

What Drove the Decline in U.S. Teen Childbearing? A Cross-Cohort Decomposition*

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Abstract

The U.S. teen birth rate has fallen sharply since the early 1990s, and lower birth rates before age 20 account for a large share of the decline in total fertility over the same period. Measured by birth cohort, early first births first rose and then fell, and the underlying forces were partly offsetting: family backgrounds improved throughout, while early births within family backgrounds first rose and then fell. I estimate a life-cycle model of schooling, work, marriage and contraceptive use on three cohorts of women, each measured with the same surveys, and decompose the change in early childbearing into the value of avoiding a birth, the cost and efficacy of contraception, exposure, abortion, the marriage market, the safety net and family background. The decomposition quantifies how much each mechanism contributed to the rise and to the fall in early childbearing.

JEL codes: J13, J12, J11, I21, J24, C61.

Keywords: teen childbearing, fertility timing, contraception, life-cycle models, cohort decomposition.

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1 Introduction

The birth rate of American women aged 15–19 peaked at 61.8 per 1,000 in 1991 and has fallen almost every year since, to 12.6 in 2024—a decline of 80%. The decline is a large part of the fall in U.S. fertility. Between 1991 and 2024 the total fertility rate fell from 2.06 to 1.60 children per woman. Lower birth rates before age 20 reduced it by 0.25 children, more than half of the fall of 0.46: had they stayed at their 1991 level, the total fertility rate would be 1.85 today. Lower birth rates before age 25 reduced it by 0.55 children, more than the entire fall, because rising birth rates after age 30 offset part of the decline.¹ Understanding why young women stopped having children early is therefore a first step toward understanding why Americans have fewer children ([Kearney and Levine, 2026](#); [Kearney et al., 2022](#)).

What changed in behavior is well established: the risk of a teen pregnancy fell mainly because contraceptive use improved, and less because teens had less sex ([Lindberg et al., 2016](#); [Santelli et al., 2007](#)). Why contraceptive behavior improved is not, and three classes of explanations compete. The first is incentives: rising returns to schooling, changing marriage prospects and a changing safety net altered the value of avoiding an early birth. The second is the technology of fertility control: contraception became cheaper, easier to obtain and more effective. The third is preferences and social norms: the erosion of the norm of shotgun marriage ([Akerlof et al., 1996](#)), the waning stigma of premarital sex ([Fernández-Villaverde et al., 2014](#)), and the “shifting priorities” of recent cohorts ([Kearney et al., 2022](#)), such as the waning belief that a fulfilled life requires children ([Fernández et al., 2026](#)). The evidence so far examines these explanations one at a time. Individual policies had measurable but local effects: Medicaid family-planning waivers reduced teen births by about 4% ([Kearney and Levine, 2009](#)), and Colorado’s initiative to provide free or low-cost long-acting reversible

¹[Onofri et al. \(2026\)](#) find the same pattern for 2000–2022. They decompose the change in the general fertility rate (births per 1,000 women aged 15–44) into changes in age-specific birth rates and in the age structure, and find that in the United States women aged 20–24 account for close to 83% of the decline, while rising fertility at older ages offsets part of it. Applying their decomposition to the vital statistics and Census population estimates used here gives 80% for women aged 20–24 and 56% for women aged 15–19 over the same period; the shares of the declining groups sum to more than 100% because older ages offset part of the fall. In terms of the total fertility rate, the measure used in this paper, the corresponding shares are 65% and 43%. Their window starts after 29% of the fall in the teen birth rate had already occurred, which is why women aged 20–24, rather than teens, lead the decline in their period, as in the 2007–2024 phase of [Section 3](#).

contraception (LARC) reduced them by 6.4% in counties with funded clinics ([Lindo and Packham, 2017](#)) and by about 20% among teens living near those clinics ([Kelly et al., 2020](#)). Nationally, lower welfare benefits and expanded access to family planning account for about 13% of the decline between 1991 and 2008 ([Kearney and Levine, 2015a](#)), and, for the fall in all U.S. births after 2007, changing preferences are inferred from what measured factors leave unexplained ([Kearney et al., 2022](#)). For the decline in early childbearing, no paper weighs the three classes against one another. The closest accounting, [Eckstein et al. \(2019\)](#), weighs incentives against contraceptive technology for five cohorts born between 1935 and 1975, only the last of which, a holdout cohort, was in its teens when the decline began.

I weigh them within one estimated life-cycle model in which each class of explanations acts through a distinct margin. Incentives act through the value of avoiding a birth, which the model derives from women’s schooling, work and marriage prospects and from the safety net. Technology acts through the cost and the efficacy of contraception and the cost of abortion. Preferences are held fixed across cohorts, as in [Eckstein et al. \(2019\)](#), so the model does not assume that norms changed: a change in norms has to show up in the data, as less sexual activity, as a lower estimated cost of contraception, which includes its stigma, or as a change in behavior that the measured environment cannot account for. Applied to cohorts that span the decline, the model attributes the change in early childbearing to each margin and measures how much is left for norms.

I start from the cohort view of the decline. Measured by the woman’s year of birth rather than the calendar year, the decline is not a steady trend. About 30% of women born between the early 1960s and the early 1970s had a first birth by age 21. The share then rose, to 33% among women born in 1976–1980, the cohorts that were teenagers in the 1990s, just after the 1991 peak, and has fallen since, to 23% among women born in 1992–1996; the share with a first birth by age 17 fell from 10% to 4%. Neither movement is for lack of change in the environment. Between the cohorts born in 1962–1966 and in 1976–1980, the share of women married by age 21 fell from 36% to 22%, the share with a bachelor’s degree at ages 25–29 rose from 23% to 32%, and the share whose mother had not finished high school fell from 29% to 23%. The improvement in family background alone would have lowered the share with a first birth by 21 by 3.0 percentage points; within family backgrounds, early first births

instead rose by 5.0 points, almost entirely among daughters of mothers with a high-school diploma or some college. Between the cohorts born in 1976–1980 and in 1992–1996 the share fell by 9.8 points, three-quarters of it within family backgrounds. The decline therefore poses two questions: which forces raised early childbearing within family backgrounds among the cohorts that reached their teens in the late 1980s and 1990s, outweighing better family backgrounds and the fall in early marriage, and which forces reversed it for the cohorts that followed.

To answer them, I estimate the model on three cohorts chosen to bracket the decline and use it as an accounting device: women born in 1962–1966, teenagers around 1980, before the rise; women born in 1976–1980, the peak cohorts; and women born in 1992–1996, the youngest cohorts observed past age 21, whose teens coincide with the steep decline after 2007. Every cohort is measured with the same instruments, as in the cohort accounting of [Eckstein et al. \(2019\)](#): the National Survey of Family Growth (NSFG) for fertility, contraception, sexual activity, marriage and schooling, pooling its rounds from 1982 to 2019 so that each cohort’s contraceptive use is measured while the cohort was young, and the Current Population Survey (CPS) for employment and earnings. Women choose schooling, work, marriage, saving and whether to use contraception from age 14, and they differ by family background, measured by their mother’s education, which is recorded on the same scale in every cohort. The model belongs to the tradition of dynamic models of fertility choice ([Wolpin, 1984](#)), in which a birth is the stochastic outcome of contraceptive choices ([Hotz and Miller, 1988, 1993](#)), and of models that jointly endogenize several of schooling, work, marriage and fertility ([Adda et al., 2017](#); [Eckstein et al., 2019](#); [Keane and Wolpin, 2010](#); [Van der Klaauw, 1996](#)). The value of avoiding a birth depends on a woman’s earnings and schooling prospects, her marriage prospects, and how much the safety net insures a birth. The cost of contraception stands for its price, the effort of obtaining it, and its stigma; its efficacy is the typical-use failure rate of the method mix a cohort used; and exposure is the share of women who are sexually active at each age. Efficacy and exposure are measured outside the model, cohort by cohort, from the NSFG; the cost of contraception is estimated from the fit to contraceptive use, given the value of avoiding a birth that the schooling, marriage and employment moments pin down. Fecundity, like preferences, is common to all

cohorts.

I estimate the model by the simulated method of moments, pooling the three cohorts so that the common parameters must rationalize all of them. Women born in 1984–1988, halfway through the decline, are not used in estimation; as in [Keane and Wolpin \(2007\)](#), they serve as a holdout sample on which I test the model’s out-of-sample predictions. I then decompose the change in early childbearing between the cohorts born in 1962–1966 and 1976–1980, the rise, and between those born in 1976–1980 and 1992–1996, the decline, following the cohort-accounting approach of [Eckstein et al. \(2019\)](#). The mechanisms are ten blocks of cohort-specific primitives: women’s earnings opportunities, schooling costs and support, the cost of contraception, the efficacy of contraception, exposure, the marriage market, the safety net, the child penalty, family background, and the cost of abortion. Because sequential accounting depends on the order in which blocks are switched, I report Shapley contributions, which are order-invariant, sum exactly to the total change, and make offsetting forces explicit.

Preview of results. The decline is, in the model, a story about fertility control first and about the incentive to avoid a birth second. Of the fall in births at 15–19 between the cohorts born in 1976–1980 and 1992–1996, when each block of primitives is switched alone, less sexual activity accounts for about a third, the improved efficacy of the methods young women used and their lower cost of use for about a fifth each, and the composition of family background for a sixth; women’s higher earnings and more schooling support, which raise the opportunity cost of an early birth, account for about 30%, while the marriage market, the child penalty and the safety net moved early births little and the cost of abortion not at all. The rise is the sum of offsetting forces: the cohorts who were teenagers in the 1990s were more often sexually active and their minors faced costlier contraception, which raised early births, while better-educated mothers, the deeming rules of the 1984 safety net and the child penalty lowered them. The model reproduces the decline, the composition effects of both phases and the direction of the rise.

Contributions. The paper makes three contributions. First, it documents that, in cohort terms, the decline in early childbearing followed a rise: early births within family backgrounds rose for the cohorts that were teenagers in the 1990s and fell for those that followed, while family backgrounds improved throughout. This reframes what an explanation has to account for. Second, it provides a structural accounting of the decline in which schooling, marriage, work and fertility control are chosen jointly, and in which the incentive to avoid an early birth is separated from the cost, the efficacy and the exposure margins of fertility control. The literature has measured these margins one policy at a time or by accounting for changes in sexual activity and contraceptive use; to my knowledge, no paper has priced them against one another within one estimated model. Third, because the cost and the efficacy of contraception are separate blocks, the decomposition speaks to policy: it indicates whether cheaper access to contraception, more effective methods such as LARC, or better economic prospects for young women did most to reduce early births ([Bailey et al., 2023](#); [Kearney and Levine, 2009](#); [Lindo and Packham, 2017](#)).

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 documents the facts. Section 4 presents the model, and Section 5 its estimation. Section 6 presents the decomposition. Section 7 discusses policy implications, and Section 8 concludes.

2 Related Literature

The paper contributes to four literatures.

The decline in U.S. teen childbearing. [Kearney and Levine \(2012\)](#) document the high level of U.S. teen childbearing and its fall after 1991, and [Kearney et al. \(2022\)](#) and [Kearney and Levine \(2026\)](#) place births to young women at the center of the fall in U.S. fertility (see also [Doepke et al., 2023](#)). Demographic accountings attribute most of the fall in adolescents’ pregnancy risk to better contraceptive use rather than less sexual activity ([Lindberg et al., 2018, 2016](#); [Santelli et al., 2007](#)). [Driscoll and Abma \(2015\)](#) find that much of the 1991–2009 decline reflects a smaller share of teens in high-risk groups, such as daughters

of mothers without a high-school degree, rather than lower risk within those groups, and [Buckles et al. \(2025\)](#) show that the post-2007 fall in U.S. births is concentrated among young and unmarried women and in unintended births, which fell by 22% between 2007 and 2019 against 8.5% for intended births. These accountings establish which behavior changed and among whom, not why. A large body of work estimates the effect of one channel at a time: access to contraception and abortion ([Bailey et al., 2023](#); [Guldi, 2008](#); [Kearney and Levine, 2009](#); [Kelly et al., 2020](#); [Lindo and Packham, 2017](#); [Myers, 2017](#); [Packham, 2017](#)), welfare ([Kearney, 2004](#); [Lundberg and Plotnick, 1995](#)), information about the consequences of teen motherhood ([Kearney and Levine, 2015b](#)), an estimate that [Jaeger et al. \(2020\)](#) dispute, inequality and local labor markets ([Autor et al., 2019](#); [Kearney and Levine, 2014](#); [Kearney and Wilson, 2018](#)), and, for the post-2007 break, smartphones and broadband, which reduced in-person contact and sexual frequency among teenagers ([Hudson and Moscoso Boedo, 2026](#); [Myers and Hooper, 2026](#)). Together, measured policies explain a small share of the decline ([Kearney and Levine, 2015a](#)). I quantify these channels jointly, in one model in which their contributions can offset one another and add up to the observed change, and I separate the reasons contraceptive use rose—a stronger incentive, a lower cost, or more effective methods—from changes in sexual activity.

Structural models of fertility. The model belongs to the tradition of dynamic models of fertility ([Hotz and Miller, 1988](#); [Wolpin, 1984](#)), which built on reduced-form models of the timing and spacing of births ([Heckman and Walker, 1990](#)), of models that jointly endogenize several of schooling, work, marriage and fertility ([Adda et al., 2017](#); [Francesconi, 2002](#); [Keane and Wolpin, 2010](#); [Sheran, 2007](#); [Van der Klaauw, 1996](#)), and of models of imperfect fertility control, in which contraception is a choice and a birth its stochastic outcome ([Ejrnaes and Jørgensen, 2020](#); [Hotz and Miller, 1993](#); [Lavado, 2014](#); [Michael and Willis, 1976](#)); [Keane and Wolpin \(2010\)](#), estimated on the NLSY79, is its closest single-cohort antecedent, and [Lavado \(2014\)](#), who estimates contraceptive effort and its failure jointly with labor supply on the 1995 NSFG, the closest treatment of fertility control. Structural models of adolescents study sexual activity and contraception ([Arcidiacono et al., 2012](#); [Díaz Casanueva, 2026](#)), abortion policy ([Amador, 2017](#); [Forsstrom, 2021](#)), and the role of the welfare state and cross-country

differences in teen childbearing (Di Nola et al., 2025). These models are estimated on one cohort or used for policy and cross-country counterfactuals; I use one to account for change across cohorts. Rather than take the cost of an early birth from causal estimates, which range from small to modest (Ashcraft et al., 2013; Hotz et al., 2005), the model disciplines it with each cohort’s schooling, marriage and employment choices.

Cohort accounting and fertility-control technology. Estimated life-cycle models have been used to account for cross-cohort changes in mothers’ labor supply (Attanasio et al., 2008), female employment (Eckstein and Lifshitz, 2011) and the delay in marriage between 1970 and 2000 (Santos and Weiss, 2016). The closest paper is Eckstein et al. (2019), who hold preferences fixed and account for the schooling, marriage, fertility and employment of U.S. women born 1935–1975 through changes in family background and transfers, the marriage market, the wage structure and contraception, the last modeled as the incidence of unwanted pregnancies. I follow their design but focus on the timing of the first birth, split fertility control into exposure, cost and efficacy, treat the safety net and the child penalty as separate blocks, and extend the accounting to the cohorts born in the 1990s; I report order-invariant Shapley contributions (Shorrocks, 2013). A macroeconomic literature makes fertility-control technology the driver of family change: the pill delayed marriage and first births (Bailey, 2006; Goldin and Katz, 2002), and better contraception accounts for the rise of premarital sex and nonmarital births and for the decline of marriage (Fernández-Villaverde et al., 2014; Greenwood and Guner, 2010; Greenwood et al., 2017, 2021). These models are calibrated to long-run aggregates and emphasize a single force. I measure efficacy from typical-use failure rates (Kost et al., 2008; Sundaram et al., 2017; Trussell, 2011), estimate the cost of contraception on micro data, and set both against the incentive channel.

Preferences, culture and social norms. A third explanation is a change in what young people want. One approach measures preferences and norms directly, from the behavior of second-generation immigrants (Fernández and Fogli, 2009) or from survey attitudes (Fernández et al., 2026). A second models how norms evolve, through learning across generations (Fernández, 2013), through socialization that weakens as contraception makes pre-

marital sex less risky (Fernández-Villaverde et al., 2014), or through norms, such as shotgun marriage, that erode once contraception and abortion are available (Akerlof et al., 1996). A third infers a change in preferences from what measured factors leave unexplained, as Kearney et al. (2022) do for the post-2007 fall in U.S. births. Structural cohort accounting disciplines this third route by holding preferences fixed (Attanasio et al., 2008; Eckstein et al., 2019), and I follow it: a change in norms about sex appears in measured exposure, a change in the stigma of contraception in its estimated cost, and a change in the stigma of early motherhood in the part of the change that the model does not fit, which the untargeted holdout cohort tests.

3 The Decline in Early Childbearing: Data and Facts

This section describes the data and documents the decline by birth cohort. A calendar-year statistic such as the teen birth rate mixes several cohorts at different ages, so every fact below is measured by the woman’s year of birth.

3.1 Data

No single source measures every margin of early childbearing for every cohort at the ages that matter. Vital statistics count every birth but record little about the mother and nothing about how births were avoided. Surveys record sexual activity, contraception and family background, but in smaller samples, and women underreport abortions in them (Jones and Kost, 2007). I therefore combine four sources, each for what it measures best, and compare them where they overlap: the vital statistics for births, the Guttmacher Institute for abortions, the National Survey of Family Growth for the histories of individual women, and the Current Population Survey for employment and earnings.

Births. Birth rates by age come from the National Vital Statistics System for 1940–2024: births to women in each five-year age group per 1,000 women in that group, with ages 15–17 and 18–19 reported separately from 1960 on (National Center for Health Statistics, 2026a). To express them by cohort, a woman born in year c is assigned, at each age a , the rate of her

age group in year $c + a$, and the sum of these rates over the ages below A gives the births per woman before age A of her cohort.²

Abortions. The Guttmacher Institute estimates abortions by age and year from its census of abortion providers and the age distribution reported to the Centers for Disease Control and Prevention, and reports them together with births for 1973–2020 (Chiu et al., 2024). Their sum is the number of pregnancies that ended in a birth or an induced abortion.

Individual histories. First births, sexual activity, contraception, marriage, schooling and family background come from the female respondent files of the National Survey of Family Growth (NSFG) (National Center for Health Statistics, 2020). It is the only national survey that records, for women of every cohort since the 1930s, dated histories of births, marriages and first intercourse together with current contraceptive use and the education of the woman’s mother. I pool the nine rounds fielded between 1982 and 2019: 1982, 1988, 1995, 2002, 2006–2010 and the four two-year rounds of 2011–2019, which interview women aged 15–44 (15–49 from 2015) born between 1937 and 2004, and I harmonize their variables (Appendix A).

Employment and earnings. The NSFG does not record earnings. Employment and earnings come from the Annual Social and Economic Supplement of the Current Population Survey (CPS), 1976–2026 (Flood et al., 2025), which observes every cohort in every year and so follows employment and earnings by age, schooling and motherhood, as in Eckstein et al. (2019); schooling at ages 25–29 also comes from the CPS (U.S. Census Bureau, 2026). The return to work experience, which requires a panel, is estimated on the NLSY79 and NLSY97 (Appendix F).

3.2 Empirical Facts

Figure 1 shows the teen birth rate by calendar year and marks the years in which the cohorts studied in this paper were aged 15–19. The rate fell from 68.3 births per 1,000 women aged

²Appendix B compares this series with the cohort fertility tables of the National Center for Health Statistics, which use single-year rates.

15–19 in 1970 to 50.2 in 1986, rose to 61.8 in 1991, and has fallen since, to 12.6 in 2024. Each calendar year mixes five birth cohorts. The rise to 1991 and the decline of the 1990s took place while women born in the 1970s were teenagers, and the steep decline after 2007 while women born in the 1990s were. I document four facts.

1. By birth cohort, early births rose before they fell. Births per woman before age 20 rose from 0.26 among women born in 1962–1966 to 0.28 among those born in 1976–1980, and fell to 0.15 among those born in 1992–1996. The share of women with a first birth by 21 followed the same path.
2. Teen pregnancies and abortions fell in both phases. From the 1962–1966 to the 1976–1980 cohort, early births rose because fewer teen pregnancies ended in an abortion. From the 1976–1980 to the 1992–1996 cohort, they fell because fewer teens became pregnant, as contraceptive use rose, the methods used became more effective and fewer teenagers were sexually active in a given year, although the age at first intercourse changed little.
3. Early marriage fell and schooling rose in both phases.
4. Mothers’ education rose in every cohort. Within family backgrounds, early first births rose and then fell, mostly among daughters of mothers with a high-school diploma or some college. Teen contraceptive use barely varies with mother’s education, while the share of teen pregnancies ending in abortion rises steeply with it.

3.2.1 By birth cohort, early births rose before they fell

Figure 2 shows births per woman by birth cohort, and Table B.1 in Appendix B reports them for the cohorts used in the rest of the paper. Births before age 20 fell among women born between the late 1940s and the late 1960s, rose to 0.30 per woman among women born in the mid-1970s and have fallen since: 0.26 among women born in 1962–1966, 0.28 among those born in 1976–1980 and 0.15 among those born in 1992–1996. Births before 25 followed the same path, with a smaller rise and a larger fall, from 0.82 to 0.52 per woman between the 1976–1980 and 1992–1996 cohorts. Births before 20 account for 44% of that fall and

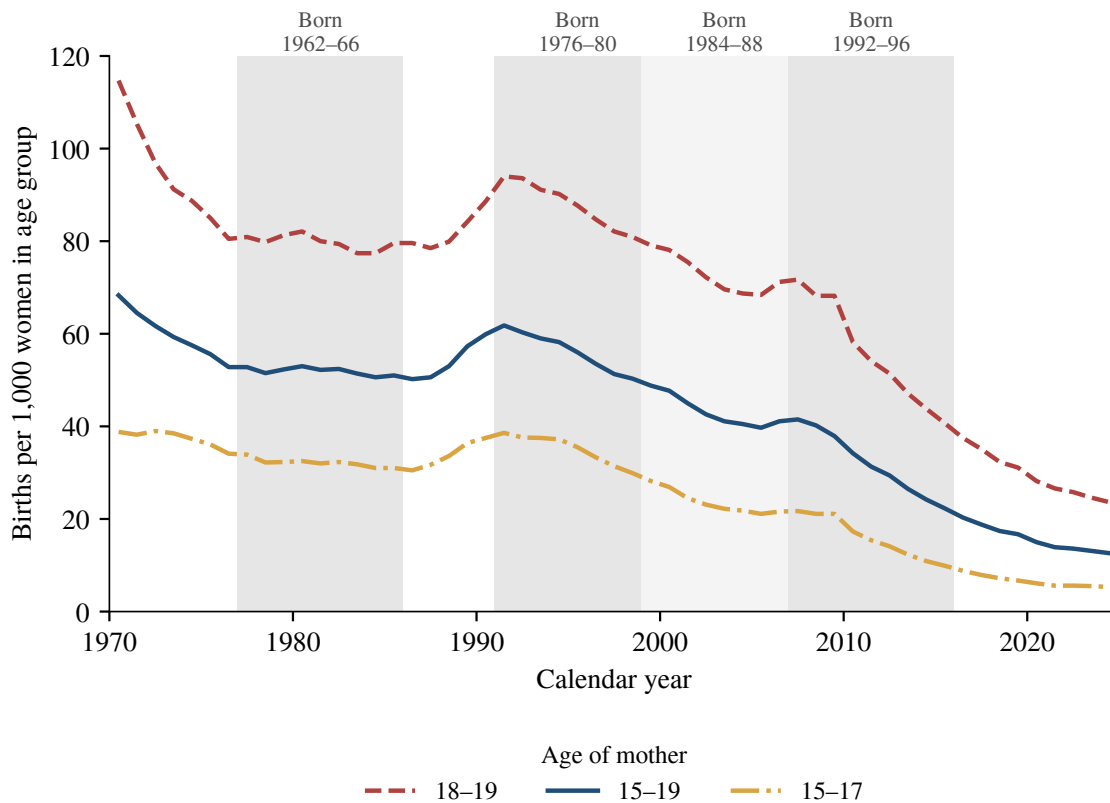


Figure 1. The Teen Birth Rate and the Teen Years of Each Cohort

Notes: Births per 1,000 women in each age group, by calendar year. Shaded areas mark the years in which the baseline, peak and decline cohorts (born 1962–1966, 1976–1980 and 1992–1996) and, lighter, the holdout cohort (1984–1988) were aged 15–19. *Source:* National Center for Health Statistics, National Vital Statistics System ([National Center for Health Statistics, 2026a](#)).

births at 20–24 for 56%. The cohorts with more early births did not have fewer births later: women born in 1976–1980 had 2.20 children by age 45, against 2.05 among women born in 1962–1966. Whether women born in 1992–1996 will catch up after their twenties is not yet known; by age 28 they had about 0.8 births per woman, against about 1.2 in the two earlier cohorts (Figure 2, panel b). In calendar terms, this postponement is a large part of the recent fall in the total fertility rate: since 1991, lower birth rates before age 20 account for more than half of it (Appendix B).

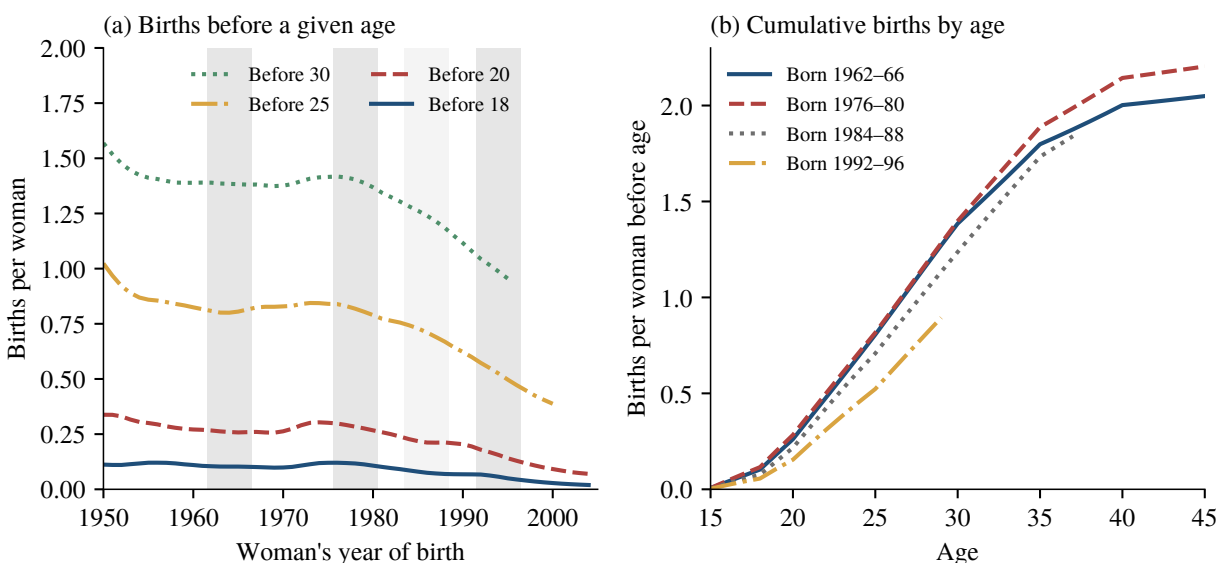


Figure 2. Births per Woman by Age and Birth Cohort

Notes: Births of any order per woman before the given age, cumulated along the cohort’s diagonal of the vital-statistics age-specific birth rates (Section 3.1). Panel (a): by single year of birth; shaded areas mark the baseline, peak and decline cohorts (1962–1966, 1976–1980, 1992–1996) and, lighter, the holdout cohort (1984–1988). Panel (b): averages over the birth years of each cohort, up to the last age observed for all of its birth years by 2024. *Source:* author’s calculations from [National Center for Health Statistics \(2026a\)](#).

First births in the NSFG show the same profile (Figure 3). Early first births fell among women born in the 1950s, were flat among women born between the early 1960s and the early 1970s, at about 30% by age 21 and 8% by 17, rose to 33% and 10% among women born in the late 1970s, and have fallen since, steeply for women born after 1990: among women born in 1992–1996, 23% had a first birth by 21 and 4% by 17. The survey and the vital statistics agree. In the cohort fertility tables of the National Center for Health Statistics, which cover women born up to 1991 ([National Center for Health Statistics, 2026b](#)), the cumulative first-

birth rate by exact age 22 is 31.5% for women born in 1962–1966 and 33.0% for those born in 1976–1980, against 30.6% and 32.8% with a first birth by 21 in the NSFG. Because the decline reached women in their early twenties, I study the timing of the first birth and focus on births before age 22.

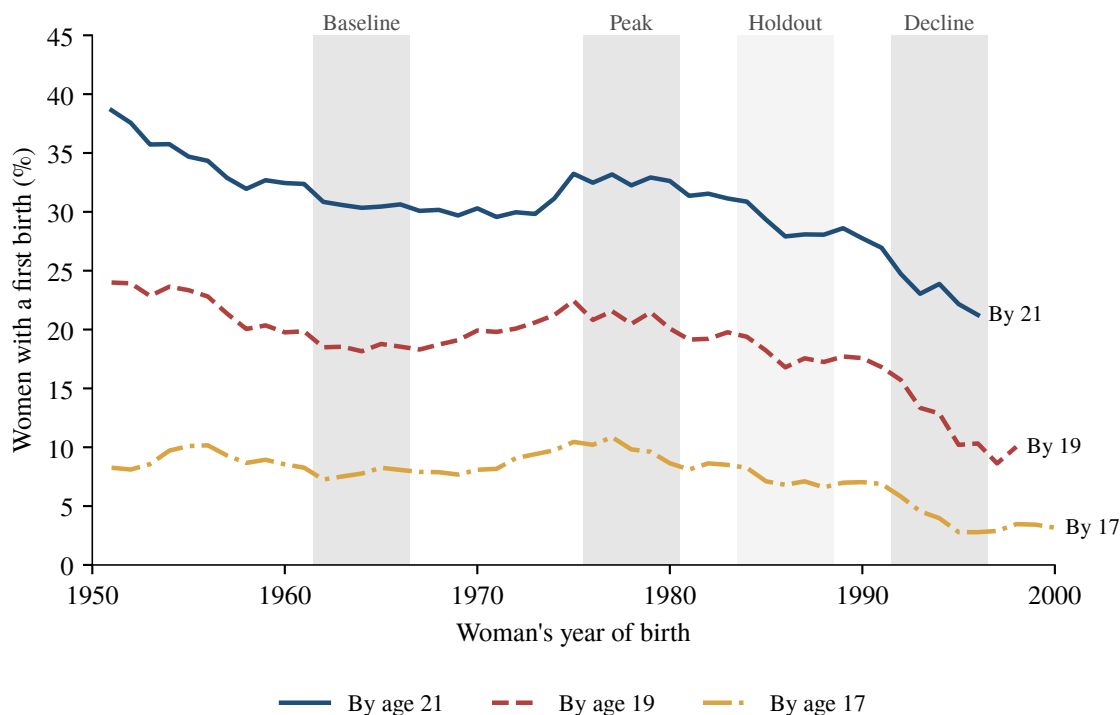


Figure 3. Early First Births by Birth Cohort

Notes: Share of women with a first live birth by ages 17, 19 and 21 (completed years), by year of birth, three-year centered moving average. Shaded areas mark the baseline (1962–1966), peak (1976–1980) and decline (1992–1996) cohorts and, lighter, the holdout cohort (1984–1988). *Source:* author’s calculations from the National Survey of Family Growth, 1982–2019 rounds ([National Center for Health Statistics, 2020](#)).

The rest of the paper compares three cohorts chosen from this profile. The baseline cohort, born in 1962–1966, reached its teens around 1980, on the flat part of the profile; the peak cohort, born in 1976–1980, was in its teens in the 1990s; and the decline cohort, born in 1992–1996, was in its teens between 2007 and 2015 and is the youngest observed past age 21. I call the change from the baseline to the peak cohort the rise and the change from the peak to the decline cohort the decline. I also report women born in 1984–1988, halfway through the decline. Each of these cohorts has its contraceptive use measured at ages 15–17 and 18–21 in a round fielded at those ages.

3.2.2 Teen pregnancies and abortions fell in both phases

Teen pregnancies were stable at about 0.47 per woman among women born in the 1960s, rose slightly among women born in the early 1970s and have fallen since (Figure 4, panel a). Women born in 1962–1966 had 0.47 pregnancies ending in a birth or an abortion per woman before age 20, women born in 1976–1980 had 0.43 and women born in 1992–1996 had 0.21.³ In the first phase, early births rose although teen pregnancies fell. Abortions before 20 fell from 0.21 to 0.15 per woman, and the share of teen pregnancies that ended in an abortion from 45% to 35%, so more of the pregnancies that did occur were carried to term (panel b). In the second phase teen pregnancies halved, births and abortions fell together, and the abortion share fell further, to 30%.

Panels (c) and (d) show how pregnancies were avoided. Among childless women at risk of pregnancy (sexually active in the three months before the interview, neither pregnant nor sterilized), the share using a method at ages 15–17 rose from 74% among women born in 1976–1980 to 84% among those born in 1992–1996, a difference larger than its sampling error; the change from 67% among women born in 1962–1966 is within it (panel d).⁴ At ages 18–21 use changed less, from 78% to 83% and 85%, and none of these changes is precisely estimated. Exposure moved with the two phases: among childless women aged 15–17, the share sexually active in the three months before the interview, the at-risk population of panel (d) and the exposure measure of the model, rose from 22% in the baseline cohort to 27% in the peak cohort and fell to 21% in the decline cohort, while the share who had had intercourse by 18 moved less (panel c). The methods also changed. Their failure rate, the share of typical users who conceive within a year, rose slightly in the first phase, from 12.0% to 12.8%, as condoms replaced part of the pill, and fell to 8.7% in the second, partly because more young women used implants and IUDs and mostly because the typical-use failure rate of each method fell. Sexual activity changed much less: 53% of women born in 1962–1966 had first intercourse before 18, 59% of those born in 1976–1980 and 55% of those born in

³The counts exclude miscarriages and stillbirths and date each pregnancy by the woman’s age at its outcome.

⁴The 95% confidence interval of the change at ages 15–17 is [3, 19] points from the peak to the decline cohort and [−5, 18] points from the baseline to the peak cohort. The estimates rest on 165, 186 and 312 women at risk in the three cohorts.

1992–1996, and between 75% and 77% of each cohort before 20 (panel c). This agrees with the accounting of [Santelli et al. \(2007\)](#) and [Lindberg et al. \(2016\)](#), who attribute most of the fall in teen pregnancy risk to contraception. The decline in sexual activity among high-school students in the Youth Risk Behavior Survey, from 54% who had ever had intercourse in 1991 to 32% in 2023, came mostly after 2013 and concerns women born from the late 1990s on, younger than the cohorts studied here ([Centers for Disease Control and Prevention, 2024](#); [Kann et al., 2012](#)).

3.2.3 Early marriage fell and schooling rose in both phases

Table 1 compares the four cohorts. The share of women married by age 21 fell from 36% among women born in 1962–1966 to 22% among those born in 1976–1980 and 13% among those born in 1992–1996. The share with a bachelor’s degree at ages 25–29 rose from 23% to 32% and then 44%, and the share without a high-school diploma fell from 13% to 12% and then 5%. From the baseline to the peak, then, early marriage fell by two-fifths and college completion rose by a third, yet the share with a first birth by 21 rose, from 31% to 33%. Both changes should have lowered early births. Fewer women married young, so an early birth was less often supported by a husband’s earnings, and more women went to college, which raises what an early birth costs.

3.2.4 Within family backgrounds, early first births rose and then fell

Early childbearing is concentrated among girls from disadvantaged families. Teen and non-marital births are far more common among girls who grow up with less-educated or lower-income parents ([An et al., 1993](#); [Haveman and Wolfe, 1995](#); [Kearney and Levine, 2012](#)). A change in the family backgrounds of successive cohorts can therefore move early childbearing by itself. I measure family background by the education of the woman’s mother, which the NSFG records on the same scale in every round; the survey has no measure of the income of the family a woman grew up in. Table 2 and Figure 5 report first births by 21 by mother’s education. The share of women whose mother had not finished high school fell from 29%

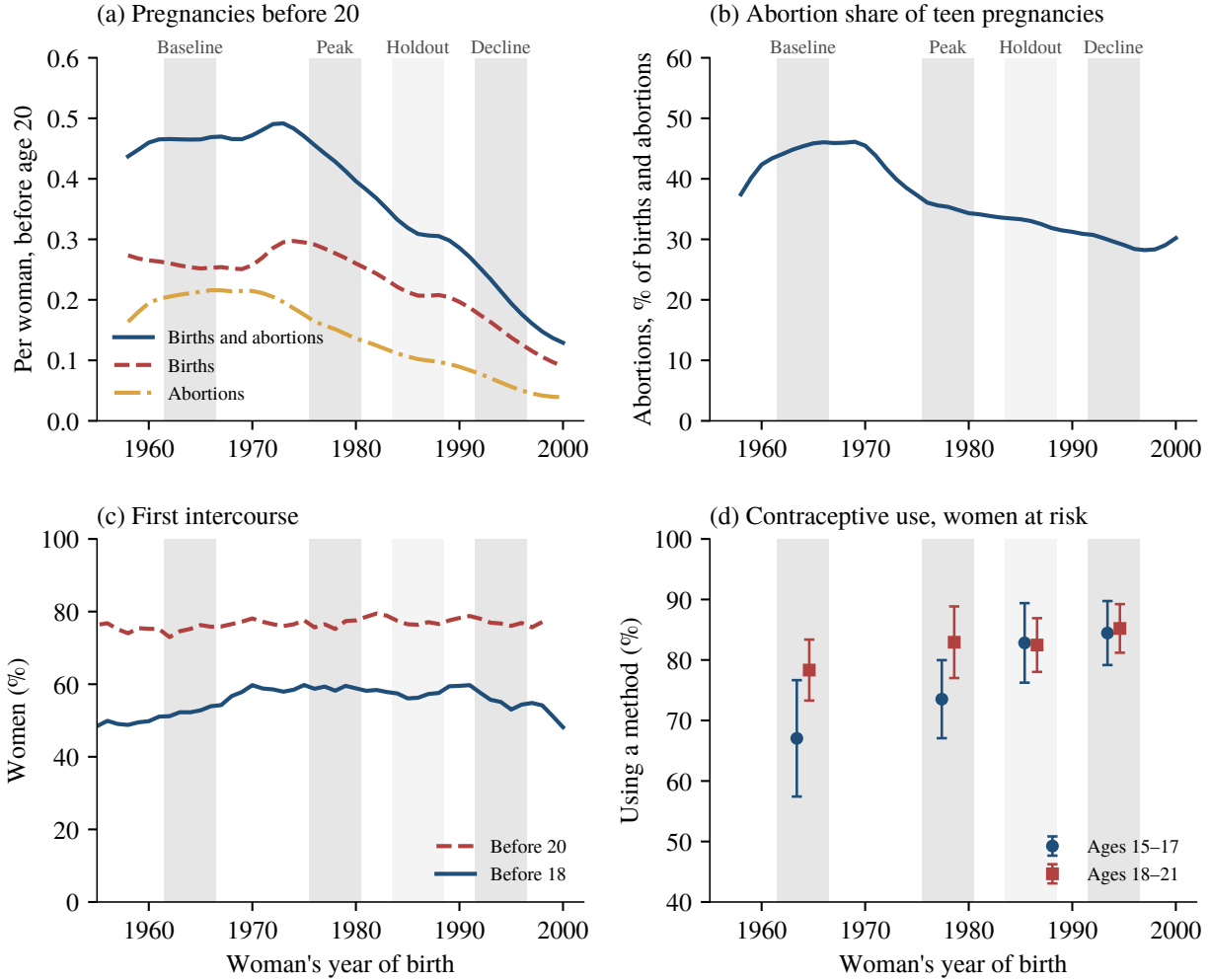


Figure 4. Teen Pregnancy, Abortion, Sexual Activity and Contraception by Birth Cohort
Notes: Panels (a) and (b): pregnancies ending in a live birth or an induced abortion before age 20, by age at outcome, cumulated along each birth year's diagonal of the Guttmacher age-specific rates for 1973–2019. Panel (c): share of women with first intercourse before the given age, among women interviewed after that age, three-year centered moving average. Panel (d): contraceptive use among childless women who had intercourse in the three months before the interview and were neither pregnant nor sterilized, for the baseline, peak, 1984–1988 and decline cohorts, measured in the rounds fielded while each cohort was at those ages; bars are 95% confidence intervals. Shaded areas as in Figure 3. *Source:* author's calculations from Chiu et al. (2024) and the NSFG, 1982–2019 rounds (National Center for Health Statistics, 2020).

Table 1. Early Childbearing, Marriage, Schooling and Family Background, by Birth Cohort

Women born in	1962–66 (Baseline)	1976–80 (Peak)	1984–88 (Holdout)	1992–96 (Decline)
<i>A. Early first births</i>				
First birth by 17	7.9	10.0	7.1	3.9
First birth by 19	18.7	21.1	18.0	12.4
First birth by 21	30.6	32.8	29.2	22.8
<i>B. Marriage and schooling</i>				
Married by 21	35.5	22.1	16.1	12.6
No high-school diploma, ages 25–29	13.4	11.8	8.7	5.1
Bachelor’s degree or more, ages 25–29	23.4	31.8	37.3	43.7
<i>C. Family background</i>				
Mother: less than high school	28.9	23.1	17.9	16.2
Mother: bachelor’s or more	13.7	21.8	24.6	27.7
<i>D. Period measure</i>				
Teen birth rate (vital statistics)	52.1	55.6	42.4	31.9
Women aged 22 or older (N)	5,735	6,843	5,070	1,592

Notes: Percent of women, except the teen birth rate. First births and first marriages by the given age (completed years), among women interviewed after that age. Schooling is the percent of women aged 25–29 without a high-school diploma and with a bachelor’s degree or more, from the Current Population Survey, averaged over the years in which each birth year of the cohort was aged about 27. Mother’s education among women with a mother figure. The teen birth rate is the vital-statistics rate at ages 15–19 (births per 1,000 women), averaged over the years each cohort spent at those ages. Mother’s education and first births by 21 among women aged 22 or older. Weights: each round’s final weight, rescaled to sum to one within the round. *Source:* author’s calculations from the NSFG, 1982–2019 rounds ([National Center for Health Statistics, 2020](#)), [U.S. Census Bureau \(2026\)](#) and [National Center for Health Statistics \(2026a\)](#).

(born 1962–1966) to 23% (1976–1980) and 16% (1992–1996), and the share whose mother had a bachelor’s degree doubled, from 14% to 28%. Because early births are far more common among daughters of less-educated mothers—47% to 49% by age 21 against 13% to 16% among daughters of college graduates—this upgrading alone lowered early first births by 3.0 percentage points from the baseline to the peak. Within family backgrounds, however, early births rose by 5.0 points, almost entirely among daughters of mothers with a high-school diploma (from 29% to 35%) or some college (from 18% to 30%), so the net change was +2.0 points. From the peak to the decline the share with a first birth by 21 fell by 9.8 points, and three-quarters of the fall, 7.4 points, happened within family backgrounds, again in the two middle groups (to 23% and 18%), while among daughters of mothers without a high-school diploma early births barely moved in either phase (47%, 49% and 48%).

Family background matters less for whether a teenager uses contraception than for how her pregnancies end. Among sexually active childless girls aged 15–17, contraceptive use ranges only from 0.58 to 0.80 across groups of mother’s education in the 1962–1966 cohort and from 0.64 to 0.77 in the 1976–1980 cohort, with no monotone gradient. The share of first pregnancies at 15–21 that end in an abortion, by contrast, rises steeply with mother’s education: from 25% among daughters of mothers without a high-school diploma to 77% among daughters of college graduates in the 1962–1966 cohort, from 20% to 68% in the 1976–1980 cohort and from 12% to 40% in the 1992–1996 cohort (NSFG pregnancy histories, scaled to the Guttmacher totals). As [Kearney and Levine \(2014\)](#) and [Singh et al. \(2001\)](#) find, the socioeconomic gap in teen births runs through abortion more than through contraception.

4 Model

The model has to capture both how a young woman can avoid an early birth and why she would want to. Exposure to the risk of conception, the costs of contraception and of abortion, and the efficacy of the methods available differ across cohorts; how much a woman gains from avoiding a birth depends on what the birth would do to her schooling, earnings, marriage prospects and eligibility for transfers. Schooling, work, marriage, saving and fertility control are therefore chosen jointly, each year from age 14, and the model keeps

Table 2. First Births by Age 21 and Mother’s Education: Composition and Within-Group Change

Mother’s education	Share of women			First birth by 21		
	1962–66	1976–80	1992–96	1962–66	1976–80	1992–96
Less than high school	28.9	23.1	16.2	47.2	48.6	47.9
High school	42.0	31.4	28.9	28.8	35.4	22.5
Some college	15.3	23.7	27.2	17.7	29.8	18.0
Bachelor’s or more	13.7	21.8	27.7	15.6	14.4	13.1
All women	100	100	100	30.6	32.6	22.8
	1962–66 to 1976–80			1976–80 to 1992–96		
Change in first birth by 21 (pp)	+2.0			-9.8		
Composition	-3.0			-2.4		
Within groups	+5.0			-7.4		

Notes: Women aged 22 or older at the interview who report their mother’s education. The change in the share with a first birth by 21 is split exactly into a composition term, $\sum_M \bar{r}_M \Delta s_M$, and a within-group term, $\sum_M \bar{s}_M \Delta r_M$, where s_M is the share of women whose mother has education M , r_M their rate, and bars denote averages of the two cohorts. The all-women shares differ slightly from Table 1 because women who do not report their mother’s education are excluded here. *Source:* author’s calculations from the NSFG, 1982–2019 rounds ([National Center for Health Statistics, 2020](#)).

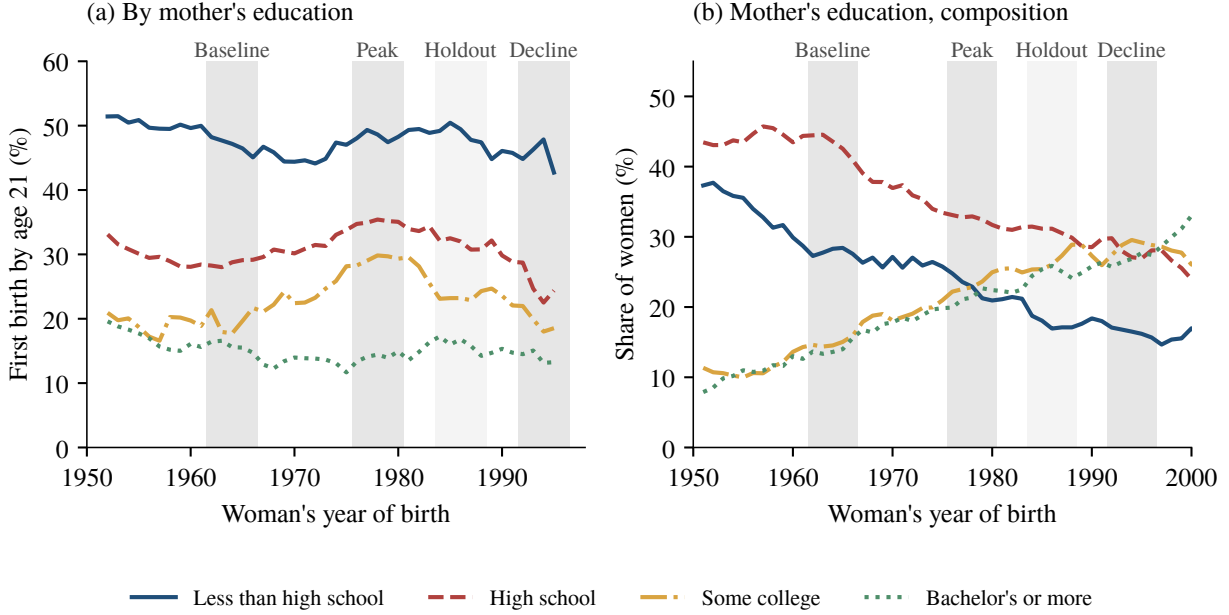


Figure 5. Early First Births and Family Background by Birth Cohort

Notes: Panel (a): share of women with a first birth by age 21 by the education of the woman's mother, five-year centered moving average. Panel (b): distribution of mother's education, three-year centered moving average. Women without a mother figure are excluded. Shaded areas as in Figure 3. *Source:* author's calculations from the NSFG, 1982–2019 rounds ([National Center for Health Statistics, 2020](#)).

four margins apart: the value of avoiding a birth, the cost of avoiding it, the efficacy of the methods, and exposure.

The model belongs to the tradition of dynamic models of fertility choice ([Wolpin, 1984](#)), in which a birth is the stochastic outcome of contraceptive choices ([Hotz and Miller, 1988, 1993](#)), and of models that jointly endogenize schooling, labor supply, marriage and fertility ([Adda et al., 2017](#); [Eckstein et al., 2019](#); [Keane and Wolpin, 2010](#); [Sheran, 2007](#); [Van der Klaauw, 1996](#)). It is common to all cohorts; cohorts differ only in a set of primitives, and those differences are what the decomposition prices.

4.1 Environment

Cohorts, mother's education and time. A cohort g is a population of women born in the same years: 1962–1966 (the baseline cohort), 1976–1980 (the peak) and 1992–1996 (the decline). A woman enters the model at age 14 with zero assets and her mother's education $M \in \{1, 2, 3, 4\}$ (less than high school, high school, some college, a bachelor's degree or

more), which summarizes her family background and is distributed as $\pi_g(M)$. A period is one year from 14 to 45 and four years afterwards, longer once the fecund window closes as in [Keane and Wolpin \(2010\)](#): a woman can conceive through 45, works through 65 and dies at the end of 81.

State. The state of a woman at the start of period t is

$$\Omega_t = \{a_t, M, u, e_t, x_t, m_t, n_t, k_t, \tau_t\},$$

where $a_t \geq 0$ is assets; $u \in \{1, 2\}$ is her unobserved preference type; e_t is schooling, which records enrollment in high school (ages 14–17) and in college (18–21) and afterwards takes the values $\{D, H, C\}$ (high-school dropout, high-school graduate, college); x_t is years of full-time experience; $m_t \in \{0, 1, 2\}$ is marital status (single, married with no child born before the marriage, married after a birth); $n_t \in \{0, 1, 2, 3+\}$ is parity, the number of children born; k_t is the age of the youngest child in four bins (none, 0–1, 2–5, 6–17); and τ_t is the number of years since age 18 in which she has received cash welfare, which matters only under the TANF time limit. As in [Adda et al. \(2017\)](#), children are carried by their number and the age of the youngest; a child is at home until age 17.

Timing. Figure 6 summarizes the order of decisions within a year. A single woman first meets a potential husband with probability $\mu_g(e_t, t)$ and decides whether to marry. A woman with fewer than three children then learns whether she is exposed to the risk of conception this year and, if exposed, decides whether to use contraception; the conception outcome is drawn, and a conception can end in an abortion. A conception in year t is a birth at the start of year $t+1$: parity rises by one and the youngest child’s bin is 0–1. Finally she chooses schooling (whether to continue, if enrolled), labor supply, consumption and saving. Because the schooling decision is taken after the conception outcome, an early pregnancy raises the cost of staying in school.

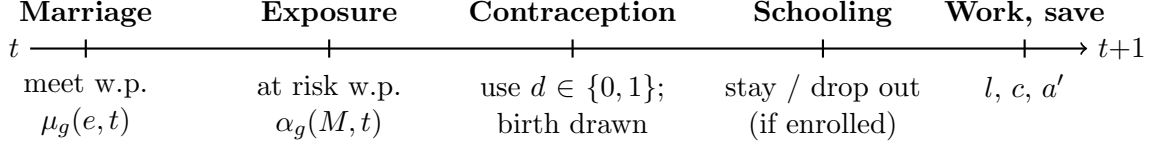


Figure 6. Timing Within a Fertile Period

Notes: Marriage is available to single women from age 18. Exposure and contraception apply to women with fewer than three children at ages 14–45; a conception in year t is a birth at the start of $t+1$. The schooling decision exists while enrolled (high school at 14–17, college at 18–21). The four-year working periods after 45 keep only the marriage stage and the last stage; retired periods keep only the marriage stage and consumption and saving.

4.2 Preferences

A woman's utility in year t is

$$\begin{aligned}
 U_t = & \underbrace{u(c_t)}_{\text{consumption}} + \underbrace{\Psi_g(t, e_t, m_t, n_t, k_t) l_t}_{\text{work}} + \underbrace{(\omega_0 + A(t) + \omega_u \mathbf{1}\{u = 2\}) b_t}_{\text{birth}} \\
 & + \underbrace{(\pi_n + \omega_y \mathbf{1}\{k_t \leq 5\}) n_t}_{\text{children}} + \underbrace{\sigma_l \varepsilon_t(l_t)}_{\text{taste shock}},
 \end{aligned} \tag{1}$$

where c_t is consumption per adult equivalent, $l_t \in \{0, 1\}$ is work, $b_t = 1$ in the year of a conception that she carries to term, n_t is the number of children, k_t the age of the youngest, and M her mother's education. Women discount the future at the annual rate β .

Consumption. Utility from consumption is $u(c) = c^{1-\gamma}/(1-\gamma)$. Household consumption is divided by the equivalence scale $\nu(m, n^h)$, which is how children cost money; utility is additively separable in consumption and work, as in [Eckstein et al. \(2019\)](#).

Work. The taste for work has four terms:

$$\Psi_g(t, e, m, n, k) = \underbrace{\psi_l(t, e)}_{\text{age, schooling}} + \underbrace{\psi_{lk,g}(e) \varrho(k) v_2^{\mathbf{1}\{n \geq 2\}}}_{\text{child penalty}} + \underbrace{\psi_{lm}(e) \mathbf{1}\{m > 0\}}_{\text{married}} + \underbrace{\psi_{lc,g}(e)}_{\text{cohort}}. \tag{2}$$

The first term is the disutility of work by schooling group, with age-band dummies for 14–25, 26–29, 30–37, 38–45, 46–49, 50–53 and 54–65, as [Keane and Wolpin \(2010\)](#) let the disutility of nonleisure time shift with age.

The second term is the child penalty, the additional disutility of working with a child at

home. Its level $\psi_{lk,g}(e)$ applies while the youngest child is under two. The factor $\varrho(k)$ is one at 0–1, ϱ_{2-5} at 2–5, ϱ_{6-17} at 6–17 and zero without a child at home, and v_2 scales the penalty for a mother of two or more. As in [Adda et al. \(2017\)](#), the cost of working with children falls with the age of the youngest child and rises with the number of children. The level is cohort-specific: it summarizes how compatible motherhood and work were for a cohort, through childcare, workplace flexibility and norms. How the penalty changes as the youngest child grows older, ϱ_{2-5} and ϱ_{6-17} , and with a second child, v_2 , is common to all cohorts.

The third term shifts the taste for work of married women. Without it, the model cannot match the employment gap between married and single women: the income effect of the husband’s earnings produces a much larger gap than in the data.

The fourth term is a cohort shift by schooling, zero for the baseline cohort. It stands for employment opportunities that median earnings do not capture, such as the job-offer rates that [Eckstein et al. \(2019\)](#) let differ by cohort, and for changes in women’s attitudes to work ([Fernández, 2013](#)).

Births and children. The third term of (1) is the value of a birth, received in the year of the conception. Its level ω_0 is why most women eventually want a child even though a birth is costly at every age. The value of a birth also changes with the age t at which it is conceived, through a quartic common to all women, $A(t) = \sum_{j=1}^4 \omega_{a,j} z^j$ with $z = (t-14)/31$; [Keane and Wolpin \(2010\)](#) specify the age effects in the utility of pregnancy the same way. Women also differ in how much they value a birth. As in [Keane and Wolpin \(2010\)](#), women belong to a finite number of unobserved preference types, here two, $u \in \{1, 2\}$, and a woman of type 2 values a birth by ω_u more at every age. The probability of type 2 depends on mother’s education, $\Pr(u = 2 | M) = \Lambda(q_0 + q_1(M - 1))$ with Λ the logistic function, and is the same in every cohort, as Keane and Wolpin let type probabilities depend on parental education. The type captures differences in fertility preferences across family backgrounds that the opportunity cost of a birth does not explain, such as norms about early motherhood.

The fourth term is the yearly utility of children. The parity taste π_n , as in [Eckstein et al. \(2019\)](#), lets the model fit completed fertility by mother’s education once the timing of the first birth is matched; with $\pi_n < 0$, each additional child is valued less than the first.

While the youngest child is five or younger, each child also gives utility ω_y . As in [Adda et al. \(2017\)](#), there is no choice of child quality: children cost money through the equivalence scale and time through the child penalty.

Taste shocks. The last term of (1) is the taste shock to the work choice. Every discrete choice except the claiming of cash welfare carries i.i.d. type-I extreme value taste shocks with a choice-specific scale.

Preferences are common to all cohorts except for the level of the child penalty and the cohort shift in the taste for work. A cohort difference in contraceptive use, abortion, births, schooling or marriage therefore has to come from a difference in the environment; only employment can also differ through tastes.

4.3 Fertility and fertility control

A woman with fewer than three children faces, in every year from 14 to 45, the risk of conception in three layers. Each layer corresponds to a distinct explanation of the decline.

Exposure. With probability $\alpha_g(M, t)$ a childless woman is sexually active during the year and therefore at risk of conception; a mother is at risk with probability one. Exposure is measured outside the model, by cohort, mother's education and single year of age, as the share of woman-years in which childless women are sexually active. It captures both later sexual debut and less activity after debut, the two margins of the decline in teen sexual activity ([Kearney and Levine, 2012](#)).

Fecundity. An exposed woman who does not contracept conceives within the year with probability

$$p^0(t, e, k) = \lambda_{\max} \Lambda(\theta_0 + \theta_{26-33} \mathbf{1}\{26 \leq t \leq 33\} + \theta_{34-45} \mathbf{1}\{t \geq 34\} + \theta_H \mathbf{1}\{e \leq H\} + \theta_D \mathbf{1}\{e = D, t \leq 25\}) (1 - \delta_{pp} \mathbf{1}\{k = 0-1\}), \quad (3)$$

a logistic function of age-band and schooling dummies, as in [Carro and Mira \(2006\)](#), scaled by $\lambda_{\max} = 0.85$, the first-year conception rate of women using no method ([Trussell, 2011](#));

δ_{pp} is the postpartum reduction in fecundity in the two years after a birth, set outside the model. The schooling dummies stand for coital frequency and for the care taken by women who do not report a method; fecundity is common to all cohorts.

In the index, a high-school student enters as a dropout and a college student as a high-school graduate, so that θ_D and θ_H describe the fecundity of women still in school as well as of those who left at that level.

Contraception. An exposed woman chooses whether to use contraception, $d \in \{0, 1\}$. A user conceives with probability $\rho_g(M) p^0(t, e, k)$, where $\rho_g(M) \in (0, 1)$ is the typical-use failure rate of cohort g 's method mix relative to using no method. The failure rate is measured outside the model: its level from each cohort's method mix in the NSFG, and its gradient in mother's education from the failure rates by poverty status of [Sundaram et al. \(2017\)](#), which are higher for poor women with every method (see also [Rosenzweig and Schultz, 1989](#)). The separation of the cost of contraception from its efficacy goes back to [Michael and Willis \(1976\)](#).

Use carries a utility cost, which stands for the price of a method, the effort of obtaining it, side effects, negotiation with a partner and stigma ([Black et al., 2010](#)). As in [Hotz and Miller \(1993\)](#), the cost is a quadratic in age plus a linear term in education, here the mother's:

$$\begin{aligned} \phi_{s,g}(t, M, n) = & \underbrace{\phi_{s,g} + \Delta\phi_{s,g}^m \mathbf{1}\{t \leq 17\}}_{\text{cohort level, minors}} + \underbrace{\phi_{s,1}(t - 14) + \phi_{s,2}(t - 14)^2}_{\text{age}} \\ & + \underbrace{\kappa_M(M - 1)}_{\text{family}} + \underbrace{\mathbf{1}\{n > 0, t \leq 21\} \Delta\phi_s^{mom}}_{\text{young mothers}}. \end{aligned} \quad (4)$$

The level $\phi_{s,g}$ differs across cohorts. So does the *premium for minors*, $\Delta\phi_{s,g}^m$, for the rules and prices that women under 18 face: parental consent and notification, confidentiality, the reach of subsidized clinics, and buying a method without income or insurance ([Kearney and Levine, 2009](#); [Packham, 2017](#)). The age profile $\phi_{s,1}, \phi_{s,2}$, the slope in mother's education κ_M , which captures differences in information about methods or in access through the family beyond those the model generates through the opportunity cost of a birth, and the *premium for young mothers* $\Delta\phi_s^{mom}$, which applies to mothers aged 21 or younger and governs the

spacing of births after an early first birth, are common to all cohorts. As in [Hotz and Miller \(1993\)](#) and [Arcidiacono et al. \(2012\)](#), age enters the use decision only through the cost.

Let $\Delta V = V^b - V^{nb}$ be the value of a birth, the value of the rest of the period with a birth minus its value without one; it is negative when a birth is unwanted. The use decision has type-I extreme value taste shocks with scale σ_s . Writing $\phi_{s,g}$ for $\phi_{s,g}(t, M, n)$ and ρ_g for $\rho_g(M)$, the value of an exposed childless woman before she decides is

$$V^{nb} + \sigma_s \log \left[\exp \left(\frac{p^0 \Delta V}{\sigma_s} \right) + \exp \left(\frac{\rho_g p^0 \Delta V - \phi_{s,g}}{\sigma_s} \right) \right], \quad (5)$$

she uses contraception with probability

$$P^{use} = \Lambda \left(\frac{(1 - \rho_g) p^0 (-\Delta V) - \phi_{s,g}}{\sigma_s} \right), \quad (6)$$

where Λ is the logistic function, and, before exposure is drawn, she has a birth this period with probability

$$p^b = \alpha_g(M, t) p^0(t, e, k) [1 - (1 - \rho_g) P^{use}]. \quad (7)$$

Equations (6)–(7) are the core of the decomposition. An early birth becomes less likely when avoiding it is worth more, because $-\Delta V$ rises with a woman's wage, schooling and marriage prospects and falls with how much the safety net insures a birth; when use is cheaper ($\phi_{s,g}$); when methods fail less often; and when fewer women are exposed (α_g). Parity enters fertility through ΔV , the value of an additional birth at the woman's current parity, and, for mothers aged 21 or younger, through the use cost.

Abortion. After a conception, a woman ends the pregnancy with probability

$$P^{ab} = \Lambda \left(\frac{-\Delta V - \phi_{a,g}(t, M)}{\sigma_a} \right), \quad (8)$$

where σ_a is the scale of the taste shocks of the abortion decision. The cost stands for the price of an abortion, the distance to a provider, legal restrictions such as parental-involvement

laws, and stigma:

$$\phi_{a,g}(t, M) = \phi_{a,g} + \Delta\phi_a \mathbf{1}\{t \geq 18\} + \kappa_a(M - 1) \mathbf{1}\{t \leq 21\}. \quad (9)$$

The level $\phi_{a,g}$ differs across cohorts and carries the changes in access over time. The shift $\Delta\phi_a$ applies from age 18 and fits the higher abortion share of minors' conceptions; the slope κ_a applies through age 21, the ages at which the abortion share by mother's education is measured, after which the woman's own schooling takes the place of her mother's; both are common to all cohorts.

Abortion insures against contraceptive failure. The value of a conception, $G = \sigma_a \log[\exp(\Delta V/\sigma_a) + \exp(-\phi_{a,g}(t, M)/\sigma_a)]$, replaces ΔV in (5) and (6), and the birth probability (7) is multiplied by $1 - P^{ab}$. A cheaper abortion therefore lowers births directly and raises them indirectly, by weakening the incentive to use contraception (Kane and Staiger, 1996). The slope κ_a matters for the same reason. Daughters of more-educated mothers end a much larger share of their first teen pregnancies in abortion, while their contraceptive use is about the same. Cheaper abortion for daughters of more-educated mothers is how the model reproduces teenage contraceptive use that barely varies with mother's education.

4.4 Schooling

All women are enrolled in high school at 14 and receive an annual consumption allowance h_g from their families while enrolled. In each year from 14 to 17, after the conception outcome, a student chooses whether to continue or to drop out and work. Continuing carries a psychic cost $\phi_H(M) = \phi_{H,0} + \phi_{H,M}(M - 1)/3$ for every student, which is what generates dropout among women who do not become mothers, and the extra cost ϕ_H^k for a mother, plus $\phi_H^{k,0}$ while her child is under two. A woman who completes the fourth year is a high-school graduate at 18 and chooses whether to enter college, at a psychic cost

$$\kappa_C(M, n^h) = \xi_C + \xi_M(M - 1) + \mathbf{1}\{n^h > 0\} \phi_C^k,$$

linear in mother's education as the schooling utility of [Eckstein et al. \(2019\)](#) is linear in parents' education, and higher for a woman who has already had a child. Students do not work. A college student receives the parental allowance $a_g^C s_g(M)$, plus need-based aid g_g if her mother did not finish high school, and pays tuition and fees TC_g each year. The allowance has a cohort-specific level a_g^C and a profile $s_g(M)$, family income at 14–17 by mother's education relative to its mean. The entry decision is available to single graduates: the marriage offer at 18 precedes it, so a woman who marries at 18 does not enter college. In each of the four college years, after the conception outcome, she chooses whether to continue, at the cost ϕ_{CD}^k if she is a mother, or to leave as a high-school graduate; completing the fourth year makes her a college graduate at 22, at a graduation cost ϕ_G . There is no re-entry, so schooling is final by 22.

4.5 Marriage

From age 18 a single woman who is not a student meets a potential husband with probability $\mu_g(e, t)$ and marries if the value of marriage, plus a type-I extreme value taste shock with scale σ_m that stands for the qualities of the match the model does not price ([Sheran, 2007](#); [Van der Klaauw, 1996](#)), exceeds that of remaining single; marriage is absorbing. A married household pools income, including the husband's earnings $w_g^h(e, t, m)$, which depend on the woman's schooling, her age, and whether she married before or after her first birth, since women who marry after a birth match with lower-earning husbands ([Appendix F](#)). Consumption is shared through the equivalence scale $\nu(m, n^h) = 1 + \nu_a \mathbf{1}\{m > 0\} + \nu_k n^h$, where n^h is the number of children at home. The meeting rates and the husbands' earnings are cohort-specific. Marriage insures the cost of an early birth, so fewer marriage opportunities raise the value of avoiding one; for a single woman, the safety net replaces part of that insurance.

4.6 Labor market

A working woman earns a cohort-specific annual earnings profile $w_g(M, e, x, t)$: the cohort's age profile of median earnings by education, from the CPS, around which earnings vary with experience and family background according to equations estimated on the NLSY (Ap-

pendix F). The returns to schooling and experience, and their growth across cohorts, are the core of the opportunity-cost channel: a woman whose returns to college and to experience are higher loses more from a birth that ends her schooling or keeps her out of work. Experience accumulates with years of work, and after retirement a woman receives Social Security.

4.7 Government: taxes and the safety net

Taxes and transfers follow the federal statutes and the median state's rules in force for each cohort, program by program, as in Keane and Wolpin (2010) and Low et al. (2022). Disposable annual income is

$$y^{net} = y - \mathcal{T}_g(y; m, n^h) + \text{EITC}_g(y; m, n^h) + \varpi B_g(y^f; n^h) + FS_g(y, \varpi B_g; 1 + \mathbf{1}\{m > 0\} + n^h), \quad (10)$$

where y is gross household earnings, y^f the woman's own earnings, $\mathcal{T}_g$ the federal income and payroll taxes, EITC_g the earned income tax credit, FS_g food stamps, and B_g the AFDC/TANF cash benefit of a single mother,

$$B_g(y^f; n^h) = \max \{ \bar{B}_g(n^h) - \chi_g \max\{y^f - D_g, 0\}, 0 \},$$

with maximum $\bar{B}_g(n^h)$ by family size, benefit-reduction rate χ_g and disregard D_g . Claiming, $\varpi \in \{0, 1\}$, carries a utility cost $\eta_g^w + \Delta \eta^w \mathbf{1}\{t \leq 21\}$, the standard representation of stigma and hassle costs (Keane and Moffitt, 1998; Low et al., 2022; Moffitt, 1983); its cohort level also absorbs the parts of TANF the model does not represent, such as work requirements and sanctions. Three rules matter for teenagers and young mothers: a minor mother's benefit is reduced when her parents' income is deemed to her unit, under TANF she receives it only while she attends high school (U.S. Congress, 1996), and TANF limits adult receipt to $\bar{\tau}_g$ years, a constraint carried in the state as in Low et al. (2022). Appendix C.2 gives the details. The safety net acts on early fertility through the incentive: a more generous guarantee lowers the cost of a birth to a single woman, the minor-parent rules raise it for a teenager, and an EITC that pays only if she works raises the value of the schooling and experience that a birth puts at risk.

4.8 Recursive problem

I state the problem of a single woman who has finished school, in a year of the fertile window, and relegate the other cases to Appendix C. Let V_t^1 , V_t^2 and V_t^3 denote the values at the marriage, fertility and work-saving stages, and let $b \in \{0, 1\}$ record whether a conception carried to term occurred this year, so that next year's child state is $(n + 1, 0-1)$ if $b = 1$ and (n, k') otherwise, with k' the youngest child's bin after its stochastic ageing. At the work-saving stage,

$$\begin{aligned} v_t^3(\Omega_t, b, l) = \max_{c, a', \varpi} & \left\{ u(c) + \Psi_g(t, e, m, n, k) l - (\eta_g^w + \Delta \eta^w \mathbf{1}\{t \leq 21\}) \varpi \right. \\ & + (\omega_0 + A(t) + \omega_u \mathbf{1}\{u = 2\}) b \\ & \left. + (\pi_n + \omega_y \mathbf{1}\{k \leq 5\}) n + \beta \mathbb{E} V_{t+1}^1(\Omega_{t+1}) \right\} \\ \text{s.t. } & \nu(m, n^h) c + a' = (1 + r) a + y_g^{net}(\Omega_t, l), \\ & a' \geq 0, \quad x_{t+1} = x_t + l, \end{aligned}$$

and

$$V_t^3(\Omega_t, b) = \sigma_l \log \sum_{l \in \{0, 1\}} \exp(v_t^3(\Omega_t, b, l) / \sigma_l).$$

At the fertility stage, with $\Delta V_t = V_t^3(\Omega_t, 1) - V_t^3(\Omega_t, 0)$ the value of an additional birth and G_t its abortion-adjusted counterpart,

$$V_t^2(\Omega_t) = V_t^3(\Omega_t, 0) + \alpha_g(M, t, n) \sigma_s \log \left[e^{p^0 G_t / \sigma_s} + e^{(\rho_g(M) p^0 G_t - \phi_{s,g}(t, M, n)) / \sigma_s} \right],$$

which is (5) averaged over exposure; for a woman with three children $V_t^2 = V_t^3(\Omega_t, 0)$. At the marriage stage, with $m^* = 1$ for a childless woman and $m^* = 2$ for a mother,

$$V_t^1(\Omega_t) = \mu_g(e, t) \sigma_m \log \left[e^{V_t^2(\Omega_t | m=m^*) / \sigma_m} + e^{V_t^2(\Omega_t | m=0) / \sigma_m} \right] + (1 - \mu_g(e, t)) V_t^2(\Omega_t | m=0).$$

The model is solved by backward induction over the 41 periods (Appendix C.9).

4.9 What differs across cohorts

A cohort is a vector of primitives. I split the primitives into those common to all cohorts and ten cohort-specific blocks, each a distinct explanation of the decline and the unit the decomposition replaces. Table 3 lists them, with how each is disciplined.

Two features of this split matter for interpretation. First, preferences over children, fecundity and the psychic costs of schooling are common to all cohorts; the only cohort-specific tastes are the child penalty and the shift in the taste for work, both disciplined by CPS employment. As in [Eckstein et al. \(2019\)](#), there is no cohort-specific taste for early births that could absorb the decline. Second, efficacy and exposure are measured outside the model, so the cost of contraception is the only fertility-control primitive whose change across cohorts is inferred from births and contraceptive use. A decline that the measured changes cannot account for shows up there or as poor fit, and the fit to the untargeted holdout cohort tests the model.

5 Estimation

I estimate the common parameters and the estimated cohort-specific primitives by the Simulated Method of Moments, pooling the three cohorts in one criterion, as [Eckstein et al. \(2019\)](#) do for the three cohorts on which they estimate preferences. Pooling disciplines the common parameters: preferences, fecundity and the psychic costs of schooling have to rationalize every cohort at once, so cohort differences in behavior have to come from the cohort-specific blocks of Table 3. Because every cohort is measured with the same surveys and definitions, a difference in targeted moments across cohorts is a change in behavior rather than in measurement. Women born in 1984–1988 are not used in estimation and serve as a holdout sample ([Keane and Wolpin, 2007](#)).

Parameters set outside the model. Risk aversion, the discount factor and the interest rate follow [Adda et al. \(2017\)](#), the equivalence scale is the OECD-modified scale, and the yearly utility of a young child is fixed at 0.18. The measured cohort-specific primitives are set cohort by cohort (Appendix E.1). Women’s earnings combine the CPS age profile of median

Table 3. Cohort-Specific Blocks of Primitives

Block	Primitives	Disciplined by
1 Women’s labor-market opportunities	$w_g(M, e, x, t); \psi_{lc,g}(e)$	CPS earnings profiles, each cohort; estimated (CPS employment)
2 Schooling costs and support	$TC_g; h_g, a_g^C, g_g; s_g(M)$	Tuition data; estimated; CPS family income by mother’s education
3 Cost of contraception	$\phi_{s,g}; \Delta\phi_{s,g}^m$ (ages 14–17)	Estimated
4 Efficacy of contraception	$\rho_g(M)$	Method mix $\times$ typical-use failure; gradient in M from failure by poverty status
5 Exposure	$\alpha_g(M, t)$	Age at first intercourse; intercourse in the last three months
6 Marriage market	$\mu_g(e, t); w_g^h$	Estimated; CPS husbands’ earnings
7 Taxes and safety net	$\mathcal{T}_g; \text{EITC}_g; \bar{B}_g(n^h), \chi_g, D_g, \bar{\tau}_g; FS_g; \varsigma_g(M); \eta_g^w$	Statutes and program rules, each cohort; η_g^w estimated (CPS claiming)
8 Child penalty	$\psi_{lk,g}(e)$	Estimated
9 Family background (composition)	$\pi_g(M)$	NSFG shares of mother’s education
10 Cost of abortion	$\phi_{a,g}$	Estimated; abortion ratios by age
Common to all cohorts	$\gamma, \beta, r; \theta_0, \theta_{26-33}, \theta_{34-45}, \theta_H, \theta_D, \delta_{pp};$ $\omega_0, \omega_{a,j}, \omega_u, q_0, q_1, \omega_y, \pi_n;$ $\psi_l(t, e), \psi_{lm}(e), \varrho_{2-5}, \varrho_{6-17}, v_2, \psi_{ret}; \xi_C, \xi_M; \phi_{H,0}, \phi_{H,M};$ $\phi_H^k, \phi_H^{k,0}, \phi_C^k, \phi_{CD}^k, \phi_G; \phi_{s,1}, \phi_{s,2}, \kappa_M, \kappa_a, \Delta\phi_s^{mom}; \nu_a, \nu_k;$ $\Delta\phi_a; \Delta\eta^w; \sigma_s, \sigma_a, \sigma_l, \sigma_m, \sigma_C, \sigma_{CD}, \sigma_H$	

Notes: “Estimated” primitives are estimated by SMM jointly with the common parameters, pooling the three cohorts (Section 5). All other cohort-specific primitives are measured outside the model, cohort by cohort.

earnings by education with the experience and family-background premia estimated on the NLSY, and husbands' earnings are scaled to the CPS earnings of husbands. Exposure comes from the NSFG rounds fielded when each cohort was at the corresponding age. Efficacy is the typical-use failure rate of each cohort's method mix at 15–21 relative to the 85 percent annual conception rate of women using no method: $\rho_g = 0.141, 0.151$ and 0.102 , as the condom replaced part of the pill for the peak cohort and implants and IUDs spread for the decline cohort. Taxes and transfers follow the rules in force when each cohort turned 20 (the tax rules of 1984, 1998 and 2014 and the nearest AFDC/TANF schedules, of January 1985, July 1998 and July 2014), and the minor-parent rules those in force when it was 14–17. Money amounts are divided by an index of aggregate real income (1.00, 1.18 and 1.33), so that growth common to all incomes does not by itself move choices.

Moments and criterion. For each cohort I build the same moments from the NSFG and the CPS: births per woman by single year of age from 14 to 24, the stock of first births by age and mother's education, children ever born and second births; contraceptive use among sexually active childless women at 15–17 and 18–21, overall and by mother's education, and by schooling at later ages; the abortion share of first pregnancies at 15–17 and 18–21 and by mother's education; high-school dropout and college attendance, by teen birth and by mother's education; marriage by schooling and age; employment by schooling and age, of childless women, of mothers by the age of the youngest child and of married women; and the share of single mothers who claim cash welfare. Two moments from the NSFG pregnancy files discipline the preference type and the conception technology: the share of first births conceived at 14–17 and at 18–21 that the mother reports as intended, and the share of those conceptions that occurred while a method was used, both by mother's education. One moment disciplines the abortion–use margin: the response of births at 15–17 to a 25% higher abortion cost for minors, with a target of zero (Section 5.2). A cell is targeted when it has at least 30 observations, which leaves 250, 240 and 153 moments for the three cohorts. The criterion is the sum of squared proportional deviations with equal weight on every cell: a share is scaled by its Bernoulli standard deviation, and a birth rate or a first-birth stock, the objects of the decomposition, by its own level, so that a 20% miss of a birth rate of 0.05

counts as much as a 20% miss of a share of one half (Appendix E.2). The parameter vector has 65 common parameters and 24 cohort-specific ones per cohort.

Incomplete life cycles. The decline cohort is observed to about age 27 in the NSFG and 33 in the CPS. As in Attanasio et al. (2008) and Eckstein et al. (2019), each cohort is scored only at the ages at which it is observed, its earnings beyond that age follow the baseline cohort’s age profile from its own level, marriage-meeting rates beyond the window are held at the previous cohort’s values, and women know their cohort’s primitives over the whole life cycle. Completed fertility beyond the window is a forecast of the model.

Identification. The first-birth stocks by age and mother’s education identify fecundity and, given exposure, the value of a birth ω_0 ; children ever born and second births identify the parity taste π_n . The schooling, marriage and employment moments pin down the continuation values, and hence ΔV , in each schooling-age cell. Given ΔV , contraceptive use among exposed women identifies the cost of use relative to the scale σ_s , and the variation of use across cells, which moves ΔV at a given cost, identifies σ_s . Use at 15–17 relative to use at older ages identifies the minors’ premium on the cost of use and the age profile of the cost; the nearly flat gradient of use in mother’s education, against an incentive that rises steeply with it, identifies κ_M . The abortion shares identify the abortion costs, and births by single year of age the age profile $A(t)$. The share of first births reported as intended and the share of conceptions that occur under a method identify the preference type: a type that values a birth conceives without a method and carries the conception to term, and its probability by mother’s education is read from the gradient of the intended share. Without these moments the type is not identified, because at the estimates no woman of the common type values a birth before 22. Employment by schooling and age identifies ψ_l ; employment of mothers relative to childless women, by the age of the youngest child, the child penalty and its profile; employment of married women ψ_{lm} ; and differences in employment across cohorts at given earnings $\psi_{lc,g}$.

5.1 Estimates

Table 4 reports the cohort-specific primitives, the objects the decomposition moves, next to the measured inputs of the same blocks; Appendix Table E.3 reports every parameter. Three features stand out. First, the measured margins of fertility control moved in opposite directions across the two phases. Exposure at 15–17 rose from 0.224 to 0.267 between the baseline and the peak cohort and fell back to 0.206 for the decline cohort, and the efficacy of the methods young women used was about constant in the rise and improved by a third in the decline (the relative failure rate fell from 0.151 to 0.102), as long-acting methods spread. Second, the estimated cost of contraceptive use was 0.052 and 0.056 in utility units for women of 18 and older in the baseline and the peak cohort and fell to 0.030 for the decline cohort, while the additional cost that minors face rose from 0.015 for the baseline cohort to 0.043 for the peak cohort and was 0.028 for the decline cohort. Minors of the baseline cohort therefore faced a cost of use a third above the adult one, minors of the peak cohort nearly twice it, and minors of the decline cohort twice an adult cost that had itself fallen by almost half. The cost is a residual—it absorbs whatever made use costlier given the value of avoiding a birth—but its path lines up with the history of subsidized family planning, the main source of confidential contraceptive care for minors. Federal Title X appropriations averaged \$137 million a year while the baseline cohort was 15–19 (1977–1985) and \$183 million while the peak cohort was (1991–1999), 27% less in real terms (CPI-U; [Office of Population Affairs, 2024](#)); between 1980 and 1994, total public spending on contraceptive services fell by 27% in real terms, as Title X fell by 65% and Medicaid, which mostly covers low-income adult women, grew by 70% ([Sollom et al., 1996](#)). The decline cohort, teenagers in 2007–2015, came of age after the Medicaid family-planning expansions ([Kearney and Levine, 2009](#)) and the first state programs that offered long-acting methods at no cost ([Kelly et al., 2020](#); [Lindo and Packham, 2017](#)), and its estimated cost of use is the lowest of the three. Not every change in access went the same way—condom promotion spread with HIV prevention in the late 1980s and 1990s—so I read the estimate as the net of these forces. Third, the cost of abortion rose across cohorts, from 0.75 to 1.01 and 1.25, which the model reads from the falling abortion share of teen conceptions (Table 5). The direction matches the history of access:

the number of abortion providers fell from 2,908 in 1982 to 2,042 in 1996 (Henshaw, 1998), and parental-involvement laws enacted before the mid-1990s lowered minors’ abortion rates by 15–20% (Joyce et al., 2020). Need-based aid to daughters of mothers without a diploma rose from 3 to 9 and 40 thousand dollars a year. The college allowance is 34 thousand for the baseline cohort and 65 for the decline cohort; the peak cohort’s allowance, 26, is the least well identified primitive of the vector (its value across the population of the search ranges over an eighth of its box), and its estimate will move before the final vector.

Among the common parameters, the cost of use falls with mother’s education ($\kappa_M = -0.030$ per step of education, against an adult cost of 0.03–0.06) and so does the cost of abortion ($\kappa_a = -0.22$ per step, through age 21); the age polynomial of the use cost is estimated at zero; the scale of the use taste shock is $\sigma_s = 0.057$, and the abortion cost is 0.28 higher from 18 on with a taste scale $\sigma_a = 0.60$. The marriage taste shock has scale $\sigma_m = 0.06$. The preference type of Keane and Wolpin (2010) is identified by the NSFG wantedness moments: the second type values a birth by $\omega_u = 1.52$ more than the first at every age, against a common value of a birth of -0.75 , so it is the type for which a conception at 15–21 is worth carrying to term; its probability falls with mother’s education, from 0.38 among daughters of mothers without a diploma to 0.27, 0.19 and 0.12 among daughters of high-school graduates, of mothers with some college and of college graduates. The share of first births conceived at 14–17 that the model classifies as intended—a conception without a method by a woman who values the birth—is 0.38, 0.24 and 0.18 in the three cohorts, against 0.29, 0.25 and 0.18 in the NSFG pregnancy files.

5.2 Model fit

Following Eckstein et al. (2019), I judge the model by its fit to every targeted moment of every cohort (Appendix Table E.4), by its fit to the objects the decomposition is about (Table 5, Figures 7 and 8), and by its prediction for a cohort it was not estimated on: women born in 1984–1988, whose primitives are interpolated between the peak and the decline cohorts and whose moments are never used in estimation. The estimates are preliminary, and work on improving the fit of the model is ongoing.

Table 4. Cohort-Specific Primitives

	1962–1966	1976–1980	1992–1996
<i>Measured inputs</i>			
Efficacy: failure rate of the users’ method mix relative to no method, ρ_g	0.141	0.151	0.102
Exposure: childless women sexually active at 15–17, α_g	0.224	0.267	0.206
College tuition, fees (thousand 2016\$ per year), TC_g	5.57	8.34	12.60
Cash-welfare time limit (years)	none	5	5
Share of mothers without a high-school diploma, $\pi_g(1)$	0.281	0.225	0.162
<i>Estimated</i>			
Cost of contraceptive use, $\phi_{s,g}$	0.052	0.056	0.030
additional at ages 14–17, $\Delta\phi_{s,g}^m$	0.015	0.043	0.028
Cost of abortion, $\phi_{a,g}$	0.754	1.014	1.252
Child penalty on work, HS graduates, $\psi_{lk,g}(2)$	-0.048	-0.032	-0.037
Work taste, cohort shift, HS graduates, $\psi_{lc,g}(2)$	0.000	-0.006	-0.002
Marriage-meeting rate, HS graduates 16–21, μ_g	0.252	0.162	0.023
College allowance (thousand 2016 \$ per year, de-trended), a_g^C	34.4	25.7	65.3
Need-based aid, daughters of mothers without a diploma, g_g	3.1	9.0	40.4
Cost of claiming cash welfare, η_g^w	0.0190	0.0232	0.0186

Notes: Measured inputs as described in Section 3.1 and Appendix A; exposure is the share of childless women sexually active in the last three months, averaged over ages 15–17 and weighted by the cohort’s family-background shares. Costs and penalties are in utility units.

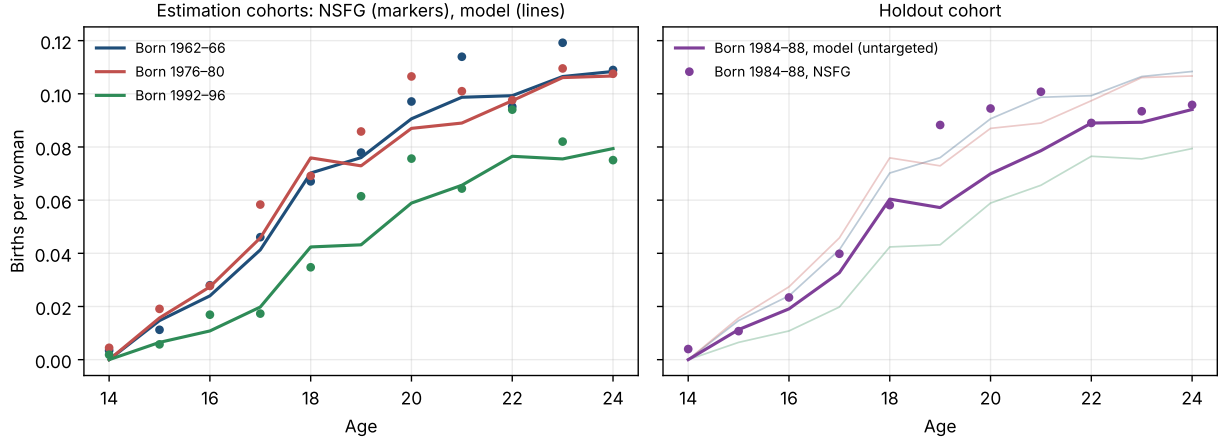


Figure 7. Births per Woman by Age: Data and Model

Notes: Births of any order per woman at each age, NSFG (markers) and model (lines). Left: the three estimation cohorts. Right: the untargeted holdout cohort born in 1984–1988, with the estimation cohorts around it in light colors.

Early childbearing. The model reproduces the level and the decline of teen births and the direction of the rise (Figure 7). Births per woman at 15–19 are 0.226, 0.238 and 0.123 in the model against 0.230, 0.260 and 0.136 in the data, 2, 8 and 10% low; first births by 21 are 0.320, 0.312 and 0.206 against 0.305, 0.325 and 0.228. The decline is 11.5 births per 100 women against 12.4, and 10.6 points of first births by 21 against 9.7; the rise is 1.2 births against 3.0, and first births by 21 fall by 0.8 points where the data rise by 2.0. First births by 17 in the peak cohort are 0.080 against 0.099. Births at 20–24 are 6–9% low in every cohort (0.50, 0.49 and 0.36 against 0.53, 0.52 and 0.39); the progression of teen mothers to a second birth within four years fits in the baseline and decline cohorts (0.56 and 0.47 against 0.55 and 0.45) and is 5 points low in the peak cohort. Within the early twenties the model bunches first births at 21–22, after high school and college end: the first-birth rate at 22 is 0.06 against 0.04 in every cohort, and at 19 it is 0.058, 0.054 and 0.035 against 0.054, 0.057 and 0.051.

Family background. Figure 8 shows the gradients that motivate the model’s treatment of family background. In the data, first births by 17 and by 21 fall steeply with the mother’s education, while contraceptive use among sexually active girls barely varies with it. The model reproduces the gradient in births in the baseline and peak cohorts; in the decline

cohort it understates first births by 21 among daughters of mothers without a diploma (0.35 against 0.48), the group whose early births did not fall in the data. It reproduces the flat gradient in use in the peak and decline cohorts; in the baseline cohort, use at 15–17 among daughters of college graduates is 0.54 against 0.80. The composition test of Table 6 compares the split of each cohort change into a composition and a within-background term in the data and in the model. The model matches the composition terms of early first births (for first births by 21: -2.9 and -2.1 points against -3.0 and -2.3) and the within term of the decline (-8.5 against -7.5), and the sign of the within term of the rise ($+2.2$ against $+5.0$). In the data teen contraceptive use rose by 5 points from the baseline to the peak cohort and by 10 points from the peak to the decline cohort, all within family backgrounds; in the model it rises by 10 and 16 points.

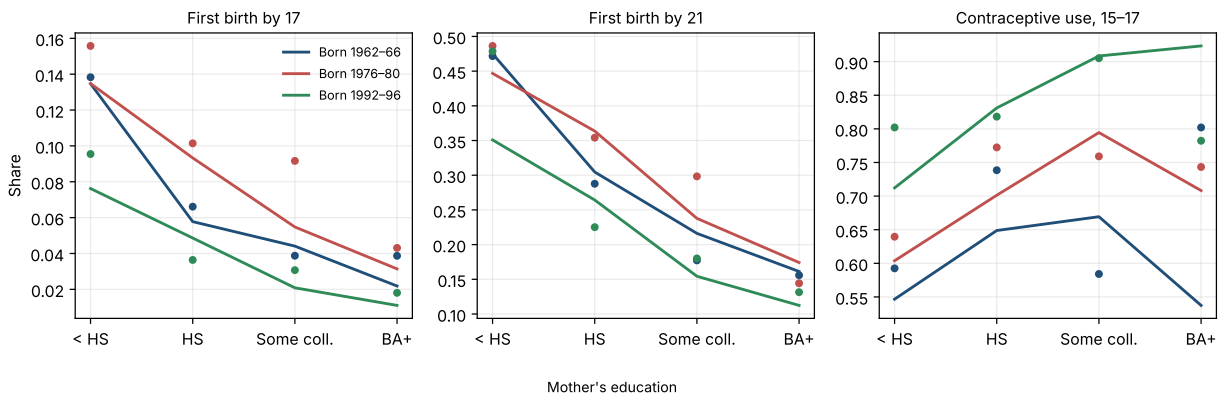


Figure 8. Early Childbearing and Contraceptive Use by Family Background: Data and Model

Notes: By mother's education. First births by 17 and by 21: share of women; contraceptive use: current use of any method among childless girls aged 15–17 who were sexually active in the last three months. NSFG (markers) and model (lines), estimation cohorts.

Margins of fertility control. Contraceptive use at 18–21 fits within 3 points in every cohort, and at 15–17 the model is 6 points below the baseline cohort's data (0.61 against 0.67), 3 below the peak cohort's and 1 above the decline cohort's. The abortion share of conceptions at 15–17 fits in the peak and decline cohorts (0.37 and 0.32 against 0.39 and 0.31) and is 10 points low in the baseline cohort (0.43 against 0.53); at 18–21 it is 0.34, 0.27 and 0.21 against 0.46, 0.35 and 0.26. The share of first conceptions at 14–17 that occur while a method is used is 0.14, 0.20 and 0.29 against 0.17, 0.33 and 0.39.

Table 5. Fit of Early Childbearing and Its Margins, and the Holdout Cohort

	Born 1962–66		Born 1976–80		Born 1992–96		Born 1984–88	
	Data	Model	Data	Model	Data	Model	Data	Prediction
Births per woman, 15–19	0.230	0.226	0.260	0.238	0.136	0.123	0.220	0.181
Births per woman, 20–24	0.534	0.503	0.522	0.486	0.391	0.356	0.474	0.421
First birth by 17	0.079	0.072	0.099	0.080	0.039	0.035	0.070	0.058
First birth by 21	0.305	0.320	0.325	0.312	0.228	0.206	0.290	0.258
mother without a diploma	0.472	0.475	0.486	0.447	0.479	0.351	0.495	0.423
mother with a BA or more	0.156	0.161	0.144	0.174	0.131	0.112	0.168	0.132
Contraceptive use, 15–17	0.670	0.606	0.735	0.705	0.845	0.856	0.828	0.790
Contraceptive use, 18–21	0.783	0.767	0.829	0.833	0.852	0.885	0.825	0.871
Abortions per conception, 15–17	0.527	0.428	0.385	0.374	0.314	0.324	0.358	0.345
Abortions per conception, 18–21	0.459	0.335	0.354	0.271	0.259	0.206	0.291	0.247
First births reported as intended, conceived at 14–17	0.287	0.381	0.250	0.243	0.183	0.178	0.205	0.156
First conceptions at 14–17 while using a method	0.167	0.138	0.331	0.198	0.391	0.294	0.409	0.256
Second birth within 4 years, first at 15–17	0.549	0.563	0.598	0.551	0.448	0.469	0.624	0.516
No HS diploma (no teen birth)	0.131	0.153	0.143	0.140	0.081	0.070	0.129	0.091
College attendance	0.538	0.524	0.646	0.564	0.697	0.727	0.687	0.658
Ever married by 21, HS diploma	0.426	0.473	0.287	0.341	0.188	0.160	0.214	0.248
Employed 26–29, BA+	0.768	0.723	0.743	0.755	0.775	0.791	0.726	0.775
Single mothers on AFDC/TANF, 18–21	0.493	0.476	0.235	0.178	0.069	0.108	0.119	0.126

Notes: Data: NSFG, except employment and cash welfare (CPS ASEC). Births per woman: sum of the single-age birth rates. First births by age: weighted by each cohort’s shares of mother’s education. Contraceptive use: current use among sexually active childless women. Abortions per conception: abortion ratios (Appendix A). Intended: first births whose conception the mother reports as wanted then or sooner; while using a method: first conceptions that occurred while a method was used (NSFG pregnancy files). The 1984–1988 cohort is not used in estimation; its primitives are interpolated between the 1976–1980 and 1992–1996 cohorts.

Table 6. Composition and Within-Background Changes: Data and Model

		Rise: 1962–66 → 1976–80			Decline: 1976–80 → 1992–96		
		Change	Composition	Within	Change	Composition	Within
First birth by 17	Data	+2.0	-0.9	+2.9	-5.9	-0.6	-5.3
	Model	+0.8	-0.9	+1.7	-4.5	-0.7	-3.9
First birth by 21	Data	+2.0	-3.0	+5.0	-9.7	-2.3	-7.5
	Model	-0.8	-2.9	+2.2	-10.6	-2.1	-8.5
Contraceptive use, 15–17	Data	+5.0	+0.2	+4.8	+9.8	+0.5	+9.3
	Model	+9.5	+0.6	+8.9	+15.6	+1.4	+14.2

Notes: Percentage points. The change between cohorts is split exactly as in Table 2: composition $\sum_M \Delta\pi(M)\bar{y}(M)$ and within $\sum_M \bar{\pi}(M)\Delta y(M)$, with bars denoting averages of the two cohorts and π the NSFG family-background shares in both rows.

The abortion–use margin. The cost of abortion acts on births through two channels: a share of conceptions that end in abortion, and the use of contraception by women who know that a conception will be costlier to end. The quasi-experimental evidence bounds the net of the two. Parental-involvement laws lowered minors’ abortions by 15–20% and left their births about unchanged (Joyce et al., 2020), so the fall in abortions was offset by fewer conceptions. I target this response with one moment: the proportional change in the model’s births at 15–17 when the minors’ abortion cost of the peak cohort rises by 25%, with a target of zero. At the estimates the response is -0.7% : the model’s minors react to costlier abortion by using contraception a little more, so that the fall in abortions is almost exactly offset by fewer conceptions, as in the evidence. The response is what gives the cost of abortion its weight in the decomposition of Section 6.2: a model whose births responded more to the cost of abortion would attribute part of the decline to that block and less to the cost and efficacy of contraception.

Schooling, marriage and work. College attendance fits in the baseline and decline cohorts (0.52 and 0.73 against 0.54 and 0.70) and is 0.56 against 0.65 in the peak cohort. Attendance after a teen birth is 0.14 and 0.27 in the peak and decline cohorts against 0.34 and 0.38. Dropout among women without a teen birth fits within 2 points in every cohort.

Appendix Figure [G.1](#) shows employment and marriage by age and education. Employment by age and education fits within a few points except for married women at 22, who work 5–10 points less in the model than in the CPS in every cohort. Marriage fits for college graduates. Marriage by 21 is 0.47 and 0.34 against 0.43 and 0.29 among high-school graduates of the two older cohorts, and 0.30 against 0.14 among dropouts of the decline cohort. The share of single mothers on cash welfare at 18–21 is 0.11 against 0.07 in the decline cohort.

The causal cost of a teen birth. The value of avoiding an early birth is the model’s central incentive, so I compare the model’s causal effect of a teen birth with quasi-experimental estimates, none of which is targeted. For the simulated women who have a first birth from a conception at 14–16, I re-simulate the same women, with the same draws, when that pregnancy ends in a miscarriage, the comparison of [Hotz et al. \(2005\)](#). Appendix Table [G.2](#) reports the effects. A birth before 18 lowers the probability of a high-school diploma by 8–12 points, college attendance by 18–19 points and earnings at 25–34 by a fifth, and raises cash-welfare receipt at 18–24 by 5–29 points, more in the cohorts with a more generous safety net. The effect on the diploma is at the top of the range of [Fletcher and Wolfe \(2009\)](#) (5–10 points), who also find lower earnings and more cash assistance; [Hotz et al. \(2005\)](#) find no lasting effect on attainment, counting equivalency degrees, and higher earnings at later ages, and [Ashcraft et al. \(2013\)](#) argue that correcting for non-random miscarriage restores part of the negative effects. The model’s effects on college attendance and on earnings are at the upper end of this literature.

The holdout cohort. The model’s prediction for the untargeted 1984–1988 cohort, halfway through the decline, is close for the margins of fertility control and for schooling: contraceptive use at 15–17 is 0.79 against 0.83, the abortion share at 15–17 is 0.35 against 0.36, college attendance 0.66 against 0.69 and the share of single mothers on cash welfare 0.13 against 0.12. Births per woman at 15–19 are 0.181 against 0.220, first births by 17 0.058 against 0.070 and first births by 21 0.258 against 0.290.

6 Decomposing the Decline

6.1 Methodology

To attribute the cohort difference in early childbearing to mechanisms, I follow the cohort-accounting approach of [Eckstein et al. \(2019\)](#). Each mechanism is one of the ten blocks of cohort-specific primitives in [Table 3](#). Starting from the baseline economy, with every block at the value of the cohort born in 1962–1966, I replace a set of blocks with the values of the peak cohort, born in 1976–1980, re-solve the model, simulate the same women with the same random draws, and record the change in outcomes. The same exercise runs from the peak economy to the economy of the decline cohort, born in 1992–1996, which splits the change into the rise and the decline.

I attribute each phase’s change to the ten blocks by their Shapley values ([Shorrocks, 2013](#)): a block’s contribution is its effect on the outcome when it is switched to the later cohort’s values, averaged over all orders in which the blocks can be switched. The contributions do not depend on the order of the switches and add up exactly to the total change, and computing them requires solving the model at all $2^{10} = 1,024$ combinations of blocks in each phase. [Paz-Pardo \(2024\)](#) uses the same decomposition to account for differences between generations in a life-cycle model. [Appendix G](#) gives the formula and reports the one-at-a-time and sequential accountings of [Eckstein et al. \(2019\)](#).

I decompose four outcomes: the birth rate at ages 15–19 (births of any order per woman-year), the share of women with a first birth before age 18, the share with a first birth before age 22, and college attendance, overall and within each family background. Block 9 holds only the composition of family background, the shares $\pi_g(M)$; what a family background brings with it—its exposure, its earnings and schooling prospects, its parents’ resources for college—belongs to the blocks of those mechanisms. The change in each outcome splits exactly into a composition term and a within term, $\Delta y = \sum_M \Delta \pi(M) \bar{y}(M) + \sum_M \bar{\pi}(M) \Delta y(M)$, with bars denoting the average of the two cohorts, the same split as in [Table 2](#), so the model’s split can be compared with the data’s. The composition effect is then traced to channels: at the earlier cohort’s estimates I remove, one at a time, the dependence on family background of exposure, earnings, schooling costs and college support, the cost of contraception and the

minor-parent rules, and attribute the gap in early births across family backgrounds to each by the same Shapley rule. Standard errors for the contributions come from the bootstrap distribution of the estimates.

6.2 Results

Table 7 reports the accounting of the two phases for the birth rate at 15–19, in births per 100 women over the five years, for first births before 18 and before 22, and for college attendance: the contribution of each block switched alone from the earlier to the later cohort’s values, with every other block at the earlier cohort’s (the one-at-a-time accounting of Appendix G.2).

Table 7. One-at-a-Time Accounting of the Change in Early Childbearing and College Attendance, Both Phases

	Births 15–19		FB < 18		FB < 22		College	
	Rise	Decline	Rise	Decline	Rise	Decline	Rise	Decline
Women’s labor market	-0.2	-2.1	-0.1	-0.9	+0.0	-2.5	-0.2	+6.2
Schooling costs and support	+0.5	-1.4	+0.1	-0.5	+0.6	-1.1	-1.7	+4.3
Cost of contraception	+1.1	-2.2	+0.3	-0.5	+0.8	-1.7	-0.3	+0.5
Efficacy	+0.4	-2.1	+0.1	-0.5	+0.6	-2.5	-0.1	+0.5
Exposure	+2.4	-4.0	+1.5	-2.6	+0.8	-1.6	-0.6	+1.0
Marriage market	+0.0	+0.0	-0.0	+0.1	-0.4	+0.1	+1.5	+0.7
Safety net	-0.4	-0.2	-0.2	-0.1	-0.2	-0.2	+0.3	+0.1
Child penalty	-0.5	-0.2	-0.3	-0.0	-0.1	-0.3	+1.6	-0.1
Family background (composition)	-2.6	-1.9	-0.7	-0.7	-2.7	-1.8	+5.2	+2.9
Cost of abortion	+0.1	+0.1	+0.1	+0.0	-1.1	-0.2	+0.3	+0.1
Total change, model	+1.2	-11.5	+0.8	-4.6	-0.7	-10.7	+4.1	+16.3

Notes: Each entry is the change in the outcome when the block named is switched alone from the earlier cohort’s values to the later cohort’s, with every other block at the earlier cohort’s values. Rise: 1962–1966 to 1976–1980; decline: 1976–1980 to 1992–1996. Births per 100 women over ages 15–19; the other outcomes in percentage points. The contributions do not add up to the total change, which the Shapley decomposition of Appendix G.1 enforces.

The decline. Between the peak cohort and the decline cohort, the model’s births at 15–19 fall by 11.5 per 100 women (the data: 12.4) and first births before 22 by 10.7 points (the data: 9.7). The fall is spread over the three margins of fertility control, the incentive blocks that act through schooling and work, and the composition of family background; no block dominates. Less sexual activity accounts for 4.0 births per 100 women, and for more than half of the fall in first births before 18, where the change in exposure was largest. The efficacy of the methods young women used accounts for 2.1 births and, because a method that fails less often protects every year of a woman’s late teens and early twenties, for 2.5 of the 10.7 points of first births before 22. The lower cost of contraceptive use accounts for 2.2 births. Women’s labor-market opportunities and schooling costs and support account for 2.1 and 1.4 births, and for 2.5 and 1.1 points of first births before 22: the decline cohort’s higher earnings relative to the peak cohort’s, which enter the opportunity cost of a birth in proportion under log earnings, and its larger college allowance and need-based aid raised the return to delaying a birth. The composition of family background accounts for 1.9 births, close to its share in the data’s split (Table 6). The cost of abortion accounts for nothing: with the abortion–use response at the size the quasi-experimental evidence implies, a costlier abortion lowers the share of conceptions that end in abortion by about as much as it raises contraceptive use. The marriage market is neutral, and the child penalty and the safety net lower births at 15–19 by 0.2 each. In the model, then, young women of the 1990s cohorts avoided early births because avoiding one became more reliable, cheaper and less often necessary, and because an early birth became costlier in schooling and earnings foregone; the first group of forces accounts for about eight births per 100 women when each is moved alone, the second for about three and a half.

The rise. Between the baseline and the peak cohort the model’s births at 15–19 rise by 1.2 per 100 women against 3.0 in the data, and first births before 22 fall by 0.7 points against a rise of 2.0. The net change is the sum of forces of opposite sign. More sexual activity raises births at 15–19 by 2.4 per 100 women and first births before 18 by 1.5 points, the largest force of the phase. The higher cost of contraceptive use that the peak cohort’s minors faced adds 1.1 births, schooling support 0.5 and the slightly worse method mix 0.4. Better-educated

mothers lower births by 2.6, the child penalty by 0.5, the 1984 deeming rules of the safety net by 0.4 and women’s labor-market opportunities by 0.2; costlier abortion lowers first births before 22 by 1.1 points and leaves births at 15–19 unchanged. Most of the rise in the data happened within family backgrounds, among daughters of mothers with a high-school diploma or some college, and the model reproduces its direction: the within-background change in first births by 21 is +2.2 points against +5.0 in the data.

Family background. The upgrading of family background lowered early births in both phases, by 2.7 points of first births before 22 in the rise and 1.8 in the decline, while the forces within family backgrounds offset each other in the first phase and lowered births in the second.

College attendance. College attendance rises by 4.1 points in the rise and 16.3 in the decline in the model, against 10.8 and 5.1 in the data. The composition of family background accounts for 5.2 and 2.9 points in the two phases, as in the data; schooling support lowers attendance by 1.7 points in the rise and raises it by 4.3 in the decline, and women’s labor-market opportunities add 6.2 points in the decline.

7 Discussion and Policy Implications

The decomposition speaks to the policy debate through the distinction between the four margins of fertility control. If the decline was driven by the value of avoiding a birth—better earnings and schooling prospects, a changing marriage market, or a safety net that insures a birth less—then the relevant levers are those that raise young women’s opportunities. If it was driven by the cost of contraception, then access policies such as subsidized family planning and Title X funding matter most (Bailey et al., 2023; Kearney and Levine, 2009; Packham, 2017). If it was driven by efficacy, the diffusion of methods that remove user error, such as LARC, is the key (Kelly et al., 2020; Lindo and Packham, 2017; Secura et al., 2014). And if it was driven by exposure, the decline reflects a change in adolescent behavior: Myers and Hooper (2026) and Hudson and Moscoso Boedo (2026) link the post-2007 break to smartphones and broadband: access to the iPhone during AT&T’s 2007–2011

exclusivity lowered births at ages 15–19 by 4.5 to 8 percent, and ten percentage points of county broadband penetration lowered the teen birth rate by 1.5 percent. [Hudson and Moscoso Boedo \(2026\)](#) also find that better contraception is the largest measured margin of the pace of the fall between 2008 and 2014, while neither the 2008 break nor the decline after 2015 comes from it. The four margins have different implications for which women benefit: a fall in the cost of contraception raises use most where use is most elastic, while an improvement in efficacy lowers births most where use is already high (Appendix D).

The decomposition answers the first question for the decline: the three margins of fertility control account for about eight of the 11.5 births per 100 women when each is moved alone, with exposure the largest; the incentive blocks that act through schooling and work account for three and a half; the cost of abortion for none (Section 6.2). It also bears on a distributional question. In the data, first births by 21 among daughters of mothers without a diploma were flat across the three cohorts (47–49%) while they fell among daughters of more-educated mothers, so the gap between them and daughters of college graduates widened slightly, from 34 to 35 points between the peak and the decline cohort. The distributional implications of the decomposition will be reported with the final estimates.

Table 8 turns the margins into policies. Each experiment changes one primitive of the peak or the decline cohort’s economy and holds everything else at that cohort’s values.

Three results stand out. First, removing the teen-specific cost of contraception is the most effective single policy for the peak cohort, lowering births at 15–19 by 3.7 per 100 women (15%), and it is the most targeted: its effect on first births before 22 is -5.3 points among daughters of mothers without a diploma and -0.3 among daughters of college graduates, because only for the former is the cost at the margin. For the decline cohort, whose teen-specific cost is lower, the same policy lowers births by 1.2. Second, a program that moves 15% of young users to long-acting methods lowers births by 1.8 and 1.0 per 100 women and acts evenly across family backgrounds (-1.3 to -3.3 points), since better efficacy protects every user; this is the mechanism of the Colorado program ([Kelly et al., 2020](#); [Lindo and Packham, 2017](#)), whose estimated effects on teen births are of a similar order. Third, policies that raise the return to avoiding an early birth through schooling—free college, or doubling need-based aid for daughters of mothers without a diploma—raise college attendance by up

Table 8. Policy Counterfactuals

	Born 1976–80 (peak)				Born 1992–96 (decline)			
	Births 15–19	FB <22	FB <22, <HS	College	Births 15–19	FB <22	FB <22, <HS	College
Baseline (level)	24.7	33.8	51.3	63.5	13.8	24.6	44.9	68.3
Free access to contraception under 20	-3.7	-3.0	-5.3	+0.8	-1.2	-1.3	-3.1	+0.3
LARC program: 15% of users under 22 switch	-1.8	-2.5	-1.9	+0.3	-1.0	-1.6	-1.3	+0.3
Cheaper abortion: the 1962–66 cohort’s cost	+4.9	+3.4	+0.4	-1.0	+5.8	+5.7	+4.7	-1.6
Free college (no tuition)	-0.6	-0.7	-1.6	+1.5	-0.4	-0.5	-0.8	+1.3
Need-based aid doubled	-0.6	-0.5	-2.1	+0.8	-0.1	-0.1	-0.5	+0.2

Notes: Change relative to each cohort’s baseline economy; first row: baseline levels. Births at 15–19 per 100 women; first births before 22 (FB<22), overall and among daughters of mothers without a high-school diploma, and college attendance, in percentage points. Free access: no teen-specific cost of use ($\Delta\phi_{s,g}^m = \Delta\phi_{s,g}^y = 0$). LARC program: 15% of users aged 14–21 switch to long-acting methods (relative failure $0.85\rho_g + 0.15 \times 0.0035$). Cheaper abortion: the abortion cost of the 1962–1966 cohort. Free college: annual tuition and fees set to zero. Need-based aid: the aid to daughters of mothers without a diploma doubled.

to 1.5 points but lower first births before 22 by less than a point.

The cost of abortion moves early births little in the model. The quasi-experimental evidence on abortion restrictions finds that they lower abortions and pregnancies and reduce births modestly (Kane and Staiger, 1996) or not at all (Joyce et al., 2020), and the model’s response to a 25% higher minors’ abortion cost is a fall in births at 15–17 of 0.7% (Section 5.2): the fall in the share of conceptions that end in abortion is offset by the use response. The abortion block’s contribution to the decline is accordingly near zero, and the fall in the cost of contraception between the peak and the decline cohort is identified by the use and wantedness moments.

8 Conclusion

Births to teens and women in their early twenties account for most of the fall in U.S. fertility since 1991. Measured by birth cohort, early first births rose before they fell: they were flat for women born in the 1960s, peaked among women born in the late 1970s, who were teenagers in the 1990s, and have fallen since, despite large and steady changes in marriage, schooling and family background throughout. This paper builds a life-cycle model in which schooling, work, marriage and fertility control are chosen jointly, estimates it on three cohorts that bracket the rise and the decline, each measured with the same surveys, and decomposes the change in early childbearing into ten blocks of primitives. By separating the value of avoiding a birth from the cost, the efficacy and the exposure margins of fertility control, the decomposition identifies which forces raised early childbearing among the peak cohorts and which forces drove the decline. In the model, less sexual activity, more effective methods and cheaper access account for most of the fall in births at 15–19 between the cohorts born in 1976–1980 and 1992–1996, women’s higher earnings and more schooling support for about 30%, and the composition of family background for a sixth; the cost of abortion, the marriage market, the child penalty and the safety net moved early births little. The rise among the cohorts who were teenagers in the 1990s was the net of more sexual activity and costlier contraception for minors against better-educated mothers, and the model reproduces its direction. The estimates are preliminary, and work on improving the fit of the model is

ongoing.

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Appendices

A Data Construction and Variable Definitions

This appendix documents how the targeted moments and the measured inputs are built. Every cohort is measured with the same instruments and the same definitions: the National Survey of Family Growth (NSFG) for fertility, contraception, sexual activity, marriage and schooling, and the Annual Social and Economic Supplement of the Current Population Survey (CPS) for employment and earnings. The code is in `Facts/code` (`nsfg_harmonize.py` and `f9-f14`).

A.1 Data sources and cohort coverage

The NSFG moments pool the female respondent and pregnancy files of the rounds fielded in 1982, 1988, 1995, 2002, 2006–2010, 2011–2013, 2013–2015, 2015–2017 and 2017–2019 ([National Center for Health Statistics, 2020](#)). Each round is a national probability sample of women aged 15–44 (15–49 from 2015); the 1982 round is the first to include women who had never married. Each round’s final weight is rescaled to sum to one, so that a cohort’s estimate averages over the rounds that observe it. Pooling adds observations on the early years of the older cohorts, whose histories every later round records again. It is also the only way to measure contraception at young ages: contraceptive use is recorded only at the interview, so the 1982 round measures women born in the early 1960s at ages 15–20, the 1995 round women born in the late 1970s, and the 2006–2015 rounds women born in the 1990s. The estimation cohorts are women born in 1962–1966 (7,891 respondents, rounds 1982–2010, plus 26 women interviewed in 2011–2017), 1976–1980 (8,151, rounds 1995–2019) and 1992–1996 (4,324, rounds 2006–2019); the holdout cohort, born in 1984–1988, has 7,004. The 2022–2023 round is not used: it was fielded mostly on the web, and for the same birth cohorts it reports shares with a first birth by age 21 that are 8 to 13 percentage points below those of the 2011–2019 rounds, a change in measurement rather than in behavior. For women born in 1980–1984, for example, the four rounds of 2011–2019 give between 30% and 34%, and the 2022–2023 round 20%. The CPS moments use every ASEC sample from 1976 to

2026 from IPUMS (Flood et al., 2025): 319,466 woman-years for the baseline cohort, 205,127 for the peak and 104,664 for the decline cohort. The ASEC records work and earnings for the previous calendar year; with age measured in March, a woman’s birth year is the survey year minus one minus her age, so her age equals her calendar-year age in the reference year, the convention of the moments. Standard errors are bootstrapped (NSFG: 500 Poisson-weight replications of respondents, rounds independent) or binomial with the Kish effective sample size (CPS).

A.2 Harmonization across NSFG rounds

Birth year and ages. The birth year comes from the century month of birth (1982–2013) or from the interview year minus age (2015–2019, exact to one year). Ages at first birth, first marriage and first intercourse are completed ages at the dated event: century months in 1982–2010, the age recodes (AGEBABY1, VRY1STAG) in every round, and years where only years are public. A woman counts toward the share with a first birth, a first marriage or first intercourse by age a (in completed years) only if she was interviewed after her $(a + 1)$ th birthday, so that every cohort is compared at the same ages. *Mother’s education.* Mother’s education is the education of the woman’s mother (or mother figure), in four groups: less than high school, high school, some college, and a bachelor’s degree or more. The 2002–2019 rounds record the four groups; the 1982–1995 rounds record years of schooling, mapped as fewer than 12, 12, 13–15 and 16 or more. Women without a mother figure are dropped. It is measured on the same absolute scale in every cohort, so the shift toward more-educated mothers is a change in composition that the decomposition can price (block 9). *Education.* Own education has three groups: no high-school diploma or GED, a diploma or GED up to an associate degree, and a bachelor’s degree or more. The schooling moments are measured at ages every cohort reaches, because the decline cohort is observed only to about 27 and the model has no re-entry. High-school dropout is no diploma or GED by age 20, from the dated diploma (the 1995 round dates diplomas and GEDs; the 2006–2019 rounds date diplomas only, and a GED-only holder is counted as credentialed by 20 with probability 0.485, the share measured in the 1995 round). College attendance is any college enrollment, among women aged 23 or older. College graduation is a bachelor’s degree by age 25, from the dated

degree (1995 and 2011–2019), among attenders aged 25 or older. Marriage by education uses women aged 25 or older, whose education is close to final. *Births*. First-birth stocks by age use the age at the first live birth. Birth rates at ages 14–24, children ever born and second births use the pregnancy files (1995–2019): a live birth at completed age a counts toward the rate at a among women interviewed after their $(a+1)$ th birthday. *Contraception*. The targeted contraception moments are use rates among women who are sexually active, childless and not pregnant,

$$\Pr(\text{Contraception}_{it} = 1 \mid \text{SexuallyActive}_{it} = 1, k_{it} = 0, \text{age group}, \text{Educ}_{it}),$$

which matches the model’s use decision among exposed, childless women. A woman is a user if her current contraceptive status at the interview is a method, and at risk if she is a user or reports intercourse in the three months before the interview without using a method; pregnant, postpartum, sterile and pregnancy-seeking women, and women without recent intercourse, are not at risk; women (or whose partners) relying on contraceptive sterilization, whom the recode counts as users, are also removed from the at-risk group, because the model’s use is a per-year choice of a reversible method and a sterilized couple has left the risk set (the exclusion is immaterial before 22 and lowers the use rates at 34–38 by 4–15 points). The cells by mother’s education at 15–17 and 18–21 use the same definition within each family-background group. The status recode (CONSTAT/CONSTAT1) is defined the same way in every round; in 1982 the nonusers with recent intercourse are identified from the separate three-month intercourse item. As a check, the harmonized share of all women aged 15–44 using a method is 55.7%, 60.3%, 64.2%, 61.9% and 62.2% in the 1982, 1988, 1995, 2002 and 2006–2010 rounds, the published NCHS figures. Because the status is current, each cohort’s use at a given age comes from the rounds in which it was that age. *Abortion*. The abortion targets are national: for each cohort and age band (15–17 and 18–21) the abortion share of abortions plus births in the Guttmacher 1973–2020 series (Chiu et al., 2024) over the calendar years in which the cohort was those ages, multiplied by the ratio of the nulliparous to the all-pregnancy abortion share in the NSFG pregnancy files 2002–2019 for the same ages and years. A pregnancy is nulliparous when no earlier

pregnancy of the woman ended in a live birth; fetal losses are excluded from both shares. The rescaling assumes that the underreporting of abortions in the NSFG is proportional across parity within an age band, so that it cancels in the ratio. The targets are 0.53 and 0.46 for the baseline cohort, 0.39 and 0.35 for the peak and 0.31 and 0.26 for the decline cohort. The targets by mother’s education rescale the national level for ages 15–21 by the ratio of each group’s abortion share of first pregnancies to the all-group share in the NSFG pregnancy files 2002–2019 (first pregnancies at 15–21 in the same calendar windows), which assumes that underreporting is proportional across groups of mother’s education ([Jones and Kost, 2007](#)). In the peak cohort the targets are 0.20, 0.34, 0.47 and 0.68 from the lowest to the highest group (`Facts/code/f9b_abortion_by_momed.py`).

A.3 Labor-market outcomes

A woman-year is classified as employed if she worked at least 26 weeks, usually more than 20 hours a week, and earned at least \$10,500 (2016 dollars) in wages and salaries, the threshold of the NLSY definition the model was first estimated with. Education is current education in March: no diploma (11th grade or less, or 12th grade without a diploma), a diploma to an associate degree (before 1992, completed 12th grade to three years of college), and a bachelor’s degree or more (before 1992, four or more years of college). Employment cells are targeted from age 22, when education is close to final. Mothers of young children are women whose youngest own child in the household is under six. Earnings are deflated to 2016 dollars with the CPI-U.

A.4 Validation against the NLSY

For the NLSY birth years (1957–1964 and 1980–1984), the NSFG and CPS moments agree with the NLSY moments built with the same definitions where the instruments coincide: high-school dropout with and without a teen birth (0.60 and 0.12 in the NSFG against 0.58 and 0.12 in the NLSY79), marriage by 21 by education, and employment by education at 22–25 (0.23, 0.54 and 0.64 in the CPS against 0.20, 0.55 and 0.65). They differ where the NLSY departs from vital statistics or uses another definition: births by 21 among daughters

of mothers with some college or a degree are lower in the NLSY79, and NLSY contraceptive use is defined differently (current use in the NLSY79, the share of protected acts in the NLSY97). The side-by-side comparison is in `Facts/output/f13_old_vs_new_moments.csv`.

B Additional Facts

Cohort fertility from vital statistics. Section 3.1 puts the five-year age-group birth rates on birth cohorts along the diagonals of the Lexis diagram. The NCHS cohort fertility tables cumulate single-year rates along the same diagonals for cohorts born up to 1991 (National Center for Health Statistics, 2026b), which gives a check on the approximation. Over the cohorts born between 1955 and 1985, my series differs from theirs by -0.2% on average at age 20 (range -1.7% to $+1.0\%$) and by $+0.3\%$ at age 25 (range -0.9% to $+1.2\%$), the ages at which the five-year groups end. Within a group the approximation is cruder: it is 4% low at age 18 and 3% high at age 22, because the rate of a group is applied to all of its ages. The same tables report cumulative first-birth rates, which check the NSFG: by exact age 22, 31.5% for women born in 1962–1966 and 33.0% for women born in 1976–1980, against 30.6% and 32.8% with a first birth by age 21 in the NSFG. Table B.1 reports the cohort series of Section 3.2 for the four cohorts of the model.

Births by age in calendar time. Figure B.1 plots the birth rates by age and calendar year. The decline was steeper among younger teens: from 1991 to 2024 the rate at ages 15–17 fell 86% , from 38.6 to 5.3, and the rate at 18–19 fell 75% , from 94.0 to 23.6. The birth rate at 20–24 followed with a lag. It fell slowly until 2007 and has fallen by half since, from 105.4 to 55.8.

Contributions to the change in the TFR. The total fertility rate (TFR), the number of children a woman would have if she experienced the birth rates of a given year over her life, adds the rates up across ages, so its change between two years splits exactly into the contribution of each age group, independent of the age structure of the population.⁵

⁵A woman spends five years in each five-year age group, so $\text{TFR} = 5 \sum_a r_a / 1,000$ children per woman, where r_a is the birth rate of age group a per 1,000 women. The contribution of group a to the change

Table B.1. Births, Pregnancies and Fertility Control before Age 20, by Birth Cohort

Born	1962–1966	1976–1980	1984–1988	1992–1996
Ages 15–19 in	1977–1985	1991–1999	1999–2007	2007–2015
	Baseline	Peak	<i>Holdout</i>	Decline
<i>A. Births per woman (vital statistics)</i>				
Before age 18	0.10	0.12	0.08	0.06
Before age 20	0.26	0.28	0.22	0.15
Before age 25	0.81	0.82	0.71	0.52
Before age 45 (completed)	2.05	2.20	–	–
<i>B. Pregnancies before age 20 (Guttmacher)</i>				
Births and abortions per woman	0.47	0.43	0.31	0.21
Abortions, % of births and abortions, before 18	48	37	36	33
Abortions, % of births and abortions, before 20	45	35	33	30
<i>C. Sexual activity and contraception (NSFG), %</i>				
First intercourse before age 18	53	59	57	55
First intercourse before age 20	75	77	77	77
Contraceptive use at 15–17, women at risk	67	74	83	84
Contraceptive use at 18–21, women at risk	78	83	82	85
Annual failure rate of the methods used	12.0	12.8	11.5	8.7

Notes: Panel A: births of any order per woman before the given age, cumulated along each birth year’s diagonal of the vital-statistics age-specific birth rates and averaged over the birth years of the cohort; completed fertility is not yet observed for the two youngest cohorts. Panel B: pregnancies ending in a live birth or an induced abortion, by age at outcome, cumulated in the same way. Panel C: first intercourse among women interviewed after the given age; contraceptive use among childless women who had intercourse in the three months before the interview and were neither pregnant nor sterilized, measured in the rounds fielded while the cohort was at those ages; the failure rate is the share of women who conceive within the first year of typical use of the method mix of users aged 15–21, with method-specific failure rates for the period in which the cohort was young (Appendix A). *Source:* author’s calculations from [National Center for Health Statistics \(2026a\)](#), [Chiu et al. \(2024\)](#) and the NSFG, 1982–2019 rounds ([National Center for Health Statistics, 2020](#)).

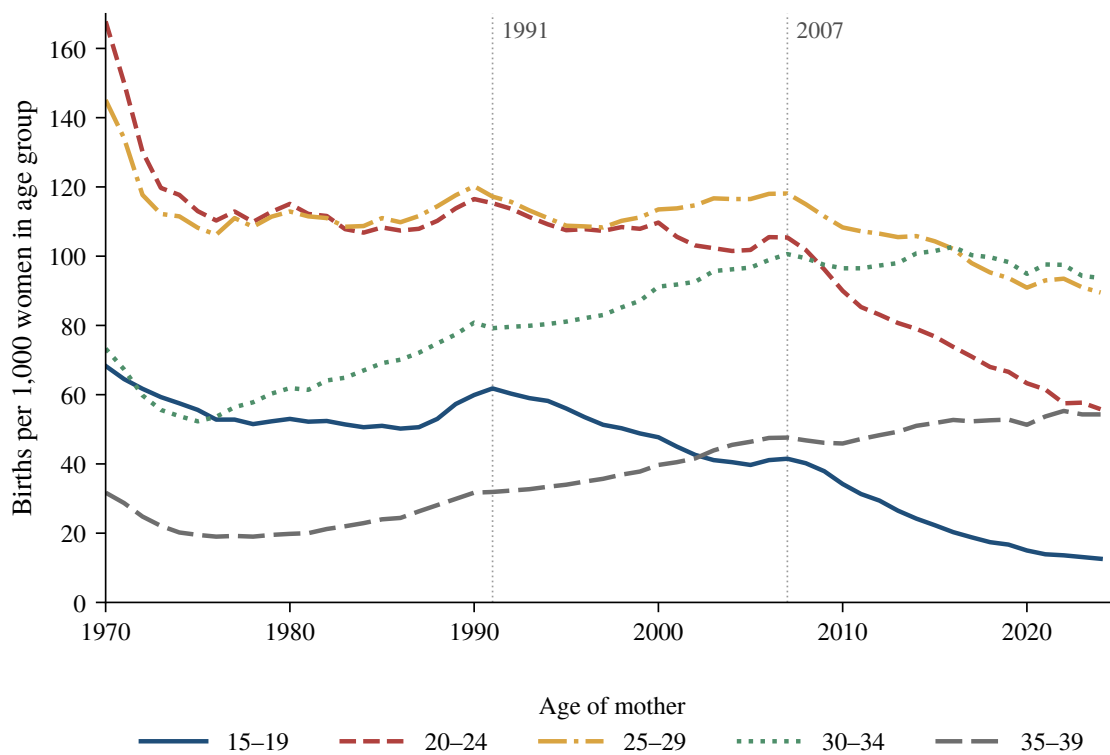


Figure B.1. U.S. Birth Rates by Age of Mother, 1970–2024

Notes: Births per 1,000 women in each age group. Rates at ages 40 and over are small and not shown. *Source:* National Center for Health Statistics, National Vital Statistics System ([National Center for Health Statistics, 2026a](#)).

Figure B.2 reports the split and Table B.2 the numbers, in children per woman and as a percent of the change in the TFR. Between 1991 and 2024 the TFR fell from 2.06 to 1.60 children per woman, by 0.46. Lower birth rates before age 20 reduced it by 0.25 (54% of the fall) and lower rates at ages 20–24 by 0.30 (64%). Together these two groups account for more than the entire fall, because rising birth rates after age 30 raised the TFR by 0.22. Between 1991 and 2007, lower birth rates before age 20 reduced the TFR by 0.11 and lower rates at 20–24 by 0.05, but rising birth rates after age 30 raised it by 0.21, so the TFR rose, from 2.06 to 2.12. Between 2007 and 2024 the TFR fell by 0.52, to 1.60; women under 20 account for 28% of the fall, women aged 20–24 for 48% and women aged 25–29 for 27%, while rising birth rates after age 35 offset 10% of it. Had birth rates before age 20 stayed at their 1991 level, the TFR would be 1.85 in 2024 rather than 1.60. Because women who delay a birth lower the TFR of the years in which they delay, part of these contributions reflects the timing of births rather than their number (Bongaarts and Feeney, 1998); the cohort measures of Section 3.2 do not have this problem.

Reconciliation with Kearney et al. (2022). Kearney, Levine and Pardue decompose the change in the general fertility rate (GFR), births per 1,000 women aged 15–44, which weights each age group by its share of the population. I rebuild the GFR from the age-specific rates and Census estimates of the female population by age (U.S. Census Bureau, 2024) and split its change into a rate effect, $\sum_a \bar{s}_a \Delta r_a$, and an age-structure effect, $\sum_a \bar{r}_a \Delta s_a$, with midpoint weights so that the two sum exactly to the change. Table B.3 reports the result. The rebuilt GFR is within 0.2 of the published series. Between 2007 and 2019 the rate effect is -13.8 and the age-structure effect is $+2.7$: the population shifted toward ages with higher fertility. The teen rate decline equals 38% of the net change in the GFR, which matches the 37% that Kearney et al. (2022) attribute to the three teen race and ethnicity groups, and 30% of the rate effect, which is also its share of the change in the TFR.

in the TFR is $5 \Delta r_a / 1,000$, and the contributions sum exactly to ΔTFR . Because every age group enters with the same weight, the decomposition does not depend on the age structure of the population, unlike a decomposition of the general fertility rate.

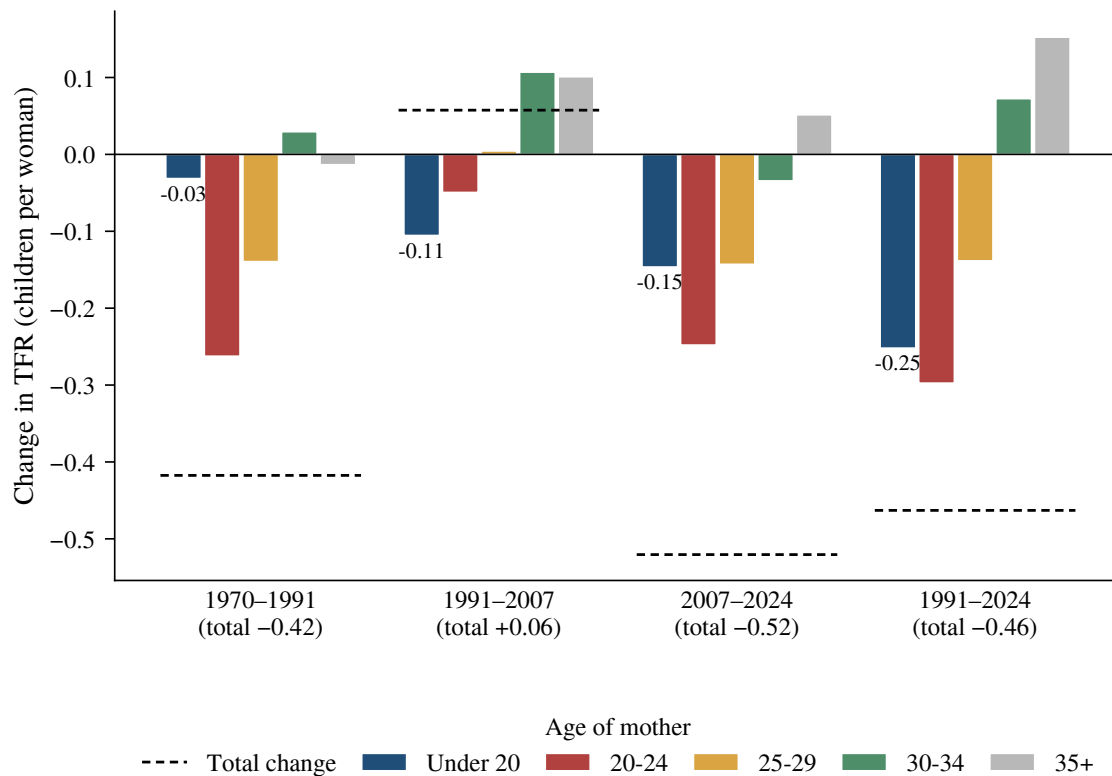


Figure B.2. Which Ages Account for the Change in U.S. Fertility

Notes: Contribution of each age group to the change in the total fertility rate, in children per woman: five times the change in the group's age-specific birth rate. Bars below zero are declines. The dashed line marks the total change in the TFR, which equals the sum of the bars. *Source:* author's calculations from [National Center for Health Statistics \(2026a\)](#).

Table B.2. Contributions to the Change in the U.S. Total Fertility Rate, by Age of Mother

Age of mother	1970–1991	1991–2007	2007–2024	1991–2024
TFR, start → end	2.48 → 2.06	2.06 → 2.12	2.12 → 1.60	2.06 → 1.60
<i>A. Contribution to the change in TFR, children per woman</i>				
Under 20	−0.03	−0.11	−0.15	−0.25
20–24	−0.26	−0.05	−0.25	−0.30
25–29	−0.14	+0.00	−0.14	−0.14
30–34	+0.03	+0.11	−0.03	+0.07
35+	−0.01	+0.10	+0.05	+0.15
Total	−0.42	+0.06	−0.52	−0.46
<i>B. Contribution, % of the change in TFR</i>				
Under 20	8		28	54
20–24	63		48	64
25–29	33	<i>TFR rose</i>	27	30
30–34	−7		7	−16
35+	3		−10	−33
Total	100		100	100

Notes: The contribution of an age group is five times the change in its age-specific birth rate; contributions sum to the change in the TFR up to rounding. Panel A reports contributions in children per woman and Panel B as a percent of the change in the TFR. A group’s share exceeds 100% in absolute value, or is negative, when other groups move in the opposite direction. Panel B is not reported for 1991–2007, when the TFR rose. “Under 20” includes births at ages 10–14 and “35+” births at ages 35–49. *Source:* author’s calculations from [National Center for Health Statistics \(2026a\)](#).

Table B.3. The Teen Contribution under Alternative Fertility Measures

	2007–2019	2007–2024
GFR, rebuilt	69.3 → 58.2	69.3 → 53.8
GFR, published	69.1 → 58.3	69.1 → 53.8
Rate effect	−13.8	−17.1
Age-structure effect	+2.7	+1.7
Teen rate decline, % of change in GFR	38	32
Teen rate decline, % of rate effect	30	29
Teen decline, % of change in TFR	30	28
Kearney et al. (2022) : teen groups, % of GFR change	37	–

Notes: Teens are women aged 10–19. The GFR numerator includes births to women aged 10–14 and 45–49, and the denominator is women aged 15–44. Population weights from Census national estimates (intercensal 2000–2010 for 2007; Vintage 2019 for 2019; Vintage 2024 for 2024). NCHS computes the published rates on its own population series, which explains the small differences with the rebuilt GFR.

The NLSY against the NSFG. Table [B.4](#) compares early first births in the two NLSY cohorts with the NSFG for the same birth years, using the NLSY’s definition of age at first birth (the child’s birth year minus the mother’s) in both surveys. This definition gives slightly lower shares than completed age, the measure used for the NSFG in Section [3](#). On it, 27% of the women in each NLSY cohort had a first birth by age 21, against 29% of the same birth cohorts in the NSFG; the two sources agree within 2.3 percentage points in every cell. Table [B.5](#) reports first births by mother’s education in the NLSY. As in the NSFG, mothers’ education rose between the two NLSY cohorts and early births rose within groups.

C The Model: Full Recursive Problem

This appendix gives the complete recursive problem of a woman in cohort g . The problem is identical across cohorts; cohorts differ only in the primitives of Table [3](#). To keep the notation light I drop the cohort index g wherever it adds nothing.

Table B.4. Early First Births in the NLSY and the NSFG, Same Birth Cohorts

First birth by age	Born 1957–1964		Born 1980–1984	
	NSFG	NLSY79	NSFG	NLSY97
17	5.7	6.6	6.4	6.4
19	18.2	16.3	16.9	16.0
21	29.3	27.0	29.0	27.1

Notes: Percent of women with a first live birth by the given age, where age at first birth is the child’s birth year minus the mother’s birth year in both surveys. NSFG: 2002–2013 cycles (the cycles that release birth dates), women interviewed after the given age, cycle weights. NLSY79: civilian cross-section and black and Hispanic supplements, 1979 weights, reported year of birth. NLSY97: women observed after the given age, round-1 panel weights.

Table B.5. Early Childbearing by Mother’s Education, NLSY79 and NLSY97

Mother’s education	Share of women		First birth by 17		First birth by 21	
	NLSY79	NLSY97	NLSY79	NLSY97	NLSY79	NLSY97
Less than high school	0.32	0.18	0.132	0.138	0.443	0.506
High school	0.46	0.36	0.044	0.066	0.234	0.283
Some college	0.11	0.26	0.021	0.048	0.119	0.224
Bachelor’s or more	0.10	0.20	0.013	0.014	0.069	0.093
All women	1.00	1.00	0.066	0.064	0.270	0.271
NLSY97 shares, NLSY79 rates				0.048		0.210
Women (N)	4,718	4,139				

Notes: Weighted shares of women and shares with a first birth by ages 17 and 21, by the highest grade completed by the respondent’s mother (NLSY79: 1979 report; NLSY97: biological mother, else residential mother). “NLSY97 shares, NLSY79 rates” holds the rate of each group of mother’s education at its NLSY79 value and uses the NLSY97 shares. NLSY79: civilian cross-section and black and Hispanic supplements, 1979 sampling weights. NLSY97: round-1 panel weights. Age at first birth is the child’s birth year minus the mother’s reported birth year. NLSY97 shares with a first birth use women observed after the given age.

C.1 Environment, timing and state space

Time is discrete, $t \in \{1, \dots, T\}$ with $T = 41$: periods $1, \dots, 32$ are the years from age 14 to age 45, periods $33, \dots, 37$ the four-year working periods from 46 to 65, and $38, \dots, 41$ the four-year retired periods from 66 to 81. Let ℓ_t be the length of period t in years. The state at the start of t is $\Omega_t = \{a_t, M, u, e_t, x_t, m_t, n_t, k_t, \tau_t\}$: assets $a_t \in [0, \bar{a}]$; mother's education $M \in \{1, 2, 3, 4\}$; preference type $u \in \{1, 2\}$; schooling $e_t \in \{D, H, C, \text{in HS}, \text{in college}\}$; experience $x_t \in \{0, \dots, 20\}$ in years of work; marital status $m_t \in \{0, 1, 2\}$ (single; married before any birth; married after a birth); parity $n_t \in \{0, 1, 2, 3+\}$; the youngest child's age bin $k_t \in \{\text{none}, 0-1, 2-5, 6-17\}$; and, for single women under TANF, years of cash-welfare receipt since age 18, $\tau_t \in \{0, \dots, \bar{\tau}_g\}$. The number of children at home is $n_t^h = n_t \mathbf{1}\{k_t \neq \text{none}\}$. The controls are next-period assets $a_{t+1} \geq 0$, consumption $c_t \geq 0$, work $l_t \in \{0, 1\}$ (not for students or retirees), contraceptive use $d_t \in \{0, 1\}$ (if exposed, $n_t < 3$ and $t \leq 32$), abortion after a conception, and schooling continuation while enrolled.

Transitions. Experience: $x_{t+1} = \min\{x_t + \ell_t l_t, 20\}$. Children: a conception in t carried to term gives $n_{t+1} = \min\{n_t + 1, 3\}$ and $k_{t+1} = 0-1$; otherwise $n_{t+1} = n_t$ and the bin advances, $k_{t+1} = \text{next}(k_t)$, with probability $\ell_t/L(k_t)$, where L is the bin length in years (2, 4, 12) and $\text{next}(6-17) = \text{none}$. This stochastic ageing keeps the state free of a within-bin counter; the expected length of each bin is exact. Schooling: a student who continues keeps her enrollment state, becomes H after the fourth high-school year and C after the fourth college year; a student who leaves becomes D (from high school) or H (from college) in the same year.

C.2 Income, taxes and transfers

Gross annual earnings are $y_t = l_t w(M, e_t, x_t, t) + \mathbf{1}\{m_t > 0\} w^h(e_t, t, m_t)$, with the woman's own earnings $y_t^f = l_t w(M, e_t, x_t, t)$; a student's own income is her allowance net of tuition. Disposable annual income is given by (10), with the maximum cash benefit $\bar{B}_g(n^h)$ by family

size and the EITC schedule

$$\text{EITC}(y, n^h) = \begin{cases} \varsigma_{n^h}^{in} y & y \leq \bar{y}_{n^h}^{in}, \\ E_{n^h}^{\max} & \bar{y}_{n^h}^{in} < y \leq \bar{y}_{n^h}^{po}, \\ \max\{E_{n^h}^{\max} - \varsigma_{n^h}^{out}(y - \bar{y}_{n^h}^{po}), 0\} & y > \bar{y}_{n^h}^{po}, \end{cases}$$

for one and for two or more qualifying children, as in force for the cohort. Period income is ℓ_t times annual income. The budget constraint is

$$\ell_t \nu(m_t, n_t^h) c_t + a_{t+1} = (1 + r)^{\ell_t} a_t + \ell_t y_t^{net},$$

with $\nu(m, n^h) = 1 + \nu_a \mathbf{1}\{m > 0\} + \nu_k n^h$ and c_t in annual units. After retirement, gross income is Social Security, $ss(e)$ times the earnings in the last working period of a woman of her schooling group with sixteen years of experience, averaged over mother's education, plus the analogous benefit of the husband if married; the replacement rates are 0.548, 0.408 and 0.336 for D , H and C . Experience accumulates as $x_{t+1} = x_t + \ell_t l_t$, up to twenty years.

Program details. $\mathcal{T}_g$ applies the rate schedule of the filing status (single, head of household for a single mother, joint for a couple), the standard deduction and personal exemptions, the child tax credit with its refundable part, and the employee payroll tax on each earner's wages up to the wage base; state income taxes are not modeled. Food stamps are available to every working-age household from age 18 except college students without a child at home: the maximum allotment for the household size minus 30% of net income (earnings net of the earned-income deduction, plus cash welfare, minus the standard deduction), for households below the gross-income limit. A minor mother (under 18) belongs to her parents' food-stamp household; where her parents' income is deemed to her unit, her cash benefit is scaled by $\varsigma_g(M)$, the share of families with mother's education M whose income is below the deeming threshold, the benefit she can expect before her parents' income is known. Under TANF a woman can claim only while $\tau_t < \bar{\tau}_g$, and each year in which she claims from age 18 raises τ_t by one (months received as a minor do not count; there is no limit under AFDC), so a woman who expects to need the benefit later weighs claiming it now against keeping that

option. Family size is where parity makes the safety net richer: a second child raises the AFDC/TANF maximum by about a quarter, the food-stamp allotment by about 40%, and, since 1991, the maximum EITC by about two-thirds.

C.3 Discrete choices and taste shocks

Every discrete choice $\delta \in \mathcal{D}$ except claiming, which is the better of the two options, carries i.i.d. type-I extreme value shocks with scale $\sigma_{\mathcal{D}}$. With choice-specific values $v(\Omega, \delta)$, the ex-ante value is $\sigma_{\mathcal{D}} \log \sum_{\delta} \exp(v(\Omega, \delta)/\sigma_{\mathcal{D}})$, up to a constant, and choice probabilities are logit. The scales are σ_l (work), σ_s (contraceptive use), σ_a (abortion), σ_m (accepting a marriage offer), σ_H (high-school continuation), σ_C (college entry) and σ_{CD} (college continuation).

C.4 Retired households ($t = 38, \dots, 41$)

Apart from the marriage stage, which works as in Stage 1 below with the meeting rate of ages 34–45, the only choice is saving:

$$V_t(\Omega_t) = \max_{a_{t+1} \geq 0} \left\{ \ell_t [u(c_t) + \pi_n n_t] + \beta^{\ell_t} V_{t+1}(\Omega_{t+1}) \right\},$$

subject to the budget constraint, and in $t = T$ the household consumes its resources.

C.5 Working households after the fertile window ($t = 33, \dots, 37$)

There is no fertility risk. A single woman meets a potential husband as in Stage 1 below, with the meeting rate of ages 34–45. For $l \in \{0, 1\}$,

$$\begin{aligned} v_t(\Omega_t, l) = \max_{a_{t+1} \geq 0} \left\{ \ell_t [u(c_t) + \Psi_g(t, e_t, m_t, n_t, k_t) l + \pi_n n_t + \mathbf{1}\{k_t \leq 5\} n_t \omega_y] \right. \\ \left. + \beta^{\ell_t} \mathbb{E}_k V_{t+1}(\Omega_{t+1}) \right\}, \end{aligned}$$

and $V_t = \ell_t \sigma_l \log \sum_l \exp(v_t(\Omega_t, l)/(\ell_t \sigma_l))$, where the expectation is over the ageing of the youngest child. The scale of the work shock is multiplied by the period length, so that a choice made for four years is not more deterministic than an annual one. The work disutility

adds ψ_{ret} for each four-year period from age 58 on (once at 58–61, twice at 62–65).

C.6 Years in the fertile window after schooling ($t \leq 32$)

Decisions within the year are ordered in three stages.

Stage 3: work, consumption and saving. Given the conception outcome $b \in \{0, 1\}$ (carried to term), with Ω'_{t+1} the next-year state implied by b ,

$$\begin{aligned} