THE BABY BOOM AND EDUCATIONAL ATTAINMENT

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August 2019

Abstract: High school and college graduation rates abruptly stagnated among cohorts born in the late 1940s and early 1950s. Previous research has attributed some of this reversal in trends to an abnormally high college completion rate for men born in the 1940s due to the Vietnam War. We add a new explanation for the surprising changes in educational attainment among these cohorts — the baby boom. We use the Health and Retirement Survey to estimate birth order effects for the baby boom generation and combine our estimated coefficients with birth order data from Vital Statistics to show that changes in birth order can explain more than 20 percent of the decline in white male college graduation rates during the baby boom. Combining the effects of birth order and cohort size, the baby boom can explain more than a third of the decline in college completion of white men, and the collapse of the baby boom can explain more than half of the rebound among the 1960–1974 cohorts.

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I. Introduction

High school and college graduation rates abruptly stagnated among cohorts born in the late 1940s and early 1950s. This was a surprising reversal of trends, as high school attainment had doubled in the previous 30 years (Goldin and Katz, 2008) and college attainment had doubled in just 15 years (Acemoglu and Autor, 2012). But across cohorts born in the 1950s, high school graduation rates did not change, and college graduation rates fell. Educational attainment then resumed a more gradual rise among the 1960s birth cohorts.

This abrupt change in educational attainment was surprising given the high returns to education at the time, and had important consequences for individuals (e.g., lower income) and for society as a whole (e.g., increased inequality and slower economic growth). Previous research has attributed some of this reversal in trends to an abnormally high college completion rate for men born in the 1940s due to the Vietnam War (Angrist and Chen, 2011; Card and Lemieux, 2001b). However, the estimated effects of the war are much smaller than the decline in men's college graduation rates, and the abrupt halt to growth educational attainment remains largely unexplained (Goldin and Katz, 2008).

We add a new explanation for the surprising changes in educational attainment among these cohorts. During the baby boom that followed World War II, the distribution of birth order changed dramatically, with first and second births becoming less common, and a far higher percentage of children being third-born or later. Because later-born children tend to have lower average educational attainment (Black et al., 2005; Kantarevic and Mechoulan, 2006), this change in birth order would tend to decrease high school and college graduation rates. We use the Health and Retirement Survey to estimate birth order effects for the baby boom generation and combine our estimated coefficients with birth order data from Vital Statistics to show that changes in birth order can explain more than 20 percent of the decline in white male college graduation rates during the baby boom. We also revisit the literature on the effect of cohort size on educational attainment, and we find that controlling for changes in the composition of parents across birth cohorts reduces the estimated effects of cohort size. Combining the effects of birth order and cohort size, the baby boom can explain more than a third of the decline in college completion of white men, and the collapse of the baby boom can explain more than half of the rebound among the 1960–1974 cohorts. Birth order generally plays a larger role than cohort size.

The baby boom was a dramatic change in fertility patterns in the U.S. The fertility rate had been gradually declining for a century until the late 1940s (Jones and Tertilt, 2006), when it abruptly increased for nearly twenty years. Figure 1 shows white and nonwhite fertility rates in the United States from 1909 to 2000. The fertility rate suddenly increased for both whites and nonwhites after World War II, and peaked around 1960. This substantial reversal of long-term fertility trends was concurrent with major social changes, including increasing educational and labor market opportunities for a generation of young veterans, changing urbanization patterns, and sharply altered labor market prospects for women (Klein, 2005). Women married earlier and at higher rates, had more children, and spaced children closer together (Bailey and Collins, 2011). Fertility rates increased during this period across income levels, racial and ethnic groups, and geographic regions, as well as in both urban and rural areas (Jones and Tertilt, 2006).[1]

We use the Health and Retirement Survey to estimate the effect of birth order on educational attainment for the baby boom generation. We estimate family fixed effects regressions of high school or college attainment on birth order indicators and cohort fixed effects. We find that birth order effects can be large. For example, among whites, third-born children are 8 percentage points less likely than first-borns to graduate from college. These results echo a large literature on the link between birth order and education. Similar results have been found by Black et al. (2005) for Norway, Kantarevic and Mechoulan (2006) for the U.S. in the PSID, Booth and Kee (2009) for Britain, and

[1] There has been much debate about the cause of the baby boom. The traditional division in the literature was between Easterlin's "relative income hypothesis" and Becker's neoclassical approach. Recent work has explored a variety of potential causes of the baby boom. Greenwood, et al. (2005) create a structural model that shows that the diffusion of household technologies may have caused the baby boom by lowering the cost of having children. However, Bailey and Collins (2011) use county-level data on electricity and appliance ownership to show that the baby boom did not occur earlier in places that got electricity and adopted household appliances more quickly. Bellou and Cardia (2016) finds that the cohort of young married women who were 20–34 years old at the time of the 1929 Crash disproportionately entered and stayed in the labor market, potentially crowding out younger women and thereby lowering the cost of childbearing for these later cohorts. Zhao (2014) argues that increases in marginal tax rates after WWII decreased the cost of having children, particularly for wealthy households, contributing to the rise in fertility. Hill (2014) posits that the expansion of the housing supply after WWII lowered the cost of marriage and children, accounting for up to 10 percent of the baby boom.

Bagger et al. (2013) for Denmark.[2] While we are narrowly interested in educational attainment in this paper, birth order has been shown to have important effects on a number of other outcomes, including IQ (Black et al., 2011), health (Black et al., 2016), and earnings (Kantarevic and Mechoulan, 2006).[3]

We use Vital Statistics published tables and birth-level records to measure how the baby boom affected the distribution of birth order. Not surprisingly, the percentage of children who were first-born spiked at the beginning of the baby boom, followed by successive peaks in the percentage who were second-born, then third-born, and so on. These changes were large: children born third or later made up about 30 percent of birth cohorts in the late 1940s, but almost half of the 1960 birth cohort. We combine these changes in birth order with our estimated birth order effects and find that changes in birth order can explain more than 20 percent of the decline in college attainment among white men across the 1946–1960 birth cohorts, and more than one third of the increase in college attainment across the 1960–1974 birth cohorts.

We also use data from decennial censuses and the American Community Survey (ACS) to estimate the effect of cohort size on educational attainment. Many authors, including Card and Lemieux (2001a) and Bound and Turner (2007), have found that larger cohorts are associated with lower educational attainment in regressions that include state and cohort fixed effects. But the composition of parents may change as fertility rates change, so we go beyond these previous papers and control for state-by-cohort measures of parents' characteristics, including race, education, age, and income. We find that the inclusion of these controls substantially reduces the estimated effect of cohort size on college attainment for white men and white women, suggesting that some of the estimated cohort size effects in prior literature may be overstated.

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[2] De Haan et al (2014) is an outlier, finding that in Ecuador, later-born children have higher educational attainment. The authors attribute this to the fact that earlier-born children receive less quality time from their mothers, and note that the high rates of poverty and teenage pregnancy in Ecuador may be important in understanding these results.

[3] There is also a small literature on the sources of birth order effects. Price (2008) finds that parents devote equal quality time to each child at any given point in time and that parents decrease total quality time as their children get older, so that earlier-born children accumulate more quality time. Black et al (2011) find limited evidence that selection plays a role; parents may stop childbearing after having a particularly "poor quality" child. Hotz and Pantano (2015) find that parents are stricter with earlier-born children, potentially leading to better outcomes.

We use our estimates of birth order and cohort size effects to study the effect of the baby boom on changes in educational attainment. We split the baby boom generation into two phases: the dramatic increase in fertility covering the 1946–1960 cohorts, and the collapse of the boom across the 1960–1974 cohorts. We multiply our estimates of birth order and cohort size effects by the national changes in the birth order distribution and in cohort size, measured from our Vital Statistics data. We estimate that the baby boom decreased college completion by 1.5–2.5 percentage points across the 1946–1960 cohorts for all race-gender groups, and the end of the boom increased college attainment by 2–3 percentage points across the 1960–1974 cohorts. Our results are particularly effective in explaining the changes in college attainment for white men: the baby boom explains more than one third of the 6.3 percentage point decrease in college attainment across the 1946–1960 cohorts, and the end of the boom explains more than half of the 5.9 percentage point rebound in college attainment across the 1960–1974 cohorts. Birth order is more important than cohort size in accounting for these changes. We also study the effects of birth order and cohort size on changes in high school attainment. In general, we find that birth order and cohort size effects are smaller for high school completion than for college completion. Consequently, the baby boom is not as important in explaining changes in high school attainment as it is in explaining changes in college graduation.

II. Data

a. Census data on educational attainment

We use individual-level data for 24–65 year olds from the 1960–2000 censuses and the 2006–2017 ACS to estimate the high school and college graduation rates for each birth cohort at age 40 at the state-race-sex level. To do this, we regress educational attainment at the state-cohort-census level on state-by-cohort fixed effects, a cubic in age, and an indicator for observations before 1990, when the census education classification was changed from years of schooling to degree attainment. For college graduation, for cohort c born in state s and observed in year t, this model is

$$\text{college}_{sct} = \gamma_{sc} + f(\text{age}_t) + \delta\, 1(t < 1990) + \varepsilon_{sct}\,. \tag{1}$$

Our estimate of college attainment for cohort c born in state s is the predicted attainment at age 40 according to the new census education question. We estimate college attainment separately for white men, white women, nonwhite men, and nonwhite women, and we repeat the process for high school completion for each of the four demographic groups.

Figure 2 presents our estimates of the percentage of men and women in each birth cohort between 1930 and 1985 who graduated from college. For white men, college attainment peaked in 1948 at 34.7 percent before declining to 27.8 percent in 1960. The college attainment rate did not return to its 1948 level until 1979. College attainment for white women experienced a shorter and smaller decline between 1951 and 1956, then increased much more quickly than for white men over the next two decades. For nonwhite men, the decline was smaller than for white men in percentage points, but similar as a percentage drop. College attainment for nonwhite women never decreased, but it did stagnate at the same time that college attainment for white women was declining.

b. Vital Statistics data on birth order

For information on birth order and cohort size, we use 1930–1980 natality data from Vital Statistics, measured at the state-race-year level. We collected data for birth cohorts 1930–1967 from published summary tables, and we tabulated data for birth cohorts 1968–1980 from the individual-level birth data. From these sources, we collect information on the total number of births (by mother's state of residence) and the percentage of total births that are first births, second births, and so on.[4]

Figure 3 presents changes in birth order during this period. The top graph plots the percentage of births that were first-borns, second-borns, etc. Here, one can see changes in fertility on the intensive and extensive margins. At the beginning of the boom in the 1940s, there was initially a spike in the percentage of first births as more women were beginning to have children. Shortly after, the percentage of first births declined and the percentage of higher-order births began to rise as these women had additional children. Around 1960, as the fertility rate started to decrease, the percentage of first births slowly started to increase and higher-order births started to decline. By the late 1960s, first and second births became more prevalent as the two-child household became more common.

The bottom graph shows a different view of the baby boom. Here, we plot the percentage of births that were third births or higher. This shows a decline in higher-

[4] Birth order is not reported for all births, so we allocate birth order not reported cases among birth orders. For details, see the data appendix.

order births in the 1930s, a quick spike around World War II, and then a longer, steady increase from the late 1940s until the early 1960s. The same pattern can be seen for whites and nonwhites, and the racial gap declines beginning in the 1960s.

c. Health and Retirement Survey data on siblings

Our estimates of the effect of birth order on educational attainment come from the Health and Retirement Survey (HRS). The HRS is a nationally representative longitudinal survey of individuals over age 50. The survey began in 1992 with an initial cohort of respondents born 1931–41, and younger cohorts have been added every six years. The survey now includes more than 42,000 respondents. Respondents and their spouses are interviewed every two years, from the time of entry into the survey until death. The HRS collects data on a wide variety of topics, including respondents' health, cognition, family structure, income, assets, and employment.

The survey also asks respondents about their siblings, and we use this data to estimate the effects of birth order. We have data on age, gender, and education for 42,167 siblings (including respondents in this count) from 16,472 respondents who reported any siblings.[5]

Table 1 reports some summary statistics for our HRS sibling data. We observe more women than men, which is not surprising since women are more likely to survive to the age of eligibility for the HRS sample (56 percent of HRS respondents are women). The average sibship sizes appear large, but are in line with census data. In our calculations from census data, the average sibship size among children born to mothers from the 1925 birth cohort who had more than one child (recall that these children would have been born around the average birth years reported in Table 1, and that our HRS sample is limited to respondents who reported any siblings) was 4.2 for white children and about 6.1 for nonwhite children.

III. The effect of the baby boom on college attainment

To estimate the effect of the baby boom on changes in college attainment, we first need to estimate the effects of birth order and cohort size on educational attainment. We estimate the effects of birth order using individual-level data from the Health and Retirement Survey, which allows us to observe the age and educational attainment of

[5] For more information about our construction of the sibling data, see the data appendix.

siblings. We then use Vital Statistics and census data to estimate the effect of cohort size on college completion rates. Finally, we take these estimates and apply them to national changes in birth order and cohort size for these cohorts. We explain these three estimation strategies and the results below.

a. The role of birth order

A major threat to identification of birth order effects is that later born children are more likely to come from larger families, which differ in both observable and unobservable ways from smaller families. We address this by using our data on siblings to run regressions with family fixed effects. Birth order effects may still be confounded by other factors. For example, as Figure 3 shows, any particular birth order is more common in some birth years than others, making it important to control for cohort effects. For person i in family j with birth order b (b = 1, 2, 3, 4, 5, 6 or above) and born in cohort c, we estimate the following family fixed effects model of college completion:

$$\text{college}_{ij} = \alpha + \sum_{b=2}^{6} \beta_b \, 1(\text{BO} = b) + \sum_{c} \gamma_c \, 1(\text{cohort} = c) + \mathbf{x}_{ij}'\delta + \lambda_j + \varepsilon_{ij} \,. \qquad (2)$$

In our preferred specification, birth order is capped at 6. The vector of controls, $\mathbf{x}_{ij}$, includes a female indicator and an indicator for whether the individual is an HRS respondent. Some specifications include additional controls, such as the individual's log cohort size. We interact the birth order indicators with a non-baby boom indicator (individuals born before 1946 or after 1974) so that our sample includes all siblings, but the birth order coefficients reported below apply specifically to the baby boom generation.

Our estimated birth order effects are presented in Table 2. In the first column, we estimate common effects for men and women. For whites, second-born children are about 5 percentage points less likely than first-borns to graduate from college, and the disadvantage relative to first-borns grows to 11 percentage points for children who are sixth-born or later. In the final two columns, we present separate estimates of birth order effects for men and women, estimated from a single regression in which we interact gender with the birth order indicators. Birth order generally matters more for white men than women: compared to first-borns, third-born men are 9 percentage points less likely to graduate from college, whereas the corresponding difference for women is 6 percentage points. We can reject the null hypothesis that the birth order effects are the same for men and women at the 10 percent level (p = 0.08).

