over the last 20 years, women's earnings have increased rapidly, and women with college degrees and age 30 or older earn by far the highest average wages (Blau 1998; Spain and Bianchi 1996; also see U.S. Bureau of the Census 1996: table 9). One might expect this trend to cause a decrease in fertility as women become more strongly committed to rewarding jobs. In the past 20 years, however, childcare has become more available and more acceptable (see Rindfuss and Brewster 1996); as a result, women and couples can use income to buffer some of the time and energy costs of raising children. Thus, as women's incomes have increased, so have their opportunities to substitute income for time in raising children.

Working women's high incomes also can exert other positive effects on fertility. Economists argue that higher earnings follow from high levels of human capital and higher individual productivity. Thus, insofar as employers make efforts to keep their most valuable employees, one would expect better-educated, higher-income women to suffer the least career disruption in connection with childbearing. There is some evidence of educational and income differences in career disruption in developed countries (Dex et al. 1996; Waldfogel 1997); this suggests that working women with higher incomes have less disincentive for childbearing, all else being equal. In addition, authors such as Oppenheimer (1988) have suggested that as women's incomes rise, their marriage market circumstances may change as the signaling importance of women's ascribed characteristics (such as family origin and attractiveness) becomes less important than achieved characteristics (such as income and income potential). Therefore, as marriage rates rise among college-educated women over age 30, birth rates should rise as well. Meanwhile the wages of less highly educated men are stagnant or declining, so marriage prospects for women over 30 without college degrees may have stagnated or declined as well.

The above arguments anticipate a growing positive correlation between women's work status and family formation, and (by extension) a positive association between education and first birth rates among women who have postponed childbearing. The implications for family *size*, however, are less clear. Specifically, one might expect that as first birth rates rise among women with high education and high incomes, the proportion that stop at one child should increase. For an example, consider childcare. Women who remain home with their children can achieve some economy of scale by caring for two or more children at once, but women who use childcare facilities incur roughly the same costs for each additional child. In addition, childcare provides "only" children with social exposure to other youngsters and thereby may decrease parental concerns about any developmental consequences of being an only child.

A similar argument applies to maternity leave. A woman with a large store of human capital may be able to negotiate a maternity leave without deflecting her career trajectory, but she faces similar concerns for each additional child she intends to bear.

Finally, some researchers have suggested that increases in women's labor force commitment, delayed marriage, and delayed childbearing all reflect a shift from normative to individualistic and experiential motives for childbearing (Hall 1993; Presser 1999). Thus a woman who has grown accustomed to having time of her own and has already borne a child may have little incentive to bear more children.

Despite the above arguments, trends in subsequent fertility after age 30 may move in the same direction as trends in first births. Norms favoring two children remain strong in the United States, and the usually brief interval between women's first and second births (two to four years) leaves women and couples relatively little time to reevaluate their plans for family size after a first birth. Furthermore, new mothers who feel guilt or sense social disapproval when they substitute organized childcare for maternal care may be reluctant to further "deprive" their child of exposure to siblings. Of course, all of these considerations depend on the mother's or parents' ability to provide a second child with a suitable level of support.

In summary, for women childless at age 30, the income, accumulated human capital, and anticipated income from their work may facilitate childbearing more than they discourage it. Taking education as a proxy for these income measures (a reasonable assumption for women 30 and older), I argue simply that women's conditional birth rates after age 30 should be highest among college-educated women, and should increase over time. First birth rates provide a test for this argument because one would expect that recent social changes would greatly facilitate first births. Subsequent birth rates should provide a more stringent test because the incentives for additional births are less clear, while the disincentives are still powerful.

DATA AND METHODS

In analyses described here I use the combined June 1990 and June 1995 Current Population Surveys (CPS). These surveys each contain a nearly complete fertility history, and the large samples in these data allow tests for interactions between period trends and age patterns in fertility. The CPS also contains a nearly complete marital history, but modeling joint processes of marriage and fertility is beyond the scope of this paper.

The CPS fertility history records the dates of each of the first four births to women age 15 to 65 at interview. I ex-

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clude Hispanic women and nonwhite/nonblack women from the analysis so as to exclude most recent immigrants who may have had births outside the United States, and I confine the analysis to the period from January 1975 to the date of interview. In this study I use data from 14,767 respondents in the June 1990 and June 1995 CPS who were childless at age 30, censoring each woman's fertility history at age 45 or at age at interview.

I assume that educational attainment is the same at age 30 as at the interview. This assumption might downwardly bias estimates of fertility rates for women at higher educational levels if a substantial proportion of women pursue additional education in midlife *and* if childlessness is a significant predictor of return to school in midlife. The literature on fertility and educational attainment in midlife is sparse, but work by Carr and Sheridan (1999) suggests that childlessness does *not* significantly affect a woman's likelihood of returning to school in midlife.

