

Opting for families: recent trends in the fertility of highly educated women

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Abstract After declining for many years, there are indications that fertility may be increasing among highly educated women. This paper provides a comprehensive study of recent trends in the fertility of college-graduate women. In contrast to most existing work, we find that college graduate women are indeed opting for families. Data from the Current Population Surveys and Vital Statistics Birth Data both show that fertility increases among college graduate women, especially at older ages since the mid- to late 1990s. There are also increases in fertility among less-educated women, but these are concentrated at younger ages.

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1 Introduction

Among college graduate women in their early 40s, childlessness increased by over 60 % between 1980 and 1998. But a number of recent, high-profile reports have suggested that highly educated women are now increasingly opting for families over careers (Belkin 2003; Wallis 2004; Story 2005; Stone 2008). If highly educated women are increasingly opting for families, it would mark a dramatic break from existing trends, but the scholarly literature is small and generally finds that no shift is occurring.

This paper provides a comprehensive study of highly educated women's fertility. Our estimates indicate that among college graduate women, the cohort born in the late 1950s represents a turning point. While this cohort continued to experience declines in fertility relative to the cohorts that preceded it through their late 30s, they reverse the trend, with large increases in fertility between their late 30s and early 40s. This cohort then leads the way for the subsequent cohorts which experience further increases in completed fertility and also increases in fertility at earlier ages.¹

We are aware of two studies that include estimates of recent trends in the fertility of highly skilled women (along with other outcomes).² Both studies, while valuable, have limitations and they come to opposite conclusions, although their results are somewhat less contradictory than their conclusions would indicate. Vere (2007) studies cumulative fertility by cohort focusing on 27-year-old college-educated women between 1982 and 2002. He finds an increase in fertility for this group, but 27 is early in the childbearing years, especially for college-educated women. Changes in fertility in the 20s may say more about the timing of fertility than completed fertility, with reductions in fertility later in life potentially offsetting any early-life increases.

By contrast, Percheski (2008) concludes that there have been no increases in fertility among professional women.³ Her sample of women in professional

¹Due to data restrictions, we define completed fertility as fertility at ages 40–44. We are aware some women may have children at later ages, but the number is likely to be small.

²More loosely related to the current work, Abma and Martinez (2006) study voluntary versus involuntary childlessness, showing a decline in voluntary childlessness between 1995 and 2002. Their results cover all women, not just highly educated women.

³A close inspection of Percheski's results indicates that there is a reduction in childlessness at ages 35 to 39 and an increase in cumulative fertility at ages 38 to 39 starting with her "late baby boom" cohort born between 1956 and 1965. Although she downplays this finding, it suggests an increase in fertility. On the other hand, Percheski finds no reduction in childlessness at ages 30–34, which are the closest her results come to Vere's estimates of increases in cumulative fertility to 27-year-old women starting with the cohorts born 1966–1967. Thus, their results are in some ways similar and in other ways divergent. These gaps may be due to the differences in the data and measures they use and Percheski's focus on professional women.

or managerial occupations, has the advantage of pinpointing women in high-powered careers, but makes her results somewhat hard to interpret because women who have more children or choose to reduce their hours may switch to less intense occupations. Our analysis, like most, addresses this concern by defining the sample using education which, while affected by expectations over employment, will be much less responsive to short-term decisions.

The present paper is considerably more comprehensive than the small and seemingly contradictory existing work on recent trends in fertility among highly educated women in a number of ways. First, we study fertility at a range of ages from the 20s through the 40s. Second, we consider both the intensive and extensive margins, including cumulative fertility by cohort and childlessness. Third, we study changes in fertility due to changes in the observable characteristics of college graduate women and conditional on their characteristics. Fourth, we estimate fertility from two very different data sets: the Current Population Survey (CPS) and the Vital Statistics Birth Data (matched to population data from the CPS). Fifth, we compare trends in fertility among highly educated women to less-educated women. Lastly, we attempt to gauge the importance of fertility treatments in the increase in fertility.

We find clear evidence of an increase in completed fertility among college graduate women since the late 1990s or 2000. This increase arises along the extensive margin (i.e., in the share of women having any children) conditional on characteristics. It occurs despite changes in observable characteristics (most notably an increase in the share of women who have never been married), which would have tended to reduce cumulative fertility. This trend is also specific to highly educated women. Less-educated women experience increases in fertility, but at younger ages, with no apparent increase in completed fertility.

Access to fertility treatments has increased in recent years and plural birth rates, which are associated with fertility treatment, have also increased dramatically, especially among highly educated women in their 40s. We use trends in plural birth rates to impute the share of the increase in fertility among college graduate women that is due to fertility treatment. Even under the very strong assumption that none of the children born with fertility treatments would have been born in the absence of fertility treatments, we find that fertility would have increased among college graduate women even in the absence of fertility treatments.

Our work also relates to research on whether highly educated women are opting out of the labor market insofar as women may opt out of careers if they are opting for families.⁴ Most such studies cast doubt on the opting

⁴More distantly related, Bertrand et al. (2010) study MBAs graduates from the University of Chicago's Booth School of Business, finding that career interruptions from childbirth are responsible for most of the earnings gap among men and women. Using alumnae from Harvard University, Herr and Wolfram (2011) find that the family friendliness of jobs is an important determinant of women's employment decisions.

out phenomenon (e.g., Boushey (2005); Cohany and Sok (2007); Percheski (2008), but Vere (2007) and Antecol (2010) provide at least some evidence to the contrary). Boushey (2005) and Percheski (2008) both focus on the child employment penalty—the gap in labor force participation between women with and without young children—finding that it has declined in recent years. Our estimates of changes in childlessness may help to explain this result. Insofar as the marginal women to have children have the strongest labor force attachment, as childlessness has declined, more women with strong labor market attachment are having children. And, as more of them have children, the difference in employment between women with and without children may drop even if the amount any given woman would work if she has children decreases relative to the amount she would work if she did not have children.

2 Data

Two major data sources are used in this paper to study the fertility patterns of college graduate women: the Fertility Supplement to the June CPS and the Vital Statistics Birth Data from the National Center for Health Statistics combined with population data from the March CPS.

Our first data set is the June CPS for 1980–2008. The June CPS asked women aged 14 to 44 how many children they had ever had. The latest release of the Fertility Supplement is the 2008 June CPS. We focus on women with 16 or more years of school.⁵

For any given year, the estimates reported below are for cells that combine data for five consecutive years of age. To control for changes in the age distribution of the population within each cell, we first construct means for individual ages within each 5-year cell and then average the estimates across the 5-consecutive ages within that cell.

We also use the 1976–2006 Vital Statistic Birth Data to estimate the number of births. The Vital Statistics are based on information abstracted from birth certificates, and include all births occurring in a given calendar year within the United States to U.S. residents and nonresidents.⁶ This section outlines the primary features of our approach. Our strategy is similar to and extends Vere (2007). A detailed discussion is in the [Data Appendix](#).

⁵The definition of educational attainment in the CPS in and after 1992 is based on the highest degree attained instead of the number of years of school as in earlier surveys. Along with the March CPS and the Vital Statistics data (discussed below), the degree-based classification was converted back to one based on years of completed schooling by weighting births by women with a college degree or higher on the new certificates by 1.007599 based on Jaeger (1997).

⁶Before 1985, only 50 % samples are available for some states. Data from these states in these years are weighted to produce nationally representative statistics.

Our birth sample includes births to mothers with 16 or more years of school.⁷ Before 1992, not all states report mother's educational attainment.⁸ We obtain national estimates for the years for which schooling is not available for some states by re-weighting births for states with schooling data to make them nationally representative.

We estimate childlessness and cumulative fertility by cohort and age from the Birth Data merged to population data from the 1976–2006 March CPS. Let n_{ca} denote the number of children born to women from cohort c at age a and let N_{ca} denote the population of women from cohort c at age a . The number of children born per woman in cohort c at age a is $f_{ca}^{\#} \equiv \frac{n_{ca}}{N_{ca}}$, which constitutes a flow of children born. Cumulative fertility to age a among women in cohort c is a stock variable, calculated as the sum of the age specific fertility rates up to age a , given by $S_{ca}^{\#} = \sum_{i=24}^a f_{ci}^{\#} + \sum_{j=1}^{\infty} j f_{c23}^j = \sum_{i=24}^a \frac{n_{ci}}{N_{ci}} + \sum_{j=1}^{\infty} j \frac{n_{c23}^j}{N_{c23}^j}$. We use the stock of women with children (at any parity, j) at age 23, $\sum_{j=1}^{\infty} j f_{c23}^j$, to initialize the process and then sum fertility from age 24 to any given age a .

We also estimate childlessness by age. Let n_{ca}^j denote the number of j th children born to women from cohort c at age a . The share of women having their first child at age a is $f_{ca}^1 \equiv \frac{n_{ca}^1}{N_{ca}}$, which constitutes a flow variable. Childlessness among women from cohort c at age a is a stock variable calculated as $S_{ca}^0 = 1 - \left(\sum_{i=24}^a f_{ci}^1 + \sum_{j=1}^{\infty} f_{c23}^j \right) = 1 - \left(\sum_{i=24}^a \frac{n_{ci}^1}{N_{ci}} + \sum_{j=1}^{\infty} \frac{n_{c23}^j}{N_{c23}^j} \right)$. Again, we begin cumulating fertility from age 23, taking the share of women having children (at any parity) at age 23, $\sum_{j=1}^{\infty} f_{c23}^j$, and then summing the share having first births from age 24 to any given age a . In a previous version of this paper (Shang and Weinberg 2009), we estimated the full distribution of cumulative fertility and describe how that can be done from these data.