Results for nonwhites follow a similar pattern: later-born children tend to have progressively lower rates of college attainment, and the effects are larger for men than for women. The estimated birth order effects are smaller for nonwhites than for whites. Part of this difference may be due to racial differences in educational attainment during this period. For the 1950 birth cohort, the college completion rate for white men and white women was 32.8 and 26.2 percent, respectively, compared to 14.8 and 14.5 percent for nonwhite men and women. The coefficient on birth order 3 for white men is consistent with a 29 percent decline in college completion from the average, while the coefficient for nonwhite men is consistent with a 35 percent decline.[6]

b. The role of cohort size

In estimating the effect of cohort size on educational attainment, both Card and Lemieux (2001a) and Bound and Turner (2007) regress college completion rates at the state-cohort level on log cohort size, state fixed effects, and cohort fixed effects. For state of birth s and cohort c, this yields the following model:

$$\text{college}_{sc} = \alpha + \beta \ln(\text{births}_{sc}) + \gamma_s + \delta_c + \varepsilon_{sc}\,. \tag{3}$$

But state and cohort effects will be insufficient controls if the composition of parents changes as cohort size changes within states over time. Therefore, we include division- or state-specific linear time trends, and we use census data to add a number of controls measuring parents' characteristics at the state-cohort level. For both mothers and fathers, we include percent white, percent foreign-born, percent achieving each of three levels of education (9 years, high school, and college), and age at birth (percentiles 25, 50, and 75). We also include the percent of mothers who are married, mothers' age at marriage (percentiles 25, 50, and 75), the percent of fathers present in the household, and father's log earnings (percentiles 25, 50, and 75).[7]

Table 3 shows our estimates of the effect of cohort size on college attainment. In the most parsimonious specification in column 1, which includes state and cohort fixed effects, a 10 percent increase in cohort size is associated with a decrease in college

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[6] We have implemented a number of sensitivity checks for our birth order estimates, and they all have very little effect on our results. These checks include: adding siblings with missing data on sex, controlling for cohort size at the level of cohort and census division, limiting the sample to families of at most 10 or 15 siblings, limiting the sample to families in which there is valid age and education data for each sibling, and excluding individuals reported by siblings-in-law instead of siblings.

[7] For more details about our construction of these variables, see the data appendix.

attainment of about 0.6 percentage points. Adding division or state trends (columns 2 and 4) does not affect the estimate much, but controlling for parents' characteristics (columns 3 and 5) decreases the estimated effect to 0.3–0.4 percentage points. The estimates for white women are broadly similar to those for white men. For nonwhites, cohort size has a modest negative effect on women but a very small and statistically insignificant effect on men after controlling for parents' characteristics.

c. Contribution of changes in birth order and cohort size to changes in college attainment

We use the estimated birth order and cohort size coefficients above to predict the impact of changes in fertility on college graduation for the baby boom generation. To compute the change in educational attainment explained by the change in the distribution of birth order, we multiply our birth order coefficients by changes in the prevalence of each birth order. That is, we compute the change in the percentage of children who are second-born between some initial and final cohorts, Δ%bo2, and so on for each birth order. Then the explained change in college completion is

$$\hat{\beta}_2\,\Delta\%\text{bo2} + \hat{\beta}_3\,\Delta\%\text{bo3} + \hat{\beta}_4\,\Delta\%\text{bo4} + \hat{\beta}_5\,\Delta\%\text{bo5} + \hat{\beta}_6\,\Delta\%\text{bo6up}\,, \qquad (4)$$

using the estimates from equation (2). Similarly, the change explained by changes in cohort size is $\hat{\beta}\,\Delta\,\ln(\text{births})$, using the estimate from equation (3), where the change in ln(births) is the change in the weighted average of state-specific values of ln(births) between the initial and final cohorts.

We examine two periods: 1946–1960 and 1960–1974. We begin the first period in 1946 because it is the beginning of the post-war baby boom, and end in 1960 when the boom was near its peak and both male and female college graduation rates were near local minimums. The period 1960–1974 covers a rapid decline in fertility rates and an increase in college graduation rates for both men and women.

Table 4 presents the results of this exercise, using the gender-specific birth order estimates from Table 2 and the cohort size estimates from column 5 of Table 3.[8] Between the 1946 and 1960 birth cohorts, college completion rates for white men fell 6.3 percentage points, of which 1.3 can be explained by changes in birth order. The change in cohort size can explain an additional 1.0 percentage point. Together, these changes account for 38 percent of the decline in college attainment for white men born between 1946 and 1960. Between the 1960 and 1974 cohorts, college graduation rates increased by

[8] Birth order distributions and cohort sizes are reported by birth year in the appendix.

5.9 percentage points, of which 2.1 percentage points (35 percent) can be explained by changes in birth order. Cohort size plays a smaller but still important role, accounting for 1.1 percentage points (19 percent).

While college attainment for white women did not decline between 1946 and 1960 as it did for white men, changes in birth order did put downward pressure on educational attainment. Our estimates suggest that college graduation rates would have been 0.8 percentage points higher in 1960 if the distribution in birth order had been the same as in 1946. They would have been an additional 1.5 percentage points higher if cohort size remained at 1946 levels. Changes in birth order and cohort size associated with the decline in fertility 1960–1974 played a smaller role in increases in college attainment for white women compared to white men, explaining 1.1 and 1.6 percentage points, respectively, of the 12.1 percentage point increase in college attainment.

For nonwhite men, college attainment fell less than a percentage point between the 1946 and 1960 cohorts. Changes in birth order can explain most of this small change, and changes in cohort size can explain the remainder. For nonwhite women, college attainment rose by 3.9 percentage points over this period, and our estimates predict that this increase would have been 1.6 percentage points larger if birth order and cohort size had remained unchanged. Between 1960 and 1974, college attainment rose for both nonwhite men and nonwhite women. Changes in birth order can explain about one third of the increase for men, and birth order and cohort size can jointly explain about one quarter of the increase for women.

An alternative way to view the impact of changes in birth order and cohort size on educational attainment is to use the estimated coefficients to plot a counterfactual of educational attainment, assigning a birth order distribution and a cohort size in a base year to future years. In Figure 4, we present actual and counterfactual trends in college graduation by gender and race for individuals born between 1940 and 1980, using 1946 as our base year.

Our counterfactuals show that in the absence of the baby boom, college graduation rates still would have declined for white men between 1946 and 1960, but by a significantly smaller amount, and that the increase in college graduation seen between the 1960 and 1974 cohorts would have been significantly smaller. The story for white women is similar, although more subtle. The decline in college attainment seen between the cohorts born in the early and late 1950s would have been somewhat smaller, and the increase in college attainment for cohorts born in the 1960s would have been slightly slower. For nonwhite men and women, the story is broadly similar to that for white women.

IV. The effect of the baby boom on high school attainment

We also estimate the effect of the baby boom on high school completion for the baby boom generation. We first discuss our estimates of birth order effects and cohort size effects, then turn to the contribution of these two mechanisms to national changes in high school attainment.

a. The role of birth order

Table 5 presents estimates of the effects of birth order on high school completion. The results indicate that earlier-born children are more likely to graduate from high school, but the magnitudes of the birth order effects are smaller for high school than for college. In the first column, we estimate common effects for men and women. The point estimates indicate that white second- and third-born children are about 2 percentage points less likely to complete high school than first-borns, but the deficit relative to first-borns stabilizes at 3–4 percentage points for children born fourth or later. In the final two columns, we present separate estimates of birth order effects for men and women, estimated from a single regression in which we interact gender with the birth order indicators. In contrast to the results for college completion, the point estimates indicate that birth order matters more for white women than for white men, but we cannot reject the null hypothesis that the effects are the same for men and women. For nonwhites, the estimated birth order effects are large for men (e.g., 9 p.p. for third-borns) but smaller and statistically insignificant for women.

b. The role of cohort size

As with college attainment, we estimate the effect of cohort size on high school completion by regressing state-by-cohort high school completion rates on log cohort size, state fixed effects, and cohort fixed effects. We also include division- or state-specific linear time trends, and a variety of aggregate parents' characteristics. The results are reported in Table 6. In column 1, we find that a 10 percent increase in cohort size is associated with a 0.5 percentage point decrease in high school graduation rates for white and nonwhite males, and smaller declines for white and nonwhite women. Adding division or state trends in columns 2 or 4 reduces these estimates, and adding parents' characteristics on top of the state trends in columns 3 or 5 further reduces the estimated effects, particularly for whites. In column 5, with state trends and parents' characteristics, our estimates imply that a 10 percent increase in cohort size is associated with a change in high school attainment of less than 0.1 percentage point for whites, and a drop of less than 0.2 percentage points for nonwhites. None of the estimates in the final column are statistically distinguishable from zero.

c. Contribution of changes in birth order and cohort size to changes in high school completion

Table 7 and Figure 5 show the estimated contributions of birth order and cohort size to changes in high school attainment, using the gender-specific birth order estimates from Table 5 and the cohort size estimates from column 5 of Table 6. For whites, the effects of birth order and cohort size are small for both 1946–1960 and 1960–1974, which is not surprising, given the estimates in Tables 5 and 6. The baby boom pushed white high school attainment down about 0.5 percentage points 1946–1960, and declining fertility raised high school attainment 0.5–1.1 percentage points 1960–1974. For nonwhite men, birth order effects are larger, so changes in birth order 1960–1974 can explain 1.6 percentage points of the increase in high school attainment over that time for this group. Otherwise, the estimated contributions of birth order and cohort size to changes in high school attainment for nonwhites are less than 1 percentage point.

V. Discussion

We find that changes in the distribution of birth order caused by the baby boom is an important new explanation for the surprising decline in college graduation experienced during that generation. Birth order does an especially good job explaining changes in college attainment for white men, accounting for more than 20 percent of the decline in college attainment across the 1946–1960 cohorts, and more than one third of the increase in college attainment across the 1960–1974 cohorts. Birth order effects are large for some other groups, as well. For example, changes in birth order can explain about one third of the increase in college graduation for nonwhite men across the 1960–1974 cohorts.

We also reexamine the role of cohort size in explaining trends in educational attainment. We find that controlling for aggregate measures of parents' characteristics can substantially reduce estimated effects of cohort size, so previous estimates may be overstated. But cohort size remains important, accounting for about one sixth of the decline and rebound in college attainment for white men during the baby boom generation. Adding up our estimated effects of birth order and cohort size, we find that the baby boom accounts for a substantial share of the decline in college attainment for both white and nonwhite men across the 1946–1960 birth cohorts, and the end of the baby boom accounts for 22–54 percent of the increases in college attainment experienced by various race-gender groups across the 1960–1974 cohorts.

The baby boom caused dramatic changes in birth order and cohort size, but a third way it might have affected educational attainment is through changes in family size. For example, additional children might spread parents' time or other investments more thinly across each child, lowering high school and college graduation rates. Many studies use twins or the sex composition of the first two children as instruments for family size. Unfortunately, we lack the sample size in our HRS data to implement these IV strategies. But previous research generally finds small effects of family size on education attainment (Black et al., 2005; Cáceres-Delpiano, 2006; Angrist et al., 2010).

Another contributing explanation that has been offered for the decline in college attainment among men is that college graduation for the late 1940s cohorts was unnaturally high due to the Vietnam War, either because of draft avoidance or the GI Bill. Card and Lemieux (2001b) find that the impact of Vietnam draft avoidance behavior on male college completion for the 1947 birth cohort was 2.2 percentage points. Angrist and Chen (2011) argue that the link between increased educational attainment and the Vietnam War was due to the GI Bill, rather than draft avoidance. They find that serving in the military in the Vietnam War increased college completion among white male veterans born 1948–1952 by 5 percentage points. Multiplying this effect by the share of these cohorts that were veterans (about 30 percent) yields an estimate of the effect of wartime service on college completion of 1.5 percentage points. We find that the baby boom was at least as important as the Vietnam war in explaining changes in college attainment for white men, accounting for 2.4 percentage points of the decrease in college graduation across the 1946–1960 cohorts.

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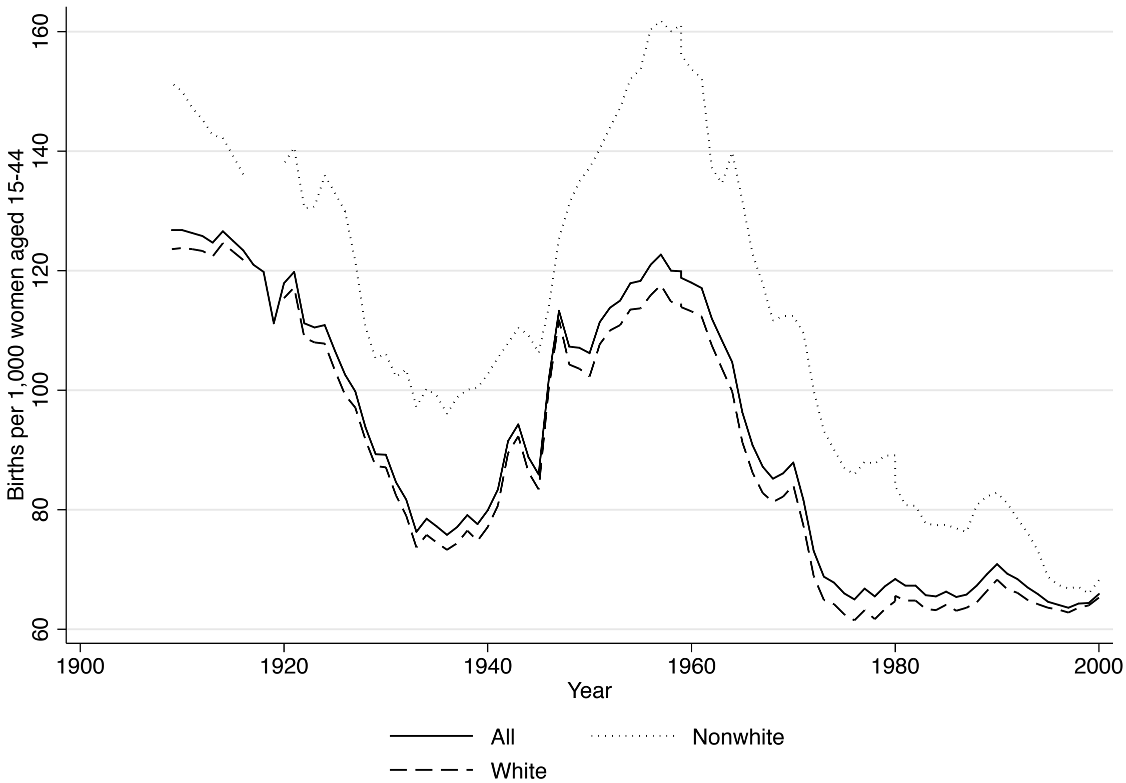
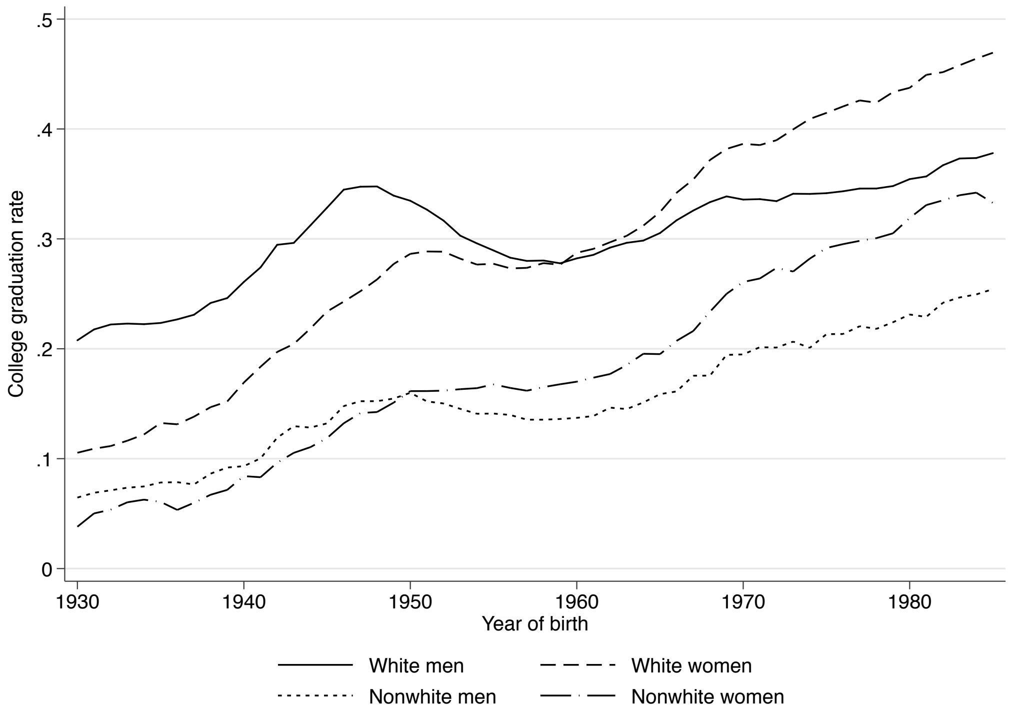
Figure 1: Changes in fertility rates, overall and by race



Notes: Data are from https://www.cdc.gov/nchs/data/statab/t001x01.pdf. Fertility rates are defined as births per 1,000 women aged 15–44. Births to nonresidents are excluded beginning in 1970. Race is defined by mother from 1980–2000 and by child before 1980. Birth counts before 1959 are adjusted for underregistration.

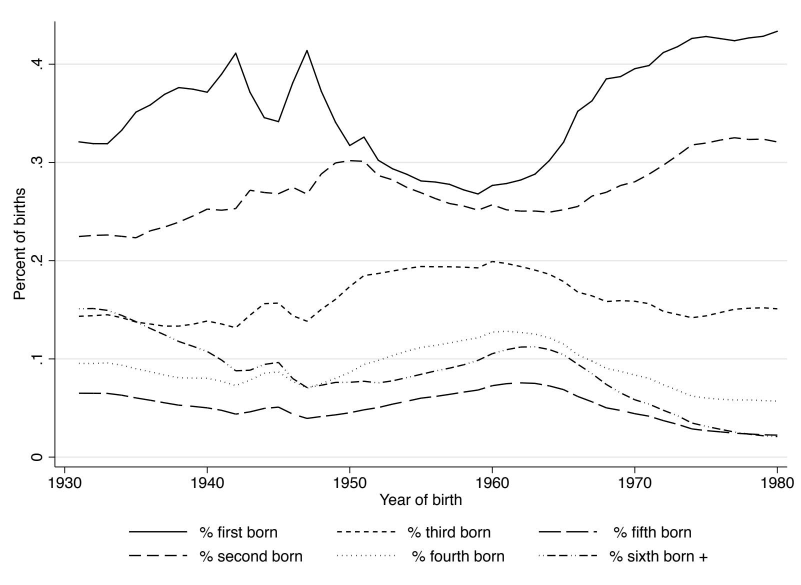
Figure 2: Changes in college graduation over time



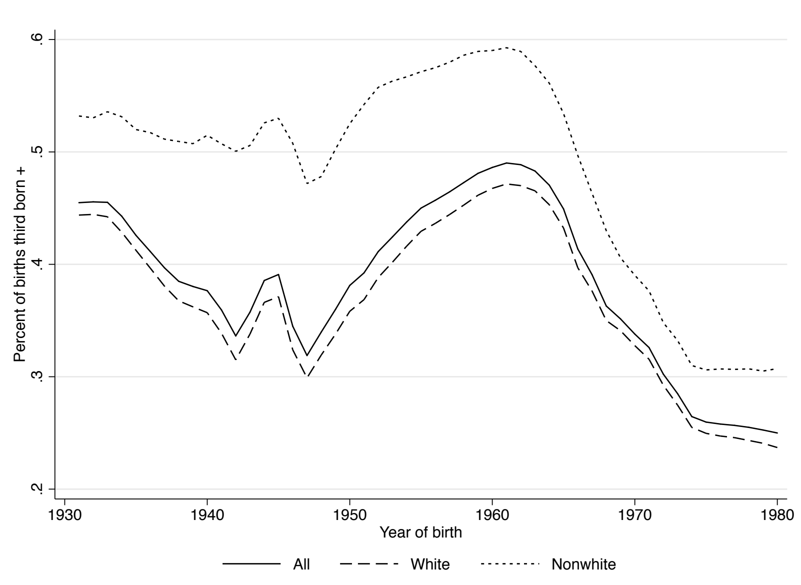
Notes: Educational attainment for each cohort is estimated using data for 25–64 year olds from the 1980–2000 censuses and the 2006–2017 ACS. We regress educational attainment on an age cubic, state-by-cohort fixed effects, and an indicator for whether the sample was before 1990, as the education question changed slightly at that time. The figure above plots predicted educational attainment for each birth cohort at age 40.

Figure 3: Changes in the distribution of birth order

a. Percent of births in each cohort with a given birth order

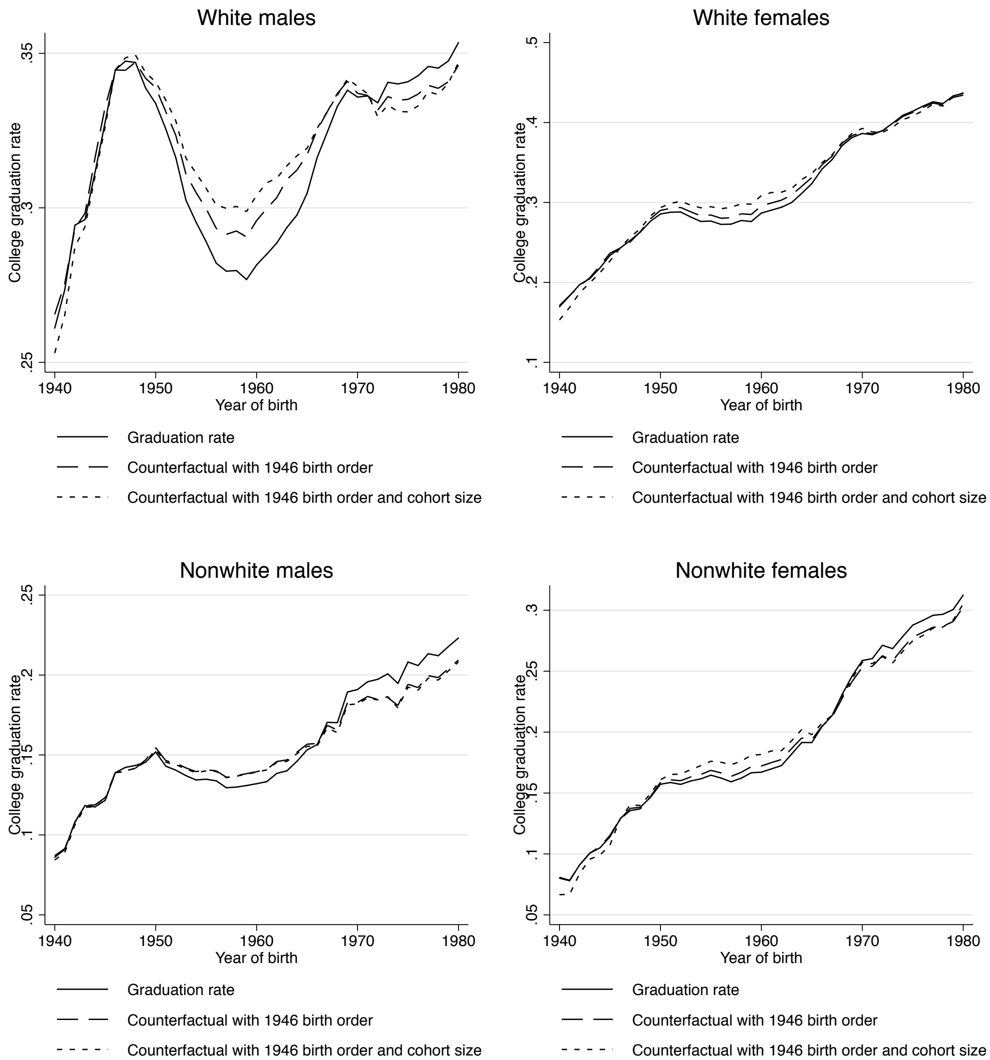


b. Percent of births in each cohort that are third-births or higher



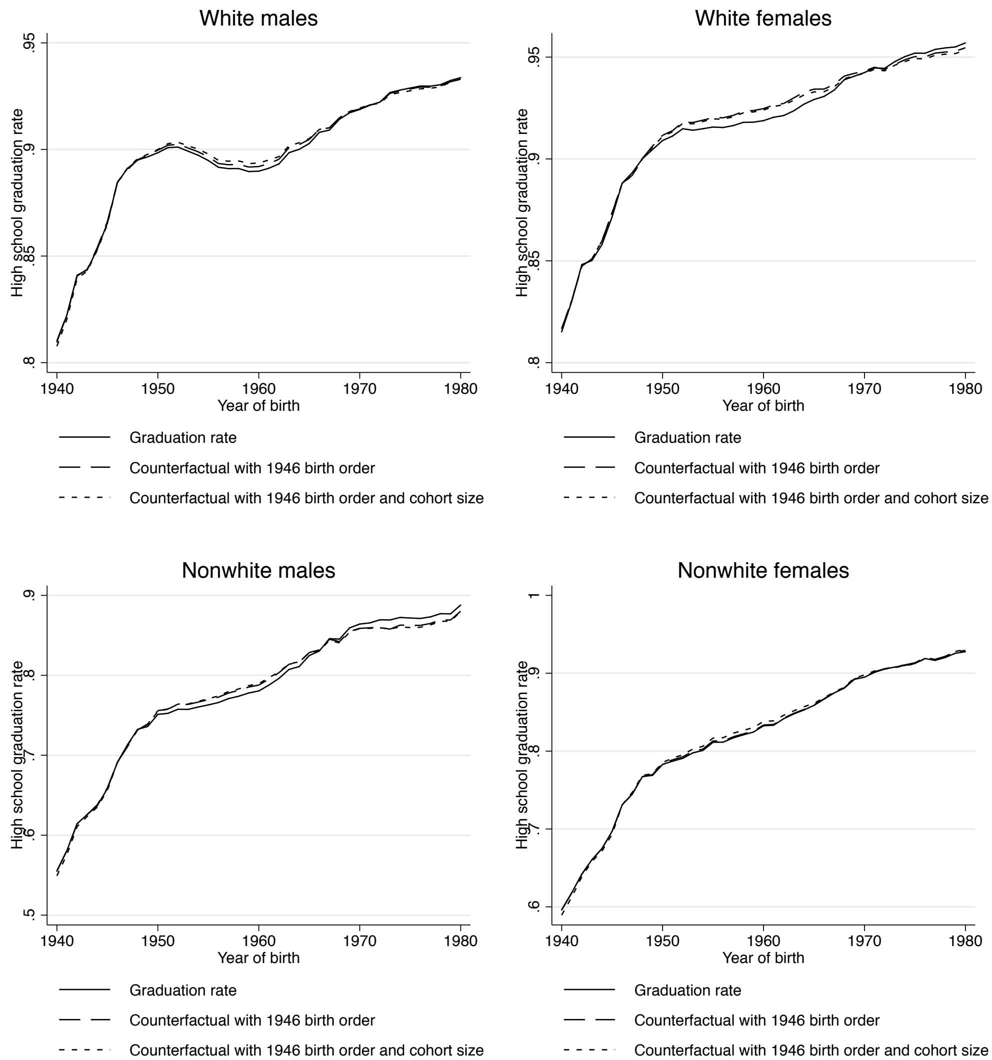
Notes: Data are from Vital Statistics and are aggregated across all states (including Washington, DC) with reported birth data except for Alaska and Hawaii. When birth order is not reported, we allocate those births to other birth orders as described in the appendix. South Dakota is missing from the sample in 1930–1931 and Texas is omitted in 1930–1932.

Figure 4: Actual and counterfactual trends in college completion



Notes: We plot predicted educational attainment at age 40 from the census and ACS for birth cohorts 1940–1980. We use the coefficients estimated for birth order and cohort size above to predict counterfactual educational attainment for each cohort using 1946 levels.

Figure 5: Actual and counterfactual trends in high school completion



Notes: We plot predicted educational attainment at age 40 from the census and ACS for birth cohorts 1940–1980. We use the coefficients estimated for birth order and cohort size above to predict counterfactual educational attainment for each cohort using 1946 levels.

Table 1: Summary statistics for HRS sample

	White	Nonwhite
Birth year	1949.1	1954.3
Female	0.526	0.550
High school (men)	0.880	0.700
High school (women)	0.888	0.732
College (men)	0.298	0.169
College (women)	0.269	0.192
Family (sibship) size	4.61	6.17
# siblings (N)	25,484	16,683
# families	9,996	6,476

Notes: We use sibling data for all waves of the HRS, 1992–2016. We drop siblings who are reported in multiple waves but who have sufficiently inconsistent reports about sex, birth year, or education. For more details about this sample selection process, see the data appendix.

Table 2: The effect of birth order on college attainment

White	All	Male	Female
birth order 2	-0.0485***	-0.0430**	-0.0536***
	(0.0141)	-0.0219	-0.0197
birth order 3	-0.0776***	-0.0940***	-0.0633***
	(0.0173)	-0.0239	-0.0222
birth order 4	-0.0709***	-0.0762***	-0.0662**
	(0.0212)	-0.0272	-0.0260
birth order 5	-0.0954***	-0.1270***	-0.0677**
	(0.0256)	-0.0322	-0.0308
birth order 6+	-0.1140***	-0.1560***	-0.0780**
	(0.0298)	-0.0347	-0.0343
Birth year fixed effects	x	x	
Family fixed effects	x	x	
# Siblings (N)	25,484	25,484	
# Families	9,996	9,996	

Nonwhite	All	Male	Female
birth order 2	-0.0378**	-0.0539**	-0.0245
	(0.0155)	-0.0229	-0.0220
birth order 3	-0.0395**	-0.0511**	-0.0305
	(0.0178)	-0.0253	-0.0234
birth order 4	-0.0583***	-0.0673**	-0.0520**
	(0.0207)	-0.0275	-0.0258
birth order 5	-0.0701***	-0.0856***	-0.0585*
	(0.0254)	-0.0328	-0.0306
birth order 6+	-0.0810***	-0.1029***	-0.0635**
	(0.0285)	-0.0341	-0.0317
Birth year fixed effects	x	x	
Family fixed effects	x	x	
# Siblings (N)	16,683	16,683	
# Families	6,476	6,476	

Notes: Data are from the HRS. Both regressions include an indicator for whether the individual is an HRS respondent and an indicator for gender. Male and female coefficients are estimated in a single regression in which gender is interacted with birth order.

Table 3: Cohort size and college completion

	(1)	(2)	(3)	(4)	(5)
White					
Male	-0.0634***	-0.0553***	-0.0301***	-0.0662***	-0.0367***
	(0.0110)	(0.0081)	(0.0088)	(0.0147)	(0.0119)
Female	-0.0710***	-0.0509***	-0.0294***	-0.0826***	-0.0540***
	(0.0119)	(0.0106)	(0.0075)	(0.0161)	(0.0126)
Nonwhite					
Male	-0.0160**	-0.0143	-0.0144	-0.0281	-0.0057
	(0.0079)	(0.0168)	(0.0174)	(0.0251)	(0.0190)
Female	-0.0214	-0.0294	-0.0359**	-0.0448**	-0.0413**
	(0.0160)	(0.0196)	(0.0173)	(0.0210)	(0.0190)
Parent characteristics			x		x
Division trends		x	x		
State trends				x	x

Notes: Each coefficient is from a separate regression of educational attainment for a specific race-gender group on cohort size, measured as the log number of births in their birth state in their birth year. Cohort size data are from Vital Statistics. Educational attainment data are from the 1960–2000 censuses and 2006–2017 ACS and are adjusted for age. Parent characteristics data are from the 1940–1990 censuses and include percent white, percent foreign-born, percent achieving each of three levels of education (9 years, high school, and college), and age at birth (percentiles 25, 50, and 75), for mothers and fathers, as well as the percent of mothers who are married, mothers' age at marriage (percentiles 25, 50, and 75), the percent of fathers present in the household, and father's log earnings (percentiles 25, 50, and 75).

Table 4: Portion of changes in college completion explained by birth order and cohort size

White	Male		Female	
1946–1960				
Δ in % college completion	-0.06306		0.04388	
Portion explained by:				
Δ in birth order	-0.01331***	[21.1%]	-0.00823***	[-18.8%]
	(0.00309)		(0.00293)	
Δ in cohort size	-0.01032***	[16.4%]	-0.01519***	[-34.6%]
	(0.00335)		(0.00355)	
Total explained:	-0.02363***	[37.5%]	-0.02342***	[-53.4%]
	(0.00456)		(0.00445)	
1960–1974				
Δ in % college completion	0.05854		0.12221	
Portion explained by:				
Δ in birth order	0.02052***	[35.1%]	0.01108**	[9.1%]
	(0.00452)		(0.00434)	
Δ in cohort size	0.01104***	[18.9%]	0.01626***	[13.3%]
	(0.00358)		(0.00380)	
Total explained:	0.03156***	[53.9%]	0.02734***	[22.4%]
	(0.00577)		(0.00577)	

Nonwhite	Male		Female	
1946–1960				
Δ in % college completion	-0.00693		0.03862	
Portion explained by:				
Δ in birth order	-0.00581***	[83.8%]	-0.00404**	[-10.5%]
	(0.00201)		(0.00188)	
Δ in cohort size	-0.00161	[23.2%]	-0.01163**	[-30.1%]
	(0.00534)		(0.00534)	
Total explained:	-0.01585***	[107%]	-0.01567***	[-40.6%]
	(0.00571)		(0.00566)	
1960–1974				
Δ in % college completion	0.06273		0.11127	
Portion explained by:				
Δ in birth order	0.02088***	[33.3%]	0.01441**	[13.0%]
	(0.00722)		(0.00677)	
Δ in cohort size	0.00172	[2.7%]	0.01245**	[11.2%]
	(0.00572)		(0.00572)	
Total explained:	0.0226**	[36.0%]	0.02686***	[24.1%]
	(0.00921)		(0.00886)	

Notes: Data on birth order and cohort size are from Vital Statistics. Change in college completion are from the 1960–2000 censuses and 2006–2017 ACS. We multiply changes in birth order by coefficients reported in Tables 2 and 3.

Table 5: The effect of birth order on high school completion

White			
	All	Male	Female
birth order 2	-0.0260***	-0.0206*	-0.0306***
	(0.0081)	-0.0119	-0.0116
birth order 3	-0.0205*	-0.0077	-0.0316**
	(0.0110)	-0.0144	-0.0138
birth order 4	-0.0384***	-0.0228	-0.0520***
	(0.0146)	-0.0178	-0.0175
birth order 5	-0.0312*	-0.0208	-0.0400*
	(0.0179)	-0.0221	-0.0212
birth order 6+	-0.0446**	-0.0263	-0.0605**
	(0.0224)	-0.0265	-0.0261
Birth year fixed effects	x	x	
Family fixed effects	x	x	
# Siblings (N)	25,484	25,484	
# Families	9,996	9,996	

Nonwhite			
	All	Male	Female
birth order 2	-0.0346**	-0.0684***	-0.0074
	(0.0137)	-0.0216	-0.0192
birth order 3	-0.0464***	-0.0846***	-0.0160
	(0.0165)	-0.0233	-0.0213
birth order 4	-0.0580***	-0.0911***	-0.0323
	(0.0205)	-0.0273	-0.0250
birth order 5	-0.0520**	-0.0743**	-0.0362
	(0.0243)	-0.0308	-0.0287
birth order 6+	-0.0234	-0.0760**	0.0181
	(0.0283)	-0.0334	-0.0311
Birth year fixed effects	x	x	
Family fixed effects	x	x	
# Siblings (N)	16,683	16,683	
# Families	6,476	6,476	

Notes: Data are from the HRS. Both regressions include an indicator for whether the individual is an HRS respondent and an indicator for gender. Male and female coefficients are estimated in a single regression in which gender is interacted with birth order.

Table 6: Cohort size and high school completion

	(1)	(2)	(3)	(4)	(5)
White					
Male	-0.0462***	-0.0320***	-0.0223***	-0.0110	-0.0074
	(0.0142)	(0.0103)	(0.0078)	(0.0077)	(0.0080)
Female	-0.0277**	-0.0197**	-0.0086	-0.0152*	0.0008
	(0.0120)	(0.0079)	(0.0062)	(0.0080)	(0.0068)
Nonwhite					
Male	-0.0452*	-0.0307	-0.0314	-0.0234	-0.0155
	(0.0267)	(0.0255)	(0.0250)	(0.0217)	(0.0214)
Female	-0.0131	-0.0086	-0.0116	-0.0197	-0.0195
	(0.0190)	(0.0179)	(0.0146)	(0.0151)	(0.0171)
Parent characteristics			x		x
Division trends		x	x		
State trends				x	x

Notes: Each coefficient is from a separate regression of educational attainment for a specific race-gender group on cohort size, measured as the log number of births in their birth state in their birth year. Cohort size data are from Vital Statistics. Educational attainment data are from the 1960–2000 censuses and 2006–2017 ACS and are adjusted for age. Parent characteristics data are from the 1940–1990 censuses and include percent white, percent foreign-born, percent achieving each of three levels of education (9 years, high school, and college), and age at birth (percentiles 25, 50, and 75), for mothers and fathers, as well as the percent of mothers who are married, mothers' age at marriage (percentiles 25, 50, and 75), the percent of fathers present in the household, and father's log earnings (percentiles 25, 50, and 75).

Table 7: Portion of changes in high school completion explained by birth order and cohort size

White				
	Male		Female	
1946–1960				
Δ in % high school completion	0.00520		0.03073	
Portion explained by:				
Δ in birth order	-0.00194	[-37.3%]	-0.00541***	[-17.6%]
	(0.00201)		(0.00199)	
Δ in cohort size	-0.00208	[-40.0%]	0.00020	[0.7%]
	(0.00224)		(0.00191)	
Total explained:	-0.00402	[-77.3%]	-0.00521*	[-17.0%]
	(0.00301)		(0.00276)	
1960–1974				
Δ in % high school completion	0.03804		0.03141	
Portion explained by:				
Δ in birth order	0.00273	[7.2%]	0.00784***	[25.0%]
	(0.00307)		(0.00305)	
Δ in cohort size	0.00223	[5.9%]	-0.00023	[-0.7%]
	(0.00240)		(0.00205)	
Total explained:	0.00496	[13.0%]	0.01078	[24.2%]
	(0.00390)		(0.00367)	

Nonwhite				
	Male		Female	
1946–1960				
Δ in % high school completion	0.08920		0.10151	
Portion explained by:				
Δ in birth order	-0.00527***	[-5.9%]	-0.000679	[-0.7%]
	(0.00192)		(0.00184)	
Δ in cohort size	-0.00437	[-4.9%]	-0.00548	[-5.4%]
	(0.00601)		(0.00481)	
Total explained:	-0.00964	[-10.8%]	-0.00616	[-6.1%]
	(0.00631)		(0.00515)	
1960–1974				
Δ in % high school completion	0.09188		0.07750	
Portion explained by:				
Δ in birth order	0.01636**	[17.8%]	0.00023	[0.3%]
	(0.00704)		(0.00671)	
Δ in cohort size	0.00467	[5.1%]	0.00586	[7.6%]
	(0.00644)		(0.00515)	
Total explained:	0.02103**	[22.9%]	0.00609	[7.9%]
	(0.00954)		(0.00846)	

Notes: Data on birth order and cohort size are from Vital Statistics. Change in college completion are from the 1960–2000 censuses and the 2006–2017 ACS. We multiply changes in birth order by coefficients reported in Tables 5 and 6.

Data Appendix

Health and Retirement Survey (HRS)

We use data from the HRS on respondents and their siblings. Data on respondents for all waves, 1992-2016, is from the RAND HRS Longitudinal File, and data on siblings comes from the HRS files for each wave.

Sibling age was collected in the 1992 and 1994 HRS waves, but not in the 1993 and 1995 waves for the oldest cohort. Beginning in 1996, sibling age and educational attainment is collected in each biannual wave. In 1992–2000, the household's family respondent reports on both siblings and siblings-in-law. We use relationship codes to assign the sibling to the appropriate respondent. If the family respondent reports a sibling-in-law but is not married in that wave, we assign the sibling to the respondent's most recent spouse. If a sibling cannot be assigned in this way, they are dropped from the sample. Beginning with the 2002 wave, the family respondent reports only on his or her own siblings.

For some siblings, there is data on age and/or education from multiple waves. We infer the sibling's birth year from the reported age. If two siblings have the same birth year, we assume that the sibling reported first was born earlier. We then drop siblings with any inconsistent reports about sex, a range of reported birth years greater greater than 2, or a range of reported years of education greater than 1. Finally, we resolve the remaining small inconsistencies by taking the median of the sibling's reported birth years and completed years of education, rounded to the nearest integer.

Parent characteristics

We use data on parents' characteristics as controls in our cohort size regressions. We begin with the 1940–1990 decennial censuses and measure parents' characteristics for children age 17 and younger. We match parents to children using the IPUMS variables MOMLOC and POPLOC. We then measure a variety of parents' characteristics for each combination of child's state of birth, child's birth cohort, and child's race. For both mothers and fathers, we measure percent white, percent foreign-born, percent achieving each of three levels of education (9 years, high school, and college), and age at birth (percentiles 25, 50, and 75). We also measure the percent of mothers who are married, mothers' age at marriage (percentiles 25, 50, and 75), the percent of fathers present in the household, and father's log earnings (percentiles 25, 50, and 75).

Vital Statistics

Total births and birth order come from the Vital Statistics' Natality files. Data for 1931–1967 come from summary tables in published pdfs. Data for 1968–2000 come from individual-level natality data from the NBER Vital Statistics page.

Birth order is not reported for all births, so we allocate birth order not reported cases among birth orders. We do this by first estimating separate regressions of the percentage of births of each birth order on the percentage of births without reported birth order, state fixed effects, and year fixed effects. Reassuringly, the coefficients across these regressions (percent birth order 1, 2, …, 6 or more) sum to –1. We allocate birth order not reported cases across our birth order bins based on these coefficients. Our results are similar when we do not do this adjustment and when we remove births without reported birth order from the denominator of our percentage calculations.

Data on annual total births and the birth order distribution by race are reported in Table A1.

Table A1: National births and birth order distribution by race

Year	Total births	Ln births	White birth order distribution (%) 1	2	3	4	5	6	Nonwhite birth order distribution (%) 1	2	3	4	5	6
1946	3,288,672	15.01	39.3	28.3	14.4	7.4	4.0	6.5	28.2	21.1	14.3	10.2	7.4	18.8
1947	3,699,940	15.12	42.6	27.5	13.8	6.7	3.6	5.7	31.5	21.3	13.9	9.4	6.8	17.1
1948	3,535,068	15.08	38.4	29.7	15.1	7.2	3.8	5.9	29.3	22.9	14.8	9.7	6.8	16.6
1949	3,559,529	15.09	35.2	31.0	16.1	7.7	3.9	6.1	26.7	23.0	15.7	10.3	7.1	17.2
1950	3,553,688	15.08	32.7	31.5	17.5	8.2	4.0	6.0	25.2	22.3	16.7	11.0	7.5	17.3
1951	3,750,850	15.14	32.7	30.5	18.1	8.7	4.2	5.8	24.4	21.3	16.9	11.8	7.8	17.6
1952	3,846,986	15.16	31.2	30.0	19.0	9.4	4.5	5.9	23.6	20.6	16.7	12.5	8.5	18.0
1953	3,902,120	15.18	30.3	29.5	19.4	10.0	4.8	6.0	23.5	20.2	16.3	12.5	9.0	18.5
1954	4,017,362	15.21	29.6	28.8	19.8	10.5	5.1	6.2	23.6	19.7	15.9	12.4	9.2	19.2
1955	4,047,295	15.21	29.0	28.1	20.0	11.0	5.5	6.5	22.9	20.0	15.8	12.3	9.2	19.7
1956	4,163,090	15.24	28.9	27.5	20.0	11.2	5.7	6.7	22.7	19.8	15.7	12.2	9.2	20.5
1957	4,254,784	15.26	28.7	26.9	20.0	11.6	5.9	7.0	22.5	19.6	15.9	12.0	9.2	20.8
1958	4,203,812	15.25	28.1	26.6	20.0	11.9	6.2	7.3	21.9	19.5	15.9	12.2	9.2	21.3
1959	4,238,504	15.26	27.6	26.2	19.9	12.1	6.4	7.7	21.9	19.2	15.7	12.2	9.3	21.8
1960	4,233,082	15.26	27.5	25.8	19.9	12.3	6.6	8.0	21.9	19.0	15.6	12.1	9.2	22.2
1961	4,248,814	15.26	27.6	25.2	19.6	12.4	6.8	8.3	22.0	18.8	15.4	12.2	9.2	22.5
1962	4,012,710	15.20	28.0	25.0	19.3	12.2	6.9	8.6	22.3	18.8	15.3	11.9	9.2	22.5

1963	3,943,662	15.19	28.5	25.0	18.9	12.1	6.9	8.7	23.3	19.0	15.0	11.7	9.0	22.0
1964	4,002,864	15.20	29.8	24.9	18.5	11.7	6.7	8.4	24.6	19.3	14.8	11.3	8.6	21.5
1965	3,736,940	15.13	31.7	25.1	17.7	11.1	6.3	8.1	26.8	19.8	14.6	10.9	8.1	19.8
1966	3,584,722	15.09	34.9	25.4	16.6	10.0	5.7	7.4	29.7	20.6	14.3	10.2	7.4	17.8
1967	3,504,803	15.07	35.8	26.6	16.3	9.5	5.2	6.7	32.1	21.5	14.0	9.6	6.8	16.0
1968	3,480,602	15.06	37.9	27.1	15.7	8.7	4.6	5.9	35.1	21.9	13.7	9.0	6.1	14.1
1969	3,577,684	15.09	38.1	27.8	15.9	8.5	4.4	5.3	36.6	22.9	13.8	8.8	5.8	12.1
1970	3,707,422	15.13	39.0	28.2	15.8	8.1	4.1	4.7	37.2	23.7	14.1	8.7	5.5	10.8
1971	3,532,846	15.08	39.4	29.1	15.6	7.8	3.9	4.3	37.9	24.5	14.2	8.4	5.2	9.9
1972	3,236,071	14.99	40.6	30.2	14.8	7.1	3.4	3.9	40.2	25.0	13.9	7.9	4.7	8.3
1973	3,114,997	14.95	41.3	31.3	14.4	6.5	3.1	3.5	40.8	26.0	14.2	7.6	4.3	7.1
1974	3,137,402	14.96	42.2	32.3	14.0	5.9	2.7	2.9	41.6	27.4	14.1	7.1	3.8	6.0