In the main analysis, I use event-history techniques (see Lillard and Panis 1998) to estimate effects of education, time period, and age on parity-specific birth rates for women childless at age 30. I report results pooled over non-Hispanic black and non-Hispanic white U.S. women. The event-history models estimate the rate or *hazard* of a live birth (a transition to a higher parity level) for each month at a given parity level. I specify the monthly hazard as a function of fixed variables (x_i) and time (t_i) as represented below:

$$\text{Log } h(t) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \gamma_1 t_1 + \gamma_2 t_2 + \gamma_3 t_3 + \gamma_4 x_1 t_1. \quad (1)$$

The terms x_1, x_2, and x_3 respectively represent one or more dichotomous variables for educational level, race, and imputation flags. The x variables exert effects that increase or decrease the log of the baseline rate of the event. The terms t_1, t_2, and t_3 represent time-varying variables for calendar time, age, and duration since previous birth (if any); $x_1 t_1$ defines an interaction term for educational level and calendar time. Thus the models control for as many as three dimensions of time. The variables of interest are education, calendar time, and their interaction.

I employ nonlinear functions to model age and duration dependence. The baseline hazard function for age is a two-piece splined function with slopes for ages 30–34 and 35+. For subsequent births, I include splined functions for age and duration; the duration function has slopes at 1–12, 13–30, and 31+ months after a previous birth. The time variable of greatest substantive interest is calendar time from 1975 to 1995; I estimate this effect of time period as a linear effect with no spline nodes. Nonlinear period specifications did not significantly improve model fit, and estimated parameters approximated a linear trend on a log scale.

The models estimate two key effects of education: a "main" effect as of 1975, and an interaction of calendar time with education that provides an estimate of the extent to which trends in birth rates differ by education between 1975 and 1995. Adding this interaction term to the main effect of calendar time produces an estimate of changes in birth rates over calendar time for each educational category.

Because of the many ways to model delayed childbearing, given the variables and the duration parameters described above, I examined a large number of alternative models with different racial groupings, educational categories, age, time, and duration specifications, and interactions. The main findings of this analysis were extremely robust with respect to model specification. (See Appendix B.)

In event-history analysis, the outcomes are expressed as rates. Another central question is *whether* births occur as well as *at what rates* they occur; thus it is informative to use estimated parameters of the models to calculate the proportion of women who have a birth or a subsequent birth. To do this, I create a synthetic estimate of parity progression ratios for the late 1970s and the early 1990s, predicting the total number of births to a woman by age 45 given that she was childless at age 30. This measure is analogous to a total fertility rate in that it analyzes births across ages for a single time period, but it differs in that it is conditioned on childlessness at age 30. To perform this calculation, I use hazard models like those shown in the results, with slight modifications. (See Appendix A for additional details.)

RESULTS

Trends in the Proportion of Women Childless at Age 30

Table 1 shows the proportion of U.S. women childless at age 30 as measured in the June 1990 and June 1995 Current Population Surveys. Scores here and elsewhere are weighted; in all parts of this study, unweighted results were nearly identical to the results shown. The first two columns display the proportion of women childless at their thirtieth birthday in the given period. In both 1975–1979 and 1990–1995, women with a four-year college degree were twice as likely as other women to be childless at age 30. Thus, even if birth rates after age 30 were independent of educational attainment, women with college degrees would be twice as likely as other women to have a first birth after age 30 because of their higher exposure to the possibility of a delayed birth.[1]

In absolute terms, childlessness at age 30 has increased by .16 (= .56 – .40) for women with a college degree, and by .07 (= .26 – .19) for women with no college degree. This measure of increase supports the finding of Rindfuss et al. (1996) that birth rates have been declining among all women in their early adult years, but especially among college-educated women. The third column of Table 1, however, shows the *relative* increase in the proportion childless between 1975–1979 and 1990–1995. The proportion of all women childless at age 30 increased from about 1 in 4 to more than 1 in 3, a relative increase of 40%. Among women with four-year college degrees, the increase was 39%; among those with no four-year college degree, the increase was 38%. Thus, in relative terms, women at all educational lev-

1. I do not show results for the 1980–1984 and 1985–1989 periods, but the education patterns are the same and the time trends are approximately linear.

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TABLE 1. PROPORTION OF WOMEN CHILDLESS AT AGE 30, BY EDUCATIONAL LEVEL AND RACE: U.S. NON-HISPANIC BLACK AND WHITE WOMEN AGE 30 IN 1975–1979 AND 1990–1995

Category	Proportion in Category Childless at Age 30		Relative Increase
	1975–1979	1990–1995	1990–1995/ 1975–1979
Total	.24	.34	× 1.40
By Educational Level			
Four-year college degree (or more)	.40	.56	× 1.39
No four-year college degree	.19	.26	× 1.38
Less than high school diploma	.13	.17	× 1.27
High school diploma	.17	.22	× 1.30
Some college, no four-year degree	.23	.32	× 1.41
By Race			
White non-Hispanic	.24	.36	× 1.46
Black non-Hispanic	.22	.23	× 1.07

Source: Current Population Survey, June 1990 and June 1995.

Notes: Proportions are based on weighted scores. N = 15,093 women age 30 in 1975–1979 and 1990–1995.

els have become more likely to delay childbearing, a fact emphasized less strongly in previous explanations of educational differences in fertility timing.[2]

Table 1 shows the proportion of all women childless at age 30 by category, but says little about the *composition* of the population childless at age 30. In results not shown in this table, I find that among women childless at age 30, 41% had a four-year college degree in 1975–1979. By 1990–1995, this percentage had increased only to 42%. Women with four-year college degrees are certainly overrepresented in the population childless at age 30, and most public discussion of delayed childbearing focuses on college-educated women, but one must keep in mind that the "typical" woman childless at age 30 does not have a four-year degree.

First, Second, and Third Birth Rates of Women Childless at Age 30

The first column in Table 2 shows descriptive statistics for the education and race variables included in the hazard models. The remaining columns display estimates from two models of first birth rates for women childless at age 30. Both models estimate effects of time period and education, with controls for race and current age. For time dimensions such as period and age, the coefficients estimate the *slopes* of the duration functions. I label these slopes as "monthly change" in the event rates. For models of first births, the intercept is set at the year 1975 and the month of the respondent's thirtieth birthday. I chose these intercepts for easier interpretation of the coefficients for the constant terms: Intercepts could be set at any time point without affecting the other coefficient effects.

Model 1 estimates effects of a four-year college degree compared with less education. I find no significant effect of educational attainment in the baseline year 1975 (–0.04), and no significant main effect of time period (0.0005). These two non-effects suggest that low or declining birth rates at early adult ages do not necessarily lead to high or increasing birth rates at older adult ages. The interaction term for time period × four-year college degree, however, is positive and highly significant (0.0024, SE = 0.0005). This interaction term (when added to the main effect of time period) indicates that first birth rates after age 30 for women with a four-year college degree have risen $\exp[(0.0024 + 0.0005) \times 240 \text{ months}] = 104\%$ between 1975 and 1995.[3]

The remaining coefficients in Model 1 show the constant term and the estimated effects of race and current age. According to the race coefficient, first birth rates after age 30 are lower among black non-Hispanic women than white non-Hispanic women. (On previous findings [Chen and Morgan 1991] of high first birth rates for nonwhites over age 30, see Morgan et al. 1999.) As expected, first birth rates decline with age. This decline translates to more than 1% per month (compared with the previous month) at ages 30 to 34, and more than 2% per month at ages 35 and older ($\exp[-0.011]$ and $\exp[-0.023]$ respectively). The intercept for the birth rate (referenced to age 30) translates to a rate of $\exp[-5.07]$, or about 0.6% per month: just over 7% per year for the baseline year 1975. Thus Model 1 implies that childless women's first birth rates are very low at age 30 and decline rapidly with age.

Model 2 divides women with no four-year college degree into three smaller groups. According to Model 2, the time-by-education interaction terms suggest that period trends in first birth rates between 1975 and 1995 do not differ significantly for women with some college, for high school graduates, and for high school dropouts. The estimated effects for four-year college graduates are comparable across the two models; the standard errors are larger in Model 2 because the comparison category (high school graduates) contains fewer cases. Thus a distinction between four-year-college graduates and other women captures most or all of the effect of education on birth rates after age 30. Recent increases in delayed family formation rates have occurred almost exclusively among women with four-year college degrees.

2. My results for nonwhites differ from previous findings, which were based on a mixture of vital statistics and census data (Chen and Morgan 1991; Rindfuss, Morgan, and Swicegood 1988). Morgan et al. (1999) regard the estimates from CPS data as more accurate than estimates from vital statistics and census data.