A natural concern with our procedure arises for women completing college after age 23. To address this concern, we convert all variables to shares of the population before constructing the stock variables from the flow variables. This procedure implicitly uses the fertility patterns of women who had already completed college by a given age to impute the distribution among women completing college at that age (a procedure that generates stocks from flows first and then converts them to population shares implicitly assumes that women completing college at later ages have not had any children. Despite this

⁷A difference between CPS and Birth Data is that the education data in the Vital Statistics is the education attained at the time of the birth of a child. Education data in the CPS corresponds to the time of interview.

⁸Schooling data is not available for all parts of Arkansas, California, Idaho, New York State, Texas, Washington State, and New Mexico in at least some years. In addition, before 1988, mother education is missing for more than 7 % of the observations in a small number of states that report mother's schooling. As explained in the [Data Appendix](#), we re-weight our Vital Statistics Birth Data by age and live birth order to account for women without reported schooling. This procedure implicitly assumes that conditional on age and live birth order, non-reporting of schooling does not vary with schooling.

difference, estimates from the two procedures are broadly similar). A variety of other potential biases are also discussed in the [Data Appendix](#).

3 Results

3.1 Childlessness

Figure 1a presents trends in childlessness and 95 % confidence intervals for college graduate women from the June CPS since 1980 (for clarity, here and below, when we refer to women who have completed college, but obtained no more schooling as “exactly college graduates;” women who have some post-college education as “graduate educated women;” and all women in either category as “college graduate women”).⁹ Separate estimates are shown for four 5-year age groups. The results are plotted by birth cohort, which has a one-to-one relationship with year (each data point is for a given year and pools data for the 5 birth years in the relevant age range). By tracing out childlessness across cohorts, the vertical distances between the curves indicate the share of women having first children between each age range. Childlessness is non-increasing as a cohort ages, so the curves for the later ages lie beneath those for the younger ages. The figure shows two series, one based on the contemporaneous education classification and a second that converts all figures to the post-1992 degree-based classification using the conversion factors in Jaeger (1997). The results from both series are quite close to each other and, for simplicity, we focus on estimates based on the contemporaneous classification below.¹⁰

The figure shows that childlessness increased in the 1980s to mid-1990s at all ages, which continues a well-known, pre-existing trend (Goldin 1997; Shang and Weinberg 2009; Bailey 2010), but childlessness declines after that at most ages. The increase in childlessness after 1980 is largest at older ages. Among women between 40 and 44, childlessness increases from less than 20 % for the 1936–40 cohort (in 1980) to close to 30 % for the 1950–54 cohort through the 1954–1958 cohorts (in the mid-1990s).

While the CPS samples are too small to make precise statements about timing, childlessness is fairly flat at ages 25–29 and 30–34 from the cohorts born around 1960 until the most recent years, when childlessness declines among women between 30 and 34. Among women between 35 and 39, childlessness peaks with the cohorts born in the late 1950s (in the mid-1990s) and declines after that. Among women between 40 and 44, childlessness peaks

⁹Before 1992, women who have completed exactly 16 years of schooling are coded as “college graduates exactly” and women with at least some of a 17th year of schooling are coded as “graduate educated.”

¹⁰By contemporaneous classification, we mean that women are classified as college graduates if they have completed at least 16 years of schooling (before 1992) or have a bachelor’s degree or higher degree (in or after 1992).

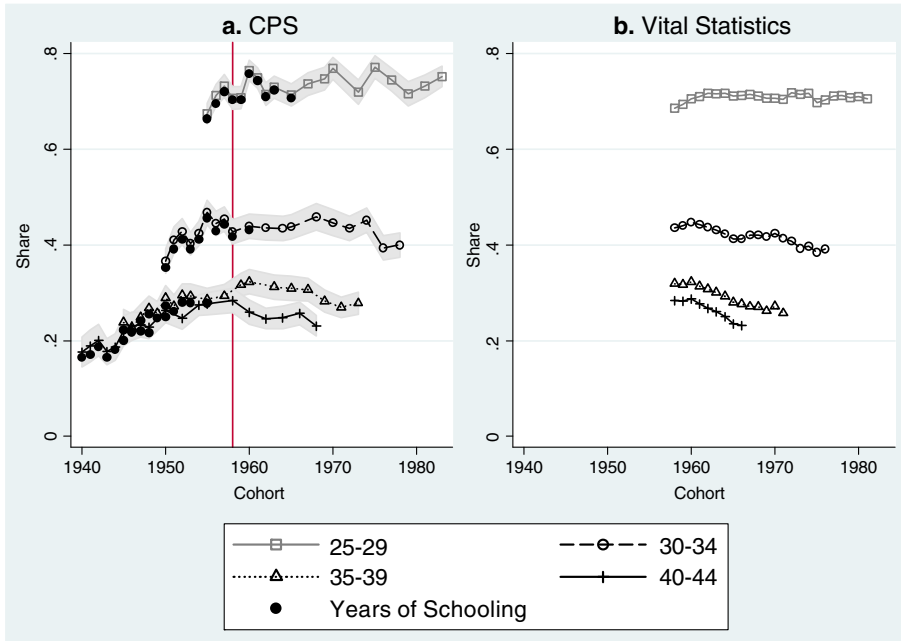


Fig. 1 Childlessness among college graduate women, by birth cohort and age. CPS estimates and associated 95 % confidence intervals for college graduate women from the June CPS using data for 1980–88, 1990, 1992, 1994, 1995, and semiannual data for 1998–2008. Vital Statistics estimates for college graduate women from the 1976–2006 Vital Statistics Birth Data matched to population figures from the March CPS. Estimates shown for 5-year birth cohorts, with the cohort shown giving the birth year of the youngest members of each cohort. Estimates based on years of schooling have been converted to degrees, except as indicated. The vertical line in Panel a indicates the 1958 birth cohort, when the Vital Statistics data begin

among slightly earlier cohorts (a few years later) before declining. The vertical distance between the curves for the 35–39 and 40–44 age groups for women born in the late 1950s and early 1960s increases. Thus, a larger share of women in these cohorts had their first child in their late 30s or early 40s, which led to an initial decline in childlessness at ages 40–44 even though childlessness among women in these cohorts at ages 35–39 is higher than in previous cohorts. For later cohorts, those born after 1963–1967, more women had children in their 30s, which further reduced childlessness at ages 40–44. It is evident from the graph that the decline in childlessness began with the women born in the late-1950s starting to have children in their late 30s and 40s and spread to younger ages, although the childless rate for women aged 25–29 does not decline even for the latest cohorts.

Figure 1b presents similar analyses using data from the Vital Statistics Birth Data. These estimates are based on considerably larger samples than the CPS, making them more precise, but they are not directly comparable to the CPS estimates. First, these estimates exclude women who had children abroad and include children born to women who subsequently left the United States.

Second, when using the Birth Data we assume that the flow of children born at age 23 equals the stock of children at age 23. Lastly, when using the Birth Records data we cumulate fertility by tracking a cohort as it ages and, as discussed above and in the [Data Appendix](#), must make assumptions about fertility among women who complete college after age 23. Because education is not reported in many states in the first years of the Birth Data, our samples begin in 1976. We begin tracking women from age 23, so we start with the 1954–1958 cohort (to facilitate a comparison of the results from the CPS (in Panel a) to those from the Vital Statistics (in Panel b), we have placed a vertical line in panel a that identifies the 1958 birth cohort indicating where the Vital Statistics data begin).

Despite these differences, the results using the Birth Data in Fig. 1b are broadly similar to those from the CPS. Specifically, women aged 25–29, show an initial increase and then a sustained plateau.¹¹ Women in the three older age groups, all show declines in childlessness over this period, with the greatest declines at the oldest ages. Thus, to the extent that it is possible to compare estimates from the Birth Data to those from the CPS, they are broadly consistent.

3.2 Cumulative fertility by cohort

Figure 2a shows cumulative fertility rates by cohort for the four age ranges from the June CPS. These estimates are based on the number of children that women in each age range report having ever had. These estimates show broadly similar patterns. For the cohorts before 1951–55, there is a large reduction in childbearing at all ages. The reduction continues to a much smaller degree through the 1956–1960 cohort at ages 35–39, although their fertility is not lower than the cohorts that precede them immediately at younger ages. However, these women reverse the trend toward declining fertility at ages 40–44. An increase in childbearing is also observed for women aged 35–39 during the same time period (the late 90s), but it is smaller in magnitude. In the most recent years, for women born after 1970, fertility increased at younger ages, 30–34. While it is too early to say how completed fertility will evolve for women born after 1970, these estimates suggest that completed fertility may well increase substantially.

Although our methods differ from Percheski (2008),¹² of all of our analyses, these are the most similar to her methods. Although she interprets her

¹¹The Birth Data require us to track cohorts since age 23. Because our data only begin in 1976, we start with the 1954–58 birth cohorts, which allows us to capture the decline in fertility at younger ages, but not the decline at older ages (which is over by the 1954–58 birth cohort).

¹²We define our sample based on education, while Percheski defines hers based on education and occupation. Insofar as women who have more children switch from professional occupations to other occupations, women who are in professional occupations would be expected to experience less (or even no) increase in childbearing even if college graduate women experience increases. We focus on 5-year birth cohorts, while she aggregates to 10-year birth cohorts and her data end before ours.

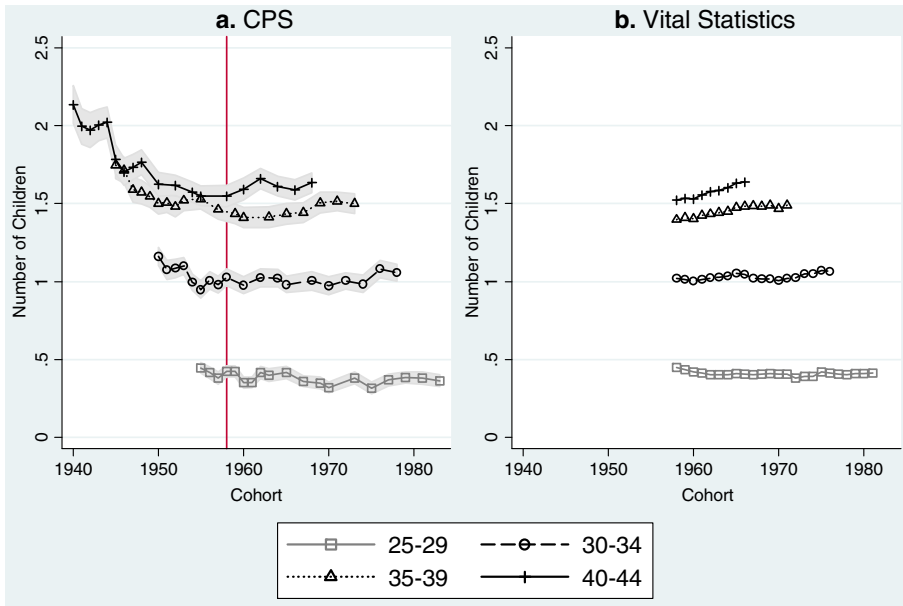


Fig. 2 Cumulative fertility by cohort among college graduate women, by age. Estimates and associated 95 % confidence intervals for college graduate women from the June CPS using data for 1980–88, 1990, 1992, 1994, 1995, and semiannual data for 1998–2008. Estimates for college graduate women from the 1976–2006 Vital Statistics Birth Data matched to population figures from the March CPS. Estimates shown for 5-year birth cohorts, with the cohort shown giving the birth year of the youngest members of each cohort. Estimates based on years of schooling have been converted to degrees. The vertical line in Panel a indicates the 1958 birth cohort, when the Vital Statistics data begin

estimates as showing that fertility is relatively constant, a careful examination of her results also shows an increase in fertility among women in their late 30s after the 1946–55 birth cohort.

Estimates using the Vital Statistics Birth Data in Fig. 2b echo those from the CPS. Our methods here come the closest to the methods of Vere (2007). He finds an increase in cumulative fertility among 27-year-old college-educated women. While we also find strong evidence of an increase in child bearing among college graduate women, our estimates show that it is concentrated at later ages, with women between 25 and 29 showing no discernable trend, which is consistent with our CPS results above. Thus, we come to the same broad conclusion as Vere, but our estimates highlight the importance of looking at measures of childbearing at older ages.¹³

¹³There are a number of sources of difference between our analysis and Vere's. We begin tracking women at 23, while he begins tracking women at 22, at which point fertility estimates are quite noisy; his data are based on 38-states without missing data on education, while we correct for missing education data; and his estimates are averages of cumulative fertility of 2-year cohorts up to age 27, whereas our estimates are the averages of 5-year age groups taken at a point in time, which are most comparable to the CPS estimates.

3.3 Other education groups

Is the recent increase in childbearing among college graduate women part of a larger trend toward higher fertility? There has also been a large expansion in the share of women graduating from college that affects the composition of the college graduate population. To assess the breadth of the increase in childbearing, and assess whether the recent increase in childbearing among college graduate women is driven by increases in the share of women graduating from college, we study trends in fertility at a variety of education levels.

Figure 3a plots cumulative fertility by age for five different education categories—high school dropouts; high school graduates (exactly); women with some college (but who did not complete college); college graduates exactly; and women with graduate education. Results for women with some college or more education (i.e., the sum of the last three groups) and women who have some college or are college graduates exactly (the same as the previous estimates, but excluding women with graduate education) are shown in Appendix Fig. 6. As expected, fertility is decreasing in education.¹⁴

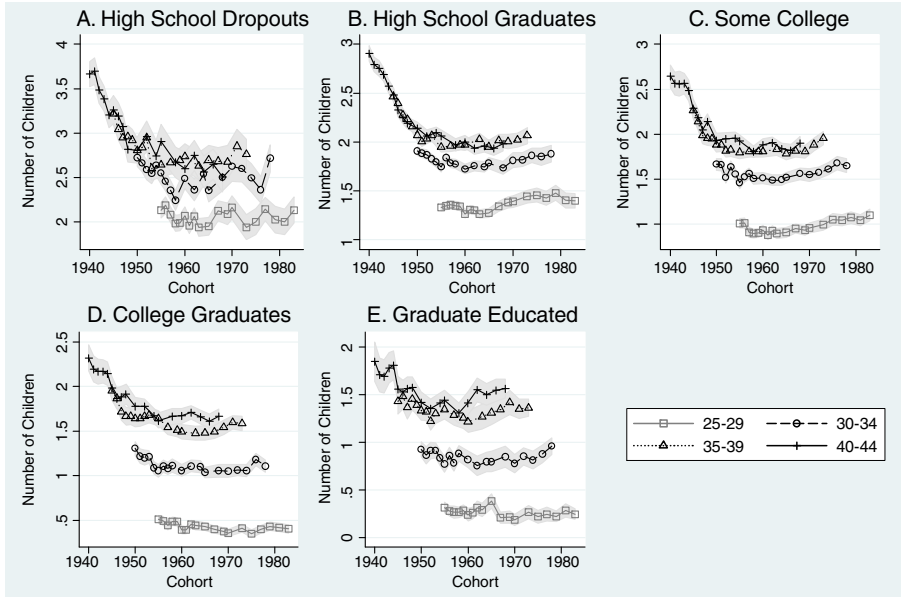
If there are trends in childbearing among high school dropout women after the 1960 cohort, they are too small to infer with confidence. At the other education levels, there is a clear pattern. Specifically, at lower education levels, increases in childbearing started earlier—in the early 1990s, versus the late 90s or early 2000s for college women. The increases among less-educated women are also greatest at young ages, with little increase in completed fertility. Among high school graduate women, for instance, cumulative fertility increases by roughly 0.2 children at ages 25–29 between the early 1960s cohorts and early 1970s cohorts before flattening out. By ages 30–34, the increase is present, but smaller. Trends at older ages are hard to infer (in part because we cannot observe completed fertility for cohorts born after 1970).

For women with graduate education, cumulative fertility is essentially flat among 25–29-year-olds in recent years. It increases somewhat among 30–34-year-olds and considerably more among older women. The trend toward more childbearing also begins in earlier cohorts among older women.

The results for women with some college and women who are exactly college graduates lie between these polar cases. For women who are college graduates exactly, there are no discernable trends in cumulative fertility at ages 25–29 or 30–34, but there are increases at older ages. Among women with some college (but who did not complete), cumulative fertility increases at all ages, with the increase starting earlier at younger ages.

¹⁴Looking after 1995 among women in their early 40s cumulative fertility among high school dropout women is above 2.5; for high school graduate women, it is around 2; for women with some college, it is close 1.9; for college graduate women, it is around 1.66; and for graduate-educated women it is around 1.5.

a. Cumulative Fertility



b. Childlessness

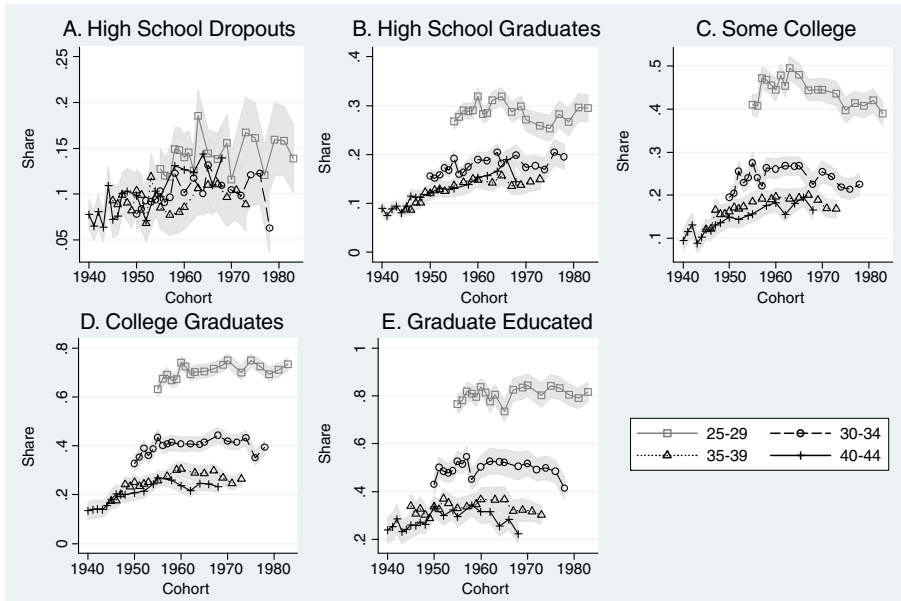


Fig. 3 Cumulative fertility and childlessness by education level, and age. **a.** Cumulative Fertility. **b.** Childlessness. Estimates and associated 95 % confidence intervals for college graduate women from the June CPS using data for 1980–88, 1990, 1992, 1994, 1995, and semiannual data for 1998–2008. Estimates shown for 5-year birth cohorts, with the cohort shown giving the birth year of the youngest members of each cohort

Figure 3b reports estimates for childlessness. While the estimates for high school dropouts and high school graduates are noisy, estimates for the other groups are broadly similar to those above. Specifically, among women with some college, there is a clear trend toward lower childlessness among women between 25 and 29 that starts after the cohorts born in the mid-1960s, but a smaller decline in childlessness that starts in later cohorts for older women. By contrast, among college graduate women and women with graduate education there is no trend toward lower childlessness (and perhaps a trend toward higher childlessness) at younger ages, but some trend toward lower childlessness at older ages.

Thus our results indicate that the timing of fertility over the life changes for highly educated and less-educated women, but in different ways and with different consequences for completed fertility. Among less-educated women, there is a clear and long-term trend toward increasing fertility at early ages, but little increase in completed fertility. Thus, the changes are mainly about the timing of births. Among highly educated women born after the late 1950s childbearing increased compared to the cohorts that precede them immediately. It is still too early to say how completed fertility will change for the cohorts born after 1970 but, if existing trends are any indication, there may be substantial increases in completed fertility.

As indicated, there has been an increase in the number of women completing college. If the marginal women to complete college have more children regardless of the amount of education they receive, the increase in childbearing among college graduate (and higher) women may be driven by the increase in the share of women completing college. One way to probe this possibility is to pool women with some college with those who completed college including or excluding those with graduate education. Appendix Fig. 6 shows these results. It shows an increase in childbearing at all ages in recent years, with a long-standing, gradual increase among younger women.

Another way to gauge the importance of changes in the composition of college graduates is to look at the timing of the increase in childbearing among college graduate women. Women with some college tend to have children earlier in their lives than college graduate women.¹⁵ If the increase in childbearing among college graduate (plus) women is driven by women who would have stopped with some college going on to complete college and if college does not have a large causal effect on fertility by age 29, it would be natural to expect childbearing to increase at younger ages more than at older ages. Figures 1, 2 and 3 show the opposite pattern, providing an indication that changes in the composition of college graduates are not the primary force driving the increase in their cumulative fertility.

¹⁵ Averaging across all years, women with some college have 0.97 children by 25–29; 1.56 children by 30–34; 1.89 by 35–39; and 2.13 by 40–44. By contrast, college graduate plus women have 0.38 children by 25–29; 1.03 by 30–34; 1.52 by 35–39; and 1.74 by 40–44. Thus, the gap closes from 0.59 children at 25–29; to 0.53 at 30–35; to 0.47 at 35–39; and 0.39 at 40–44.

3.4 Regression estimates

The composition of college graduates has changed considerably over time, with the share of women who are non-Hispanic, and white declining and a greater share of college graduates obtaining additional education. Insofar as fertility patterns vary across demographic groups, changes in immigration or in the racial or ethnic composition of college graduate women are likely to affect our estimated trends toward increased childbearing. To study the extent to which the increase in childbearing shown above is due to changes in the composition of college graduates, and to probe the statistical significance of our estimates, Tables 1 and 2 report regression-based estimates. Here, we switch from birth year-based estimates to year-based estimates to simplify the tables. The first year reported for each age group still correspond to the first birth cohort for the CPS results in Figs. 1 and 2 with each successive year corresponding to the successive points in the figures. The models are

$$\text{Table 1 : } \text{Childless}_{it} = X_{it}\beta + \text{Year}_t\Gamma + \varepsilon_{it}. \quad (1)$$

$$\text{Table 2 : } \text{Cumulative Fertility}_{it} = X_{it}\beta + \text{Year}_t\Gamma + u_{it}. \quad (2)$$

Here Childless_{it} indicates if woman i in year t is childless; $\text{Cumulative Fertility}_{it}$ denotes cumulative fertility for woman i in year t (i.e. the number of children she has had); X_{it} denotes the characteristics of woman i in year t ; and Year_t denotes a set of year dummy variables that give the time trends that are of interest. The omitted year in all the estimates is 1995. The characteristics include dummy variables for schooling (to capture variations in schooling among college graduates) and dummy variables for individual years of age (within the age groups), race (black or other), and Hispanic background.¹⁶ Thus, we explicitly model age effects and year effects. To account for possible birth year effects and for the fact that our main estimates pool data for 5-year age groups, with women born in a given birth year appearing in the same model up to 5 times, we cluster our standard errors by birth year.

The first column of both tables reports time trends, the estimated coefficients on the year dummy variables, for all women between ages 25 and 44. They show an increase in childlessness and a decrease in cumulative fertility between 1980 and 1995 and then a decrease in childlessness and an increase in cumulative fertility in the following years. The increase in childbearing is large and statistically significant, building over time. The remaining columns report separate estimates for the 4 age groups. They all show an increase in childlessness and a decrease in cumulative fertility until around 1995 and then a reversal. For women ages 25–29 childlessness peaks (cumulative fertility

¹⁶We do not control for marital status because it might be endogenous, but include it below. We do not control for immigration status because the data is not available for earlier years.

Table 1 Childlessness among college graduate women

Year	(1) Ages 25–44	(2) Ages 25–29	(3) Ages 30–34	(4) Ages 35–39	(5) Ages 40–44
1980	−0.093 ^a (0.012)	−0.102 ^a (0.010)	−0.084 ^a (0.025)	−0.085 ^a (0.024)	−0.100 ^a (0.026)
1981	−0.067 ^a (0.012)	−0.066 ^a (0.008)	−0.036 (0.027)	−0.096 ^a (0.023)	−0.088 ^a (0.025)
1982	−0.049 ^a (0.011)	−0.042 ^a (0.015)	−0.020 (0.028)	−0.076 ^a (0.024)	−0.076 ^a (0.021)
1983	−0.064 ^a (0.012)	−0.067 ^a (0.007)	−0.042 (0.032)	−0.061 ^a (0.020)	−0.100 ^a (0.021)
1984	−0.059 ^a (0.011)	−0.065 ^a (0.016)	−0.019 (0.023)	−0.075 ^a (0.020)	−0.090 ^a (0.026)
1985	−0.014 (0.011)	−0.011 (0.018)	0.023 (0.027)	−0.034 ^c (0.020)	−0.055 ^b (0.024)
1986	−0.029 ^b (0.011)	−0.020 (0.015)	−0.002 (0.025)	−0.054 ^b (0.022)	−0.049 ^c (0.26)
1987	−0.029 ^b (0.011)	−0.057 ^a (0.014)	0.010 (0.025)	−0.034 ^b (0.016)	−0.039 (0.024)
1988	−0.035 ^a (0.011)	−0.045 ^a (0.012)	−0.020 (0.026)	−0.035 (0.022)	−0.043 (0.026)
1990	−0.027 ^b (0.011)	−0.059 ^a (0.011)	−0.001 (0.026)	−0.035 ^b (0.014)	−0.014 (0.022)
1992	−0.023 ^b (0.009)	−0.035 ^b (0.016)	−0.003 (0.021)	−0.028 ^b (0.013)	−0.033 (0.019)
1994	−0.005 (0.007)	−0.015 (0.014)	−0.004 (0.018)	−0.003 (0.015)	−0.003 (0.015)
1995 (Excluded)	0	0	0	0	0
1998	−0.005 (0.009)	−0.052 ^a (0.013)	0.018 (0.023)	−0.006 (0.016)	0.014 (0.019)
2000	−0.003 (0.010)	0.002 (0.010)	0.003 (0.022)	−0.008 (0.015)	−0.011 (0.023)
2002	−0.016 (0.013)	−0.026 ^c (0.013)	−0.008 (0.030)	−0.017 (0.014)	−0.021 (0.024)
2004	−0.023 ^b (0.010)	−0.052 ^a (0.011)	0.013 (0.021)	−0.038 ^b (0.016)	−0.020 (0.020)
2006	−0.038 ^a (0.011)	−0.043 ^a (0.013)	−0.054 ^b (0.022)	−0.050 ^a (0.014)	−0.007 (0.021)
2008	−0.037 ^a (0.011)	−0.021 ^a (0.007)	−0.044 ^c (0.026)	−0.048 ^a (0.013)	−0.039 (0.025)
Observations	95303	24841	26195	23891	20376
R-squared	0.170	0.065	0.029	0.015	0.013

Estimates control for schooling (among college-graduates) and dummy variables for years of age (within categories) race (black or other), and Hispanic background. To account for the fact that each age group includes women born in the same birth year in multiple years and that we do not formally model birth year effects, we cluster our estimates by birth year

^a1% statistical significance

^b5% statistical significance

^c10% statistical significance

troughs) in 1995, implying a low point of childbearing among the 1966–1970 cohort. For women between 40–44 childlessness peaks (cumulative fertility troughs) in 1998, implying a low point of childbearing among the 1954–1958

Table 2 Cumulative fertility for college graduate women

Year	(1) Ages 25–44	(2) Ages 25–29	(3) Ages 30–34	(4) Ages 35–39	(5) Ages 40–44
1980	0.269 ^a (0.036)	0.137 ^a (0.020)	0.212 ^a (0.056)	0.333 ^a (0.048)	0.576 ^a (0.105)
1981	0.212 ^a (0.033)	0.110 ^a (0.016)	0.118 ^c (0.059)	0.306 ^a (0.060)	0.448 ^a (0.088)
1982	0.169 ^a (0.031)	0.067 ^a (0.020)	0.128 ^b (0.062)	0.181 ^a (0.045)	0.412 ^a (0.062)
1983	0.191 ^a (0.032)	0.110 ^a (0.013)	0.143 ^b (0.068)	0.167 ^a (0.034)	0.432 ^a (0.056)
1984	0.158 ^a (0.031)	0.109 ^a (0.033)	0.033 (0.052)	0.157 ^a (0.036)	0.448 ^a (0.048)
1985	0.076 ^a (0.025)	0.040 (0.035)	−0.007 (0.052)	0.098 ^a (0.033)	0.230 ^a (0.062)
1986	0.084 ^a (0.025)	0.032 (0.026)	0.051 (0.049)	0.112 (0.067)	0.160 ^a (0.046)
1987	0.091 ^a (0.024)	0.100 ^a (0.021)	0.018 (0.049)	0.090 ^b (0.038)	0.172 ^a (0.055)
1988	0.117 ^a (0.026)	0.088 ^a (0.018)	0.071 (0.058)	0.127 ^b (0.055)	0.193 ^b (0.086)
1990	0.076 ^a (0.026)	0.103 ^a (0.021)	0.008 (0.054)	0.120 ^a (0.027)	0.075 (0.045)
1992	0.052 ^b (0.022)	0.042 ^c (0.024)	0.048 (0.050)	0.052 ^b (0.022)	0.073 (0.058)
1994	0.025 ^c (0.015)	0.019 (0.021)	0.045 (0.032)	0.019 (0.039)	0.023 (0.029)
1995 (Excluded)	0	0	0	0	0
1998	0.017 (0.024)	0.064 ^b (0.024)	0.036 (0.062)	−0.006 (0.035)	−0.024 (0.051)
2000	0.012 (0.019)	−0.002 (0.022)	0.013 (0.045)	0.016 (0.019)	0.017 (0.053)
2002	0.052 ^c (0.030)	0.052 ^b (0.025)	0.042 (0.061)	0.045 (0.040)	0.073 (0.065)
2004	0.053 ^c (0.027)	0.064 ^b (0.025)	0.009 (0.047)	0.110 ^b (0.048)	0.035 (0.060)
2006	0.081 ^a (0.027)	0.071 ^a (0.021)	0.142 ^a (0.047)	0.120 ^a (0.033)	−0.008 (0.042)
2008	0.089 ^a (0.023)	0.054 ^a (0.013)	0.106 ^b (0.051)	0.128 ^a (0.033)	0.066 (0.070)
Observations	95303	24841	26195	23891	20376
R-squared	0.196	0.066	0.045	0.025	0.025

Estimates control for schooling (among college-graduates) and dummy variables for years of age (within categories) race (black or other), and Hispanic background. To account for the fact that each age group includes women born in the same birth year in multiple years and that we do not formally model birth year effects, we cluster our estimates by birth year

^a1% statistical significance

^b5% statistical significance

^c10% statistical significance

cohort. These peaks (troughs) coincide with the maxima (minima) in Fig. 1 (Fig. 2). In the figures the birth year at which fertility peaks (troughs) increase by roughly 5 years as one moves to older age groups, which corresponds to

a peak (tough) in roughly the same calendar year. The trends are statistically significant for all groups except the 40–44 group (the estimates for 40–44-year-olds are not significant because cumulative fertility among 40–44-year-olds reaches its lowest point in 1998. When 1998 is the excluded year, the estimate for 2008 is statistically significant at the 10 % level).

Thus, changes in the racial and ethnic composition of college graduate women do not drive the estimated increase in childbearing, in part because even in 2008, 73.7 % of college graduate women aged 25–44 were non-Hispanic whites and 68.9 % are native-born, non-Hispanic, whites. The estimated increase in childbearing is also strongly statistically significant. Of course, changes in the distribution of unobservable characteristics of college graduate women may play a role in the increase in their fertility.

4 Fertility treatments and childlessness

Fertility treatments have been estimated to account for 6–7 % of babies born in 2005 (Schieve et al. 2009). The real cost of fertility treatments may have fallen due to technological improvements, increased access, or greater insurance coverage.¹⁷ If so, at least some of the increase in fertility among highly educated women may be due to the reduction in the real cost of fertility treatments. Under the admittedly extreme assumption that all fertility treatments are due to reductions in real costs, this section provides rough estimates of the impact of fertility treatments on childlessness among college graduate women (note that if there has not been a reduction in the real cost of fertility treatments, then the increase in fertility treatments is direct evidence of an increase in demand for children).

Fertility treatments are associated with high rates of plural births (Reynolds et al. 2003). Martin et al. (2007) write, “ART (Assisted Reproductive Technology) therapies alone are estimated to account for 17 percent of all twins and 40 percent of triplets born in 2004.” We use trends in the share of babies born to college-graduate women that are plural births to estimate the impact of fertility treatments on childlessness.

Figure 4 plots the share of children born to college graduate women who were born in a plural birth.¹⁸ The rate of plural births increased dramatically over time. And while it increases among all age groups, the increase is substan-

¹⁷California required health insurance plans to cover fertility treatments other than in vitro fertilization in steps in 1989 and 1990; New York took similar steps in 1990, which were expanded in 2002; Texas includes coverage for in vitro fertilization in laws enacted in 1987 and 2003; and Illinois passed laws requiring health plans that provide pregnancy benefits to cover infertility treatments including in vitro fertilization in 1991 and 1996. Among the five largest states, only Florida does not mandate benefits for fertility treatments (see <http://www.ncsl.org/default.aspx?tabid=14391>).

¹⁸These estimates are weighted by children, so each child in a set of twins, triplets, etc. is counted separately. Implicitly, higher-order plural births receive more weight.

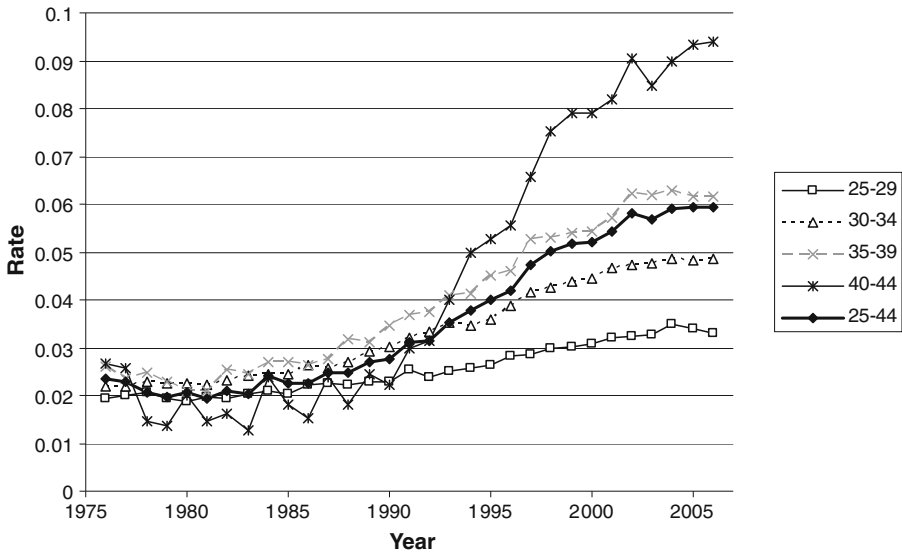


Fig. 4 Plural birth rates for college graduate women, by age and year. Estimates from the Vital Statistics. The estimates are the share of children born in plural births. These results are based on the 46 states (excluding California, New Mexico, Texas and Washington State) for which education data are available in all years

tially larger for older women.¹⁹ In the late 1970s, the plural birth rate was only slightly higher for older women than younger women, which is consistent with physiological evidence that older women are more likely than younger women to have multiple births. As plural birth rates begin to increase around 1990, they also spread apart. From 1976 to 2006, the plural birth rate increased by slightly more than 50 % (from 2 % to just over 3 %) among college women aged 25 to 29, but among college-graduate women in their early 40s, the plural birth rate more than triples (from under 3 % to over 9 %). The increase in plural births and the spreading out coincide with the expansion of coverage for fertility treatments and have influenced the implementation of fertility treatments.²⁰

To infer the impact of fertility treatment on childlessness, we use a simple accounting model. Let π^{FT} be the share of first births to mothers using fertility treatment that are plural births. Let π_a^{NT} be the share of first births to age a mothers who are not using fertility treatment that are plural births (our data permit us to allow π_a^{NT} to vary by age, but not π^{FT}). Let f_{at}^{FT} (and f_{at}^{NT}) be the

¹⁹Plural birth rates initially decline among 40–44 year old women, but reverse dramatically in subsequent years. Race, obesity, and maternal age have all been linked to plural birth rates and changes in the race or age distribution of mothers or in their obesity rates may account for the initial decline.

²⁰See footnote 17. It is also noteworthy that the American Society of Reproductive Medicine introduced recommendations in the late 1990s, which were revised in 2004 and 2006, to prevent higher-order multiple gestations.

number of first births with (and without) fertility treatment to age a women at time t and S_{at} and P_{at} be the number of single and plural first births to age a women at time t . By definition,

$$P_{at} = \pi^{FT} f_{at}^{FT} + \pi_a^{NT} f_{at}^{NT} \quad (3)$$

and

$$S_{at} = (1 - \pi^{FT}) f_{at}^{FT} + (1 - \pi_a^{NT}) f_{at}^{NT}. \quad (4)$$

We estimate f_{at}^{FT} and f_{at}^{NT} using the available data on S_{at} and P_{at} and use other information to calibrate π^{FT} and π_a^{NT} .

Fertility treatments are divided into two categories. In assisted reproductive technologies (ART) such as *in vitro* fertilization, the eggs and sperm are handled in the laboratory. These treatments began in the United States in 1981. Non-ART therapies such as ovulation-inducing drugs and artificial insemination have been available in the United States since 1967 with FDA approval of Clomiphene. The Centers for Disease Control and Prevention (CDC) collect data on the use of ART (but not by the education of the mother). There are no systematic data on non-ART fertility treatments.

We calibrate our model in three ways intended to span the range of plausible parameters. One scenario is intended to roughly capture the case where fertility treatment corresponds only to ART. In this case, we set π^{FT} to 0.326, the average multiple birth delivery rate among all deliveries using ART in 2000 to 2006 reported in Assisted Reproductive Technology Surveillance by the Centers for Disease Control and Prevention (CDC).²¹ A second scenario is calibrated so that fertility treatments correspond only to non-ART fertility treatments. Here we set π^{FT} to 0.180 which is drawn from Schieve et al. (2009). The last scenario is calibrated so that fertility treatments are a weighted average of ART and non-ART fertility treatments. In this we set π^{FT} to 0.209.²² This parameter is considerably closer to the non-ART case because non-ART treatments represent the vast majority of fertility treatments.

In all cases, we set π_a^{NT} as the average plural birth rate of age a college women using data from 1976–1980. Non-ART fertility treatments were in use prior to 1981, but plural birth rates in the 1976–1980 period are quite similar to 1971 and earlier years, when most plural births were born without fertility treatments (Schieve et al. 2009).²³ To estimate the prevalence of fertility treatments, we solve this system for the total number of first births without treatment in each year, f_{at}^{NT} .

²¹The multiple birth delivery rate is not reported by education groups.

²²To obtain the estimate 0.209, we take a weighted average of the plural birth rates for women using ART and non-ART fertility treatments. Schieve et al. (2009) estimate that roughly four-fifths of births using either ART or non-ART treatments are born with non-ART treatments. From their numbers it is possible to estimate a plural birth rate of 18.0 % for women using non-ART fertility treatments. We calculate $0.326 \times 20\% + 0.180 \times 80\% = 0.209$.

²³Although there were fluctuations in plural birth rates before 1971, Hoekstra et al. (2008) conclude that changes in the age distribution of women giving birth were a major determinant of these fluctuations.

Our procedure makes a number of significant assumptions. For instance, we rely on outside sources and an approximation to obtain π^{FT} . Nor is π_a^{NT} estimated exactly. Moreover, the baseline data we use to estimate π_a^{NT} contains at least some amount of non-ART fertility treatments. We assume that π^{FT} does not vary by age or change over time. The first of our three scenarios implicitly assumes that there are no increases in the use of non-ART fertility treatments. The second scenario, assumes that there are no increases in ART. The last scenario assumes that the ratio of women using non-ART treatments relative to ART treatments is constant among women using either form of treatment. There are also three sets of assumptions that likely overstate the effect of reductions in the effective cost of fertility treatments on fertility. As discussed, we implicitly assume that the entire increase in fertility treatments is due to reductions in their real cost. We assume that women who have a first birth with a fertility treatment would not have had a baby without fertility treatment at some later point. Lastly, we ignore any behavioral responses (e.g., that some women who could and would have had babies without fertility treatment delay, even marginally, when they have a baby because of the option value of using

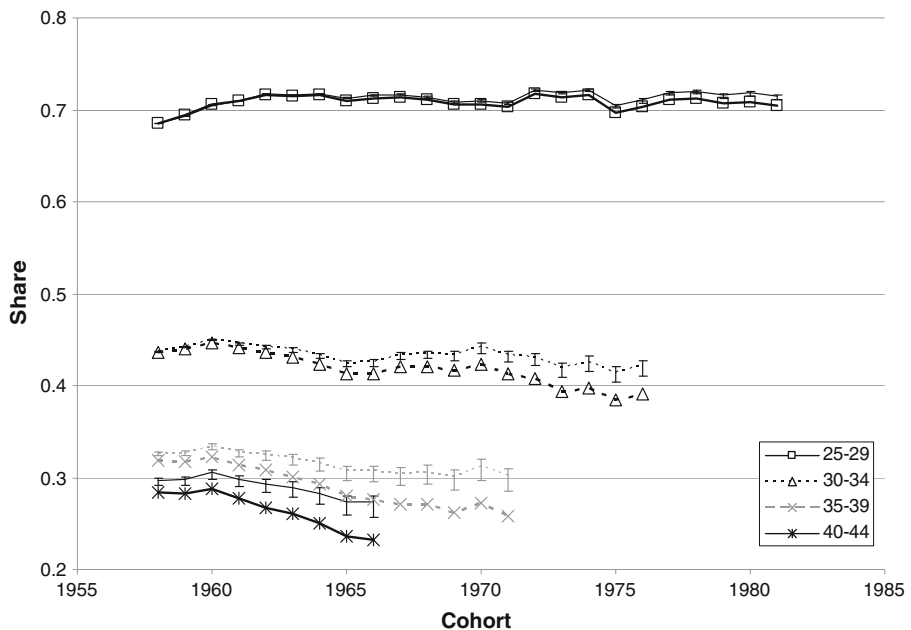


Fig. 5 Childlessness among college graduate women with adjustments for fertility treatments, by birth cohort and age. Estimates for college graduate women from the June CPS using data for 1980–88, 1990, 1992, 1994, 1995, and semiannual data for 1998–2008. Estimates shown for 5-year birth cohorts, with the cohort shown giving the birth year of the youngest members of each cohort. Also shown are a range of estimates of childlessness in the absence of fertility treatments for each of the four age groups. The imputed effects of fertility treatments are based on the plural birth rates shown here and varying assumptions about the plural birth rates for different types of fertility treatments described in the text

a fertility treatment and ultimately use fertility treatments as in Rainer et al. (2011). Given these sources of slippage, these estimates should only be taken as rough approximations, with the largest estimates of fertility treatments (those based on non-ART) almost surely overstating the effect of fertility treatments on fertility.

The estimates are presented in Fig. 5, which shows that fertility treatments likely played a meaningful role in reducing childlessness, especially at older ages. By construction, the implied effect of fertility treatments is larger when the non-ART treatments are included as treatments—with a lower rate of plural births under non-ART fertility treatments, the increase in plural birth rates can only be matched with a larger increase in fertility treatments. It is likely that reductions in the real cost of fertility treatments contributed to the decline in childlessness among college-graduate women. And although they hinge on many assumptions, even the estimates based on non-ART, which are likely to be very conservative, indicate that in the absence of fertility treatments, childlessness is likely to have declined among college graduate women.

5 Decomposing changes in fertility

This section decomposes the increase in college graduate women's cumulative fertility from its trough in 1995 to 2008 into four components:

1. Changes in cumulative fertility along the extensive margin, which we identify as the change in cumulative fertility generated by women who are at the margin to have children, versus changes in cumulative fertility along the intensive margin, which we identify as the change in cumulative fertility among women who are inframarginal to have children.
2. For each of these components we estimate the portion of the change in cumulative fertility due to changes in behaviors conditional on observable characteristics and changes in observable characteristics

Thus, we generate a 2×2 decomposition.

We use a Type II Tobit model to estimate the probability that women would have had children and the number of children conditional on having had any children in both years. It is important to bear in mind that while the model allows us to distinguish between changes along the intensive and extensive margins, it does not address endogeneity of the regressors.

Let $D_t(x_i) = 1$ iff woman i with characteristics x_i has had at least one child by year t . We assume selection into having any children is given by $\Pr[D_t(x_i) = 1] = \Pr[\gamma_t x_i + u_i > 0] = \Phi(\gamma_t x_i)$, where γ_t denotes a set of coefficients at time t and u_i denotes a standard normally distributed error. As is standard, conditional on having had a child by t , $E[n_{it}|x_i, t, D_t(x) = 1] = x_i \beta_t + E[\varepsilon_{it}|x_i, t, D_t(x_i) = 1]$, where the expectation over ε_{it} can be expressed using the inverse Mills ratio from the selection equation.

To separate changes along the intensive and extensive margins, we estimate the probability that a woman with a given set of observable characteristics will

fall into each of four groups: always have children ($D_0(x_i) = 1$ and $D_1(x_i) = 1$); would have children in time 0, but not in time 1 ($D_0(x_i) = 1$ and $D_1(x_i) = 0$); would have children in time 1, but not in time 0 ($D_0(x_i) = 0$ and $D_1(x_i) = 1$); and never have children ($D_0(x_i) = 0$ and $D_1(x_i) = 0$). The selection models estimated for each year (1995 and 2008) imply the truncation of u_i and hence $E[\varepsilon_{it}|x_i, t, D_0(x_i), D_1(x_i)]$ for each woman and given our estimates of β_t , we predict the expected number of children each woman would have conditional on having at least 1 child for both 1995 and 2008.²⁴ In estimating fertility in the year that a woman is not in the sample (i.e., in 1995 for women in the sample in 2008), we apply the coefficients from the year for which we are making the imputation, but do not adjust time-varying characteristics like age. In this way, we estimate how fertility for a population with a given set of characteristics would change over time as behaviors change.

We then construct

$$\begin{aligned}
 & E[n|t = 1] - E[n|t = 0] \\
 &= \int_X \left\{ \begin{array}{l} \Pr[D_0(x) = 1, D_1(x) = 1|x] \\ (E[n|x, t = 1, D_0(x) = 1, D_1(x) = 1] \\ - E[n|x, t = 0, D_0(x) = 1, D_1(x) = 1]) \\ + \Pr[D_0(x) = 0, D_1(x) = 1|x] \\ (E[n|x, t = 1, D_0(x) = 0, D_1(x) = 1] - 0) \\ + \Pr[D_0(x) = 1, D_1(x) = 0|x] \\ (0 - E[n|x, t = 0, D_0(x) = 1, D_1(x) = 0]) \end{array} \right\} f_0(x)dx \\
 &+ \int_X \left\{ \begin{array}{l} \Pr[D_0(x) = 1, D_1(x) = 1|x] \\ E[n|x, t = 1, D_0(x) = 1, D_1(x) = 1] \\ + \Pr[D_0(x) = 0, D_1(x) = 1|x] \\ E[n|x, t = 1, D_0(x) = 0, D_1(x) = 1] \\ + \Pr[D_0(x) = 1, D_1(x) = 0|x]0 \end{array} \right\} (f_1(x) - f_0(x))dx \tag{5}
 \end{aligned}$$

The first term in the first integral represents changes in fertility for women who are inframarginal to have children in the sense that they would have children in both years. This term captures changes in fertility along the intensive margin. We integrate over the time 0 distribution of characteristics to conditional on observable characteristics. The second two terms in the first integral represent women who switch from not having a child in year 0 to having a child in year 1 and vice versa. In this sense, it captures changes in fertility along the extensive margin. Again, we integrate over the time 0 distribution of characteristics to maintain a fixed distribution of characteristics. The second integral reflects the effects of changes in the entire distribution of characteristics (where we use fertility patterns at time 1 to impute how women will behave conditional on their characteristics to ensure that the cross-year terms in the first integral cancel).

²⁴For instance, $D_0(x_i) = 1, D_1(x_i) = 1$ iff $u_i > \max\{-\gamma_0x_i, -\gamma_1x_i\}$; $D_0(x_i) = 0, D_1(x_i) = 1$ iff $-\gamma_0x_i < u_i \leq -\gamma_1x_i$; $D_0(x_i) = 1, D_1(x_i) = 0$ iff $-\gamma_1x_i < u_i \leq -\gamma_0x_i$; and $D_0(x_i) = 0, D_1(x_i) = 0$ otherwise.

The results of this decomposition are shown in Table 3. Panel a show means for 1995 and 2008 and the third row shows the change between the two years. Cumulative fertility increases by 0.068 children between 1995 and 2008, with the share childless falling by 3.3 %. Fertility conditional on having had at least one child increases very slightly, by 0.008 children. Panel b reports estimates from our model. The model fits the data well, matching the sample means of the three variables closely in both years.

Panel c shows results from our decomposition. We have ordered the columns so that they correspond to the extensive and intensive margins above. It is important to note that in the second and third columns, panels a and b report the share of women with children and fertility conditional on having any children, but in panel c these columns give the contribution to cumulative fertility of changes in the share of women with children and fertility conditional on having any children. The increase in the share of women having children would have increased cumulative fertility by 0.091 children, with the vast majority of this change being due to changes in behaviors conditional on

Table 3 Decomposition of changes in college graduate women's fertility

Panel a. Data			
Year	Cumulative fertility	Share of women with children	Fertility conditional on >0
1995	1.070	0.551	1.943
2008	1.138	0.583	1.951
Difference	0.068	0.033	0.008
Panel b. Estimates from model			
Year	Cumulative fertility	Share of women with children	Fertility conditional on >0
1995	1.068	0.550	1.941
2008	1.137	0.583	1.949
Difference	0.069	0.033	0.009
Panel c. Estimated change in cumulative fertility due to:			
	Total	Extensive margin	Intensive margin
Changes in Joint Distribution of all Xs	-0.040	0.006	-0.045
Changes in Behaviors	0.109	0.085	0.023
Total	0.069	0.091	-0.022

Estimates from the 1995 and 2008 June CPS Fertility Supplements. Panel a reports tabulations of the data. Panel b reports estimates from the Type II Tobit model in the text. Estimates in Panel c are based on the model in Eq. 5 and show the predicted change in fertility along the intensive and extensive margins. Changes in fertility along the extensive margin capture the change in cumulative fertility generated by women who would not have had children in 1995 but who would have had children in 2008 (less the reverse). This expression is based on the product of the probability that women would switch and the expected number of children they will have conditional on having any children. The third column shows the change in cumulative fertility along the intensive margin, which captures the change in cumulative fertility among women who would have had children in both years. This term depends on the share of women predicted to have a child in both years and the change in fertility among women predicted to have a child. The first column gives the sum of the second and third columns

observable characteristics and not due to changes in characteristics. Changes in fertility among women who were inframarginal to have children decreased cumulative fertility by a 0.022 children, with the decrease entirely due to changes in observable characteristics. Taken as a whole, cumulative fertility primarily increased because the share of women having children increased conditional on their characteristics and not because of changes in women's characteristics or increases in fertility among women who have children. In fact, changes in the joint distribution of all characteristics would have reduced cumulative fertility and fertility decreased along the intensive margin.²⁵

This approach gives the effect of changes in the joint distribution over x between the years, but does not allow us to partial out the effect of changes in particular dimensions of x . To do that, we start from the expected fertility in a given year,

$$E[n|t] = \Pr[D_t = 1]E[n|t, D_t = 1] \quad (6)$$

We estimate the change in the expected number of children from changing the j th dimension of x from its mean at $t = 0$ to its mean at $t = 1$ using

$$\frac{dE[n|t]}{dx_j} = \frac{d\Pr[D_t = 1]}{dx_j} E[n|t, D_t = 1] + \Pr[D_t = 1] \frac{dE[n|t, D_t = 1]}{dx_j} \quad (7)$$

Here $\frac{d\Pr[D_t=1]}{dx_j} = \gamma_{ij}\phi(\gamma_t E[x|t])$.²⁶

Table 4 implements this decomposition, showing the change in cumulative fertility due to changes in specific characteristics along both the intensive and extensive margin. Panel a shows the change in the mean of each characteristic. As discussed, college graduate women are increasingly diverse. They are increasingly obtaining more schooling (i.e., beyond their bachelor's degrees), they are becoming somewhat younger, and are less likely to be married.²⁷

²⁵The increase in fertility conditional on having children in the raw data can be reconciled with the decrease in fertility along the intensive margin implied by the model if the marginal women to have children have somewhat more children than the inframarginal women to have children.

²⁶As above, we define changes in cumulative fertility along the intensive margin to be those arising among women who are inframarginal to have children and changes along the extensive margin to be those arising among women who are marginal to have children. The definition here differs from that above because the previous approach explicitly accounts for finite changes between 1995 and 2008 whereas this approach uses a continuous approximation. Formally, in the first approach we define inframarginal women to be those for whom $D_0(x) = 1$ and $D_1(x) = 1$. In this approach, we define inframarginal women to be those for whom $D_t(x) = 1$ for $t = 0$ (or $t = 1$). For differential changes in β and γ the set for which these definitions differ (the set for which $D_0(x) \neq D_1(x)$) is measure zero. The fact that our first approach accounts for finite changes while the other uses a continuous approximation generates some difference in the two sets of estimates.

²⁷In a previous version, we show that most of this increase is among women in the 25–29 and 40–44 age groups and that the share of women who have never been married is fairly stable among women in their 30s since the late 1950s cohorts.

Table 4 Decomposition of changes in college graduate women's fertility due to changes in observable characteristics

A. Means of characteristics and changes							
Year	Black	Other	Hispanic	Schooling	Age	Never Married	Sum
1995	0.076	0.051	0.041	16.621	34.505	0.230	
2008	0.091	0.116	0.056	16.738	34.434	0.259	
Difference	0.015	0.065	0.015	0.118	-0.070	0.029	
B. Relationship between characteristics and fertility							
Marginal effect in probit for having any children (in 2008)	0.184 ^a	0.068 ^b	0.138 ^a	-0.022 ^b	0.027 ^a	-0.615 ^a	
Marginal effect in linear model for number of children conditional on having any children	0.047	-0.236 ^a	-0.073	-0.062 ^a	0.042 ^a	-0.454 ^a	
C. Decomposition of change in fertility due to changes in characteristics into intensive and extensive margins							
Extensive margin—change in cumulative fertility due to changes in the probability of having any children	0.005	0.009	0.004	-0.005	-0.004	-0.035	-0.026
Intensive margin—change in cumulative fertility due to changes in number of children conditional on having at least 1 child	0.000	-0.009	-0.001	-0.004	-0.002	-0.008	-0.023
Sum of effects of change in characteristic	0.006	0.000	0.003	-0.009	-0.005	-0.043	-0.049

Estimates from the 1995 and 2008 CPS Fertility Supplements. Panel a reports the means of each characteristic in 1995 and 2008 and their changes between the years. Panel b reports the marginal effect of changes in each characteristic in the Type II Tobit model. Panel c reports the change in cumulative fertility due to changes in each characteristic through the extensive and intensive margins based on Eq. 7

^a0.01 % statistical significance

^b1 % statistical significance

Panel b reports the (marginal) effects of changes in each characteristic on the probability of having any children and on cumulative fertility. These estimates should be interpreted carefully because of endogeneity—women who are particularly interested in developing careers relative to families may well go to school for longer and be less likely to marry. Bearing this caveat in mind, women who have more years of schooling and who have never been married are less likely to have children and, among those with children, have fewer children. Not surprisingly, older women are both more likely to have children and among those with children have more children.

Panel c shows how the observed change in each characteristic between 1995 and 2008 contributed to the change in cumulative fertility through both the extensive and intensive margins.²⁸ The increase in the share of women who were never married accounts for a reduction in cumulative fertility of 0.035 children along the extensive margin.²⁹ Increases in schooling account for a 0.005 child decrease along the extensive margin. By contrast, increases in the share of women who are black, other race, or Hispanic account for a 0.018 child increase in cumulative fertility along the extensive margin.

The next row shows how changes in each characteristic would affect cumulative fertility through changes along the intensive margin, that is, by changing the number of children that women have conditional on having any children. The increase in the share of women who were never married and the increase in years of schooling both work to reduce cumulative fertility along the intensive margin. The increases in the share of women who are black, other race, or Hispanic taken together, work to reduce cumulative fertility along the intensive margin, partially offsetting the increase they are associated with along the extensive margin.

The final row shows the effect of changes in each characteristic on cumulative fertility combining the effects on the intensive and extensive margins. Laying aside the causality issues discussed above, the 2.9 % increase in the share of women who have never been married accounts for a 0.043 decrease in cumulative fertility. The increase in schooling accounts for a further 0.009 reduction in cumulative fertility, while changes in racial and ethnic background (as a whole) account for a comparable increase in cumulative fertility.

All told, the entire increase in the share of women with children arose because of changes in behaviors conditional on characteristics and along the extensive margin. These increases happened despite a small reduction in fertility along the intensive margin and despite changes in observable characteristics

²⁸When each characteristic is changed separately and the effects are summed, the implied change somewhat exceeds the effect of changing the entire distribution. This difference is due to the covariance in characteristics in the population and to the fact that we generate the marginal effects at the mean of each characteristic.

²⁹A previous version of this paper shows that the share of women who have had any children increases among both the never-married and ever-married groups, but the increase among ever-married women dominates the overall increase because the vast majority of college graduate women in their 30s and above have been married.

which would have tended to reduce cumulative fertility (most notably an increase in the share of women who have never been married and in the mean years of completed school).

6 Conclusion

This paper has provided a comprehensive study of college graduate women's fertility. Data from the CPS and Vital Statistics Birth Data both show that among college graduate women the cohort born in the late 1950s represents a turning point. While they have lower fertility than the cohorts that preceded them through their late 30s, their fertility then increases markedly, so that they have higher fertility than the previous cohorts by their early 40s. The cohorts that follow them continue this trend, having both higher completed fertility and higher fertility at earlier ages.

Our finding that highly educated women are increasingly choosing not to sacrifice their families for careers raises a number of questions that we leave to future work. At a factual level—when women opt for families, are they opting out of the labor market, as has been argued in the media, or are they (somehow) having both families and careers?

Our finding that women are increasingly opting for families also calls for explanations. One potential explanation is a learning story, whereby higher fertility is a reaction to previous generations of women who postponed fertility and ultimately had little opportunity to have families. Another explanation involves selection—as more women have gone to college, the average college graduate woman is likely to have become less career oriented. While we cannot rule out this explanation, our estimates suggest that selection does not drive our results.³⁰ A number of researchers have pointed to the growth in personal services in recent years (Mazzolari and Ragusa 2011; Autor and Dorn 2011; Cortes and Tessada 2011; Furtado and Hock 2010). An increase in the supply of personal services would reduce the price to women of having children, allowing women to shift the burden to the market. Alternatively, Feyrer et al. (2008) have argued that men may be taking more responsibility for child care. Lastly, the gender wage gap, which had been closing rapidly since the 1970s has since been constant, so the opportunity cost of women's time is no longer increasing relative to men's time, which may have lead to an increase in fertility.³¹

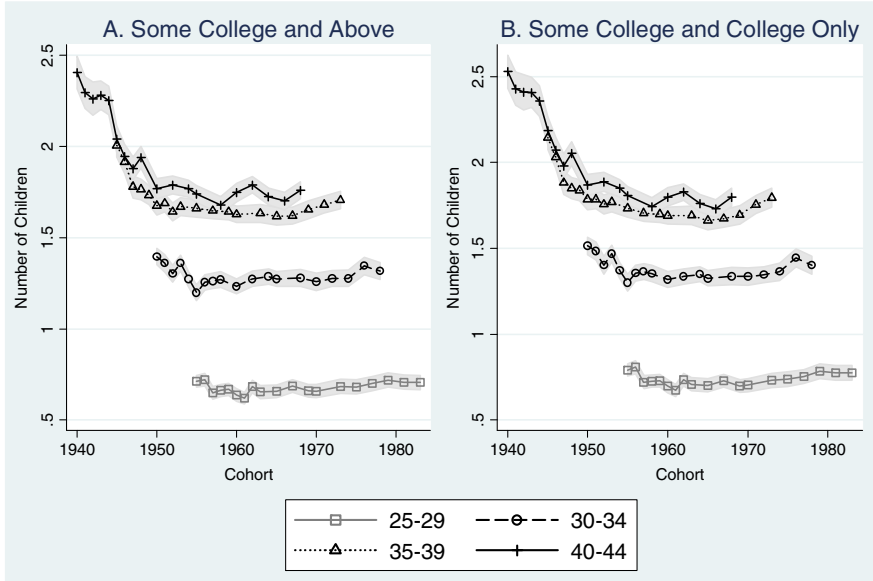
Appendix

Figure 6

³⁰Goldin (1997) casts doubt on selection as a primary explanation for earlier changes.

³¹Blau and Kahn (2006) find essentially no convergence in the gender pay gap at high quantiles during the 1990s.

a. Cumulative Fertility



b. Childlessness

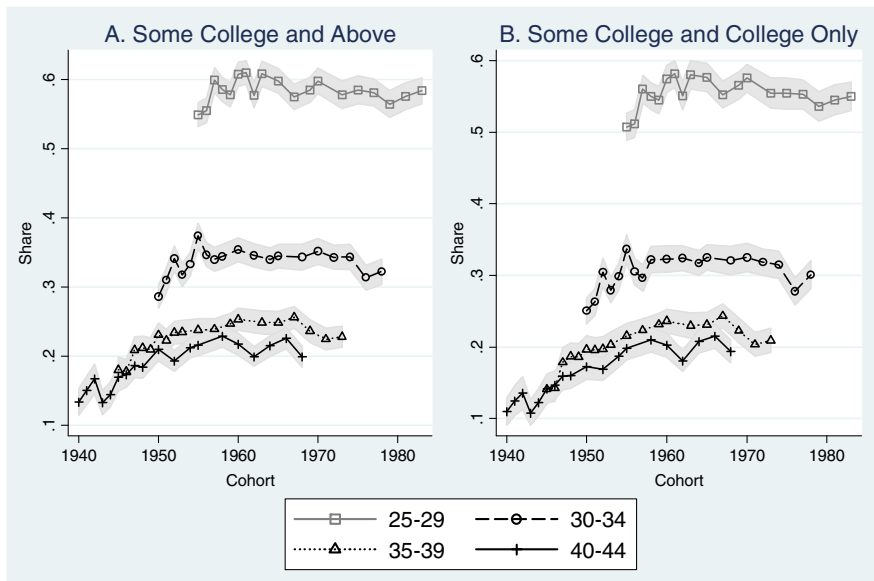


Fig. 6 Cumulative fertility and childlessness for alternative education groupings by age. **a.** Cumulative Fertility. **b.** Childlessness. Estimates and associated 95 % confidence intervals for college graduate women from the June CPS using data for 1980–88, 1990, 1992, 1994, 1995, and semiannual data for 1998–2008. Estimates shown for 5-year birth cohorts, with the cohort shown giving the birth year of the youngest members of each cohort

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