3. When I estimate rates, I extend coefficients to four significant digits (not shown).

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TABLE 2. FIRST BIRTH RATES AFTER AGE 30, BY TIME PERIOD AND EDUCATION: U.S. NON-HISPANIC BLACK AND WHITE WOMEN CHILDLESS AT AGE 30, 1975–1995

		First Birth Rate	
	% of Sample	Model 1	Model 2
Educational Attainment, Effect as of 1975			
Four-year college degree	40	–0.04 (0.08)	0.03 (0.10)
No four-year college degree (omitted category)		—	
Some college	25		0.18 (0.11)
High school diploma (omitted category)	28		—
No high school diploma	7		0.02 (0.18)
Monthly Change, 1975 to 1995			
Monthly Change × Educational Attainment		0.0005 (0.0004)	0.0008 (0.0006)
Four-year college degree		0.0024** (0.0005)	0.0022** (0.0007)
No four-year college degree (omitted category)		—	
Some college			–0.0006 (0.0008)
High school diploma (omitted category)			—
No high school diploma			–0.0016 (0.0013)
Race			
White non-Hispanic (omitted category)	90	—	—
Black non-Hispanic	10	–0.16* (0.06)	–0.15* (0.06)
Age			
Monthly change, age 30–34		–0.011** (0.001)	–0.011** (0.001)
Monthly change, age 35+		–0.023** (0.001)	–0.023** (0.001)
Constant		–5.07** (0.06)	–5.15** (0.08)
Log-Likelihood		–20,869.2	–20,862.8

Source: Current Population Survey, June 1990 and June 1995.

Notes: Coefficients indicate the change in the log birth rate corresponding to a unit change in the covariate. Imputed were 0.6% of education responses and 0.4% of race responses; coefficients for imputation flags are estimated but not shown. See text for additional details. N = 13,432.

*$p < .05$; **$p < .01$

One can summarize the findings from Table 1 and Table 2 in two key points: (1) In the late 1970s, women with four-year college degrees had first births at the same rates as other women *after* age 30, but fewer first births *before* age 30; and (2) from the 1970s to the 1990s, first births decreased *before* age 30 for all women, and first birth rates increased *after* age 30 only for women with four-year college degrees. Thus both the 1970s and the 1990s witnessed demographic shifts consistent with widening educational differences in fertility timing, but the nature of the shifts is quite different.

I turn now from models of changes in family formation to models of changes in family size. Table 3 shows estimates for period change in second and third birth rates, conditional on a previous birth, to women who were childless at age 30 but who then had a child. The models in Table 3 differ from those in Table 2 in that I control for a third time dimension: duration since previous birth. For second and third births, the intercept is set at the year 1975, the month of the respondent's thirty-fifth birthday, and the thirtieth month after the previous birth. Table 3 shows models for

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TABLE 3. RATES OF SECOND AND THIRD BIRTHS, BY TIME PERIOD AND EDUCATION: U.S. NON-HISPANIC BLACK AND WHITE WOMEN WITH A FIRST BIRTH AT AGE 30 OR OLDER, 1975–1995

	Second Birth Rate	Third Birth Rate
Educational Attainment, Effect as of 1975		
Four-year college degree	–0.13 (0.11)	–0.51* (0.25)
No four-year college degree (omitted category)	—	—
Monthly Change, 1975–1995	–0.0003 (0.0005)	–0.0018 (0.0009)
Monthly Change × Educational Attainment		
Four-year college degree	0.0023** (0.0008)	–0.0003 (0.0016)
No four-year college degree (omitted category)	—	—
Race		
White non-Hispanic (omitted category)	—	—
Black non-Hispanic	–0.08 (0.08)	0.26 (0.16)
Age		
Monthly change, age 30–34	0 .009** (0.002)	–0.018 (0.008)
Monthly change, age 35+	–0.014** (0.001)	–0.002 (0.002)
Duration Since First Birth		
Monthly change, 1–18 months postpartum	0.21** (0.01)	0.15** (0.02)
Monthly change, 19–30 months postpartum	0.04** (0.01)	0.02 (0.01)
Monthly change, 31 or more months postpartum	–0.03** (0.002)	–0.05** (0.004)
Constant (Intercept at Age 35, Duration 30 Months)	–3.43** (0.08)	–4.27** (0.16)
Log-Likelihood	–8,315.5	–2,309.0
Sample Size	4,127	2,185

Source: Current Population Survey, June 1990 and June 1995

Notes: Coefficients indicate the change in the log birth rate corresponding to a unit change in the covariate. Imputed were 0.6% of education responses and 0.4% of race responses; coefficients for imputation flags are estimated but not shown. See text for additional details.

$^{*}p < .05$; $^{**}p < .01$

two educational categories (including the omitted category, as in Model 1 of Table 2), omitting models for four educational categories (including the omitted category, as in Model 2 of Table 2).

The first column in Table 3 reports estimates for second birth rates for women with a first birth after age 30. As was true for first births, the main effects of education and time are not statistically significant; again, however, the interaction of period with education is positive and statistically significant. The combined period-education interaction and period coefficients imply a 62% ($\exp[(0.0023 + (-0.0003)) \times 240]$) increase in second birth rates between 1975 and 1995 for women with four-year college degrees. For all other women, the coefficient for the period effect is slightly negative and not statistically significant.

The coefficients for age and duration provide additional information about second births to women in their later reproductive years. According to the duration coefficients, second birth rates first increase and then decline with duration since the first birth. Beyond 30 months postpartum, second birth rates decline by about 3% per month; for example, the rate at 32 months postpartum would be 0.97 time the rate at

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31 months postpartum. The age coefficient shows an increase in birth rates from ages 30 to 34; after age 35, second birth rates decline fairly rapidly. Perhaps this nonmonotonically decreasing function of age reflects women's urgency to have a second child as they enter their mid-thirties. The constant term has been scaled to show the second birth rate at age 35 and 30 months postpartum, implying a second birth rate of exp[–3.43] = 3.3% per month. Thus, second birth rates are quite high at short durations following a first birth, but they decline rapidly at longer durations and older ages.

The second column in Table 3 shows estimates for third birth rates conditional on a second birth to women who had been childless at age 30. Estimates suffer from a smaller sample size and a very small number of (third birth) events, but the results highlight some important differences between second and third birth transitions for women in their later reproductive years. First, third birth rates are low. The constant term (scaled to age 35, 30 months postpartum) reflects a third birth rate of 1.5% per month—less than half the rate for second births—and the monthly third birth rate drops extremely rapidly (5% per month, multiplied by the previous month's rate) at durations beyond 30 months after a second birth. Second, third birth rates were particularly low in 1975 for women with four-year college degrees. Finally, third birth rates apparently have declined for women at all educational levels who were childless at 30, although the coefficient for this term is not statistically significant below the .05 level.

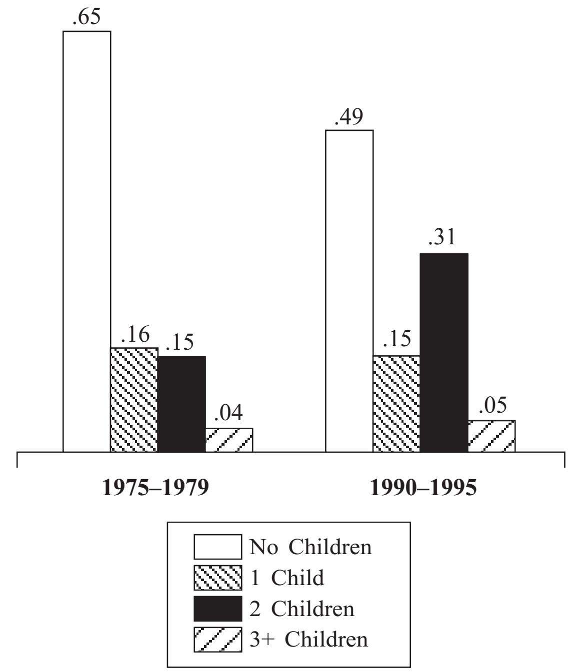
Taken together, the results in Table 3 suggest that second births are common among women who have a child after age 30, and are increasingly prevalent among women with four-year college degrees. By comparison, third births remain uncommon, especially among women with four-year college degrees.

Total Expected Births for Women Childless at Age 30

Tables 2 and 3 quantify change in delayed childbearing in terms of birth rates after age 30 to women childless at 30. Figures 1 and 2 show results when these period changes are reexpressed in terms of total births by age 45 to women childless at 30. In these figures I ask "If a woman was childless at age 30 in 1975–1979 (or 1990–1995), and if she experienced the age- and duration-specific first, second, and third birth rates for 1975–1979 (or 1990–1995), how many children would she be expected to have at age 45?" (For details on the estimation procedure, see Appendix A.) The estimates depicted in Figure 1 are for all non-Hispanic black and non-Hispanic white women with a four-year college degree; the estimates in Figure 2 pertain to all non-Hispanic black and non-Hispanic white women without a four-year college degree.

Figure 1 shows pronounced shifts in delayed fertility across the two-decade span. Consider the bars for women who had a four-year college degree and were childless at age 30 in 1975–1979, displayed on the left-hand side of Figure 1. If a woman experienced age-specific and parity-specific 1975–1979 birth rates for her remaining reproductive years, her chance of remaining childless at age 45 would be about

FIGURE 1. PERIOD ESTIMATES OF THE DISTRIBUTION OF BIRTHS BY AGE 45 FOR WOMEN CHILDLESS AT AGE 30 WITH A FOUR-YEAR COLLEGE DEGREE



65%.[4] Among women with at least one child, almost half (.16 of .35) would have only one child.

Now consider predictions under 1990–1995 birth rates. Just under 50% of women would be expected to remain childless. Perhaps most strikingly, however, the proportion of women with exactly two children increases twofold. Thus the period between 1975 and 1995 has seen a dramatic increase in childbearing, *especially in the formation of two-child families*, among women with four-year college degrees who had been childless at age 30.

Figure 2 shows that the fertility increases evident in Figure 1 are largely absent among women with some college or less education. Estimates for the proportion of such women who would remain childless are only slightly lower in 1990–1995 than in 1975–1979. The proportion of women who would have exactly two children may have increased slightly, but that change is due as much to a decline in third birth rates as to an increase in first or second birth rates.

A comparison of Figure 1 with Figure 2 highlights the increasing effect of education on fertility among women who postpone childbearing. Both family formation and family size have increased among college-educated women who postpone childbearing, but such trends are largely absent among all other women who do so. Furthermore, the com-

4. Rindfuss et al. (1988) estimate that through most of the twentieth century, about 60 to 65% of all U.S. women who were childless at age 30 remained childless at age 45. Estimates for 1975–1979 are thus in the lower range of average values across the century.

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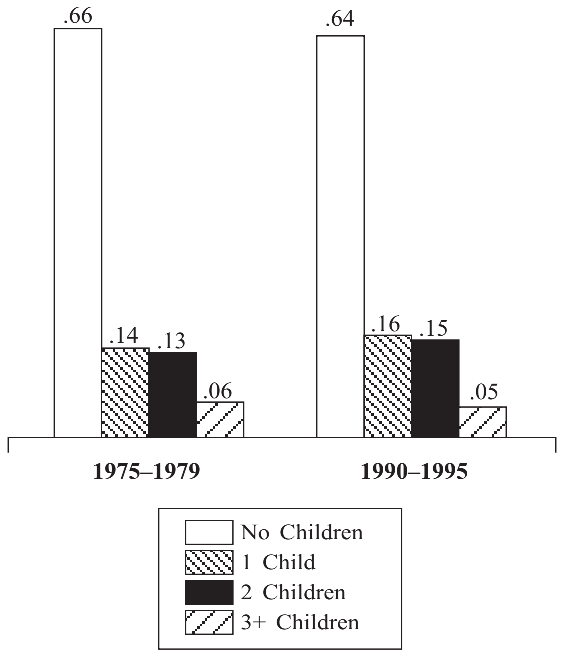
FIGURE 2. PERIOD ESTIMATES OF THE DISTRIBUTION OF BIRTHS BY AGE 45 FOR WOMEN CHILDLESS AT AGE 30 WITH NO FOUR-YEAR COLLEGE DEGREE



bined effects of increased family formation and increased family size have had a multiplicative effect on the total fertility of college-educated women who postpone childbearing. By the estimation method used in Figures 1 and 2 (including an estimate of fourth birth rates conducted in the same way as the estimate of third birth rates), the expected total fertility for college-educated women childless at age 30 increased from .59 in 1975–1979 to .94 in 1990–1995. For women with some college or less education, the corresponding estimates are .61 and .64.

DISCUSSION

I have examined recent fertility patterns across three dimensions: education, age, and period. In the mid-1970s, most women *without* a college degree formed families before age 30. Most women *with* a college degree did the same, but a substantial proportion of college-educated women postponed childbearing past age 30. First birth rates after age 30 were universally low; thus, among those women who postponed childbearing past that age, the large majority remained childless. Fertility patterns in the mid-1970s therefore were consistent with commonly accepted arguments about competition between women's work and family roles: College-educated women who were committed to establishing careers before starting families tended to postpone childbearing, and many remained childless as a result. According to this perspective, competition between work and family roles exerted its strongest effects on young career-minded women. Women's labor force attachment and participation acted primarily to increase childlessness among women with college degrees and secondarily to increase the occurrence (but not the parity-specific rates) of childbearing at later ages.

Fertility trends from 1975 to 1995 do not invalidate this mid-1970s picture of work and family roles for women under 30, although declines in birth rates before age 30 suggest that role competition has increased for women at all educational levels, not only for the most highly educated. Among women over 30, however, trends indicate a countervailing fertility pattern of increased first birth rates, but only for four-year college graduates; this education-specific increase also holds for second birth rates. In contrast, the growing proportions of noncollege graduates who are childless at age 30 are likely still to be childless at the end of their reproductive years.

I have argued that rising birth rates after age 30 reflect some women's increasing ability to use their incomes and human capital to facilitate childbearing and child raising. In support of this claim, fertility increases have been specific to college graduates, fully half of whom now proceed to have a first birth. Yet it is important not to overstate the positive relationship between education and birth rates after age 30. Even among college graduates who postpone childbearing to age 30, almost half remain childless by choice or necessity. Thus, although increasing incomes may help women to combine work with family, it is still very difficult to add a family to an existing work life.

In interpreting these results, it is important not to assume that childlessness is a negative outcome for all women who experience it, although most women who are childless at age 30 would like to have children (Rovi 1994). It is likely that childlessness is a different experience for women at different socioeconomic levels, and results from this study imply that a growing majority of childless women are not college graduates. In that respect, the sociological literature on childlessness, which draws largely from college graduates' experiences, may need to accommodate recent fertility trends.

What might we learn from women without four-year college degrees, who constitute the majority of women who postpone childbearing? Their continued low rates of childbearing after age 30 suggest that even if they are strongly committed to having children, they have little flexibility for timing their births across their lives. Growing income inequalities may explain this lack of flexibility; access to childcare and to a family-friendly workplace may disproportionately enable socially advantaged women to time their births optimally. Insofar as flexibility in birth timing allows parents to maximize their children's life chances, the increase in social inequality could be both a cause and a result of diverging patterns in fertility timing.

APPENDIX A. PROCEDURE FOR ESTIMATING BIRTHS BY AGE 45 TO WOMEN CHILDLESS AT AGE 30

1. From Tables 2 and 3, obtain estimates for the intercept, education, and race coefficients, and the time, age, and

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duration baselines. Exponentiate to translate the rate out of log form.

$$r(t) = \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \gamma_1 t_1 + \gamma_2 t_2 + \gamma_3 t_3). \quad (1a)$$

2. Calculate the "survivor function" for the predicted rate, where the rate is the proportion of cases with a transition in a time interval divided by the proportion of cases "at risk" at the start of the time interval (see Cox and Oakes 1984). S is the proportion of cases that have not undergone the transition at the start of each interval.

$$r(t) = (-dS(t)/dt)/S(t). \quad (2a)$$

$$S(t) = \exp \int -r(t)dt. \quad (3a)$$

3. Define the proportion of cases that experience a transition in a given time interval in terms of the hazard model, integrated across age. (I use time intervals of one year of age.)

$$P(t) = 1 - S(t) =$$

$$1 - \exp \int_{t_{2\,start}}^{t_{2\,end}} -\exp\left(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \gamma_1 t_1 + \gamma_2 t_2 + \gamma_3 t_3\right) dt_2, \quad (4a)$$

where t_1 (calendar year) is a constant fixed at 30 months from each end of the time span (June 1977 or December 1992); where t_3 (duration, for subsequent births) is expressed in terms of t_2: $t_3 = t_2 + (t_3 - t_2)$; and where $(t_3 - t_2)$ is a constant.

4. For each value of x_1 and x_2 (education and race), solve for $P(t)$ to estimate the proportion of women childless at age 30 who have a first birth each year from 30 to 45.
5. For each year of age of a first birth, solve a full series of equations to estimate the yearly proportion of women with a second birth for each year from the first birth to age 45.
6. For each year of age of a second birth, solve a full series of equations to estimate the yearly proportion of women with a third birth for each year from the second birth to age 45. Repeat this procedure for fourth births.
7. Twin births constitute about 1 to 2% of the sample. Count twin births by time period and education, assign a corresponding proportion of twin births, and adjust accordingly.
8. Combine the final estimates for each racial category and calculate the totals as weighted averages.

APPENDIX B. DECISIONS LEADING TO THE CHOICE OF MODELS

In this section I summarize the decisions that led to the choice of models, and discuss the results of sensitivity analyses of alternative model specifications.

Restriction by Racial Categories

In this paper I present combined results for black non-Hispanic women and white non-Hispanic women, as did Rindfuss et al. (1996). In alternative analyses I estimated separate age, education, time, and duration effects for blacks. The age and duration coefficients for blacks were different from those for whites, but I found no evidence that the education and education × time interaction varied by race. Because Hispanics and Asian Americans represent a growing proportion of the U.S. population, I estimated models for women in those groups even though recent immigration patterns would preclude any interpretation of period trends. For those groups, the education and education × time period interactions were consistent with the results for white and black non-Hispanic women, although standard errors were extremely large.

Specification of Educational Categories

Most models presented in this study specify education in two categories (yes/no for a four-year college degree). I also specified all models with four educational categories: four-year college graduate, some college, high school diploma, and no high school diploma. In no case was the four-category specification justified by the *BIC* criterion for an improvement in model fit. The four-category model shown in Table 2 is included to demonstrate the important point that fertility effects for the "some college" category are *not* intermediate between those for "high school diploma" (the omitted category) and "four-year college degree." An additional concern about the four-category designation is the likelihood that many women with "some college" education acquired that education after age 30. I also specified all models with five educational categories: The added category was a master's or higher degree. Apparently there is no identifiable fertility difference between college graduates and those who pursue postgraduate education.

When I estimated four separate educational categories and a race interaction, the interaction effect of a high school diploma × time was positive and statistically significant at .05 for whites, but negative and statistically significant at .05 for blacks. Models that accommodated this race/education/time interaction, however, did not meet the *BIC* criterion for model improvement, and I found no evidence in other educational categories (e.g., some college) or at higher parities to indicate that this one coefficient reflected any systematic differences between whites and blacks.

Imputed Values of Covariates

All models include controls for race and for imputed values in the explanatory variables. Race or ethnicity is imputed in 0.4% of the sample, and education is imputed in 0.6% of the sample. The coefficients are never statistically significant and are suppressed in the tables. Two percent of the sample have imputed birth dates, usually proxies provided by the focal woman's partner. Excluding or controlling for imputed birth dates distorted the intercepts (because a non-event cannot have an imputed date) but did not change any other coefficients. The models shown do not include controls for imputed birth dates.

Spline Specifications for the Baseline Hazard Functions for Age, Duration, and Time Period

The choice of spline "nodes" for the age and duration variables was somewhat arbitrary, based on prior knowledge of

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the age and duration dependency of women's birth rates. I specified numerous models with other spline nodes (e.g., a node for each year) and verified that the choice of nodes exerted only a negligible effect on the coefficients for the education variables. The choice of age 30 as a cutoff was based on previous studies (e.g., Chen and Morgan 1991) indicating declines in first birth rates in the twenties and increases in those rates at older ages. Other cutoffs (age 25, age 35) did not affect the substantive findings.

I also tried models using a specification for time period that estimated separate effects of education for 1975–1979, 1980–1984, 1985–1989, and 1990–1995 rather than as a single linear variable for time period. The separate significance levels in such models were understandably lower, but I found little or no evidence of nonlinearity in the effects of education over time. I found no evidence at all of an upturn in fertility in the 1980s or 1990s for women without a four-year college degree. The (statistically nonsignificant) increase in first birth rates for such women was explained entirely by an increase in the late 1970s.

Separate Models by Birth Order

In this study I conduct separate analyses of fertility rates for first, second, and third births. Fourth births were too few to model. The distinction by parity was motivated by a prior theoretical interest in differences between family formation and family size; thus I did not attempt to combine birth orders into a single model.

Interactions between explanatory and baseline variables. The models shown in Tables 2 and 3 estimate main effects for education, age, duration since the previous birth, and race, plus an interaction term for the effect of education across the period 1975 to 1995. Many other interaction models are possible; some (e.g., adding a race × duration variable to the second birth model) improved model fit according to the *BIC* criterion. I did not use more complicated interaction models, however, for several reasons. First and most important, the effects of education across time periods did not change in these complicated models, an indication that the effects of the key explanatory variables were specified correctly in the simpler models. Furthermore, numerous tests for unmeasured heterogeneity in the simpler models failed to find an unmeasured effect. Second, the more complicated models were confusing to read and interpret. Finally, it is not possible to test all potential interactions because neither aML nor any other existing program can solve a model that interacts two splined baseline functions.

One coefficient in the simpler models may be misidentified because of an unmeasured interaction effect. In Table 3 in the model for second births, the coefficient for the effect as of 1975 for college graduates is negative but not statistically significant (p = –.15). In a comparable model with an interaction for education as of 1975 × duration, that coefficient was negative and statistically significant at duration 0 with a statistically significant increase across duration since the first birth. These coefficients suggest that in 1975, women with a college degree and a first birth after age 30 had their second births at later durations than women without a college degree, but were as likely as other women, or more so, to have a second birth. The estimates of total births shown in Figures 1 and 2 are based on separate full models for each education category; therefore those summary estimates are not affected by this difficulty.

Models for the Synthetic Estimates of Total Fertility

The results shown in Figure 1 are based on models in Tables 2 and 3, with no estimated coefficients for imputation flags. As I mentioned above, modeling duration × education interactions did not affect the overall coefficients. I feared, however, that such interactions, if unmeasured, might place births at incorrect ages and affect the synthetic estimates of total fertility. To test this problem, I estimated separate birth rate models for each educational category; the results were substantively the same. To further test the estimation procedure, I compared the estimates with the actual outcomes reported in the 1990 and 1995 CPS, and found that the synthetic estimates accorded fully with the (partially censored) raw data.

No direct test of the variance of the estimates is shown in Figures 1 and 2. I chose not to attempt bootstrap estimation because the computation procedure would have led to weeks or months of spreadsheet work. Instead I replicated the procedure on two other data sets. No single set of data properly covered the entire 1975–1995 time span, so I used the June 1985 CPS to verify the estimates for 1975–1979 and the 1995 National Survey of Family Growth to verify the estimates for 1990–1995. The 1985 CPS and the 1995 NSFG produced results extremely close to those displayed in Figures 1 and 2, and showed the same trends and differences in fertility by educational attainment.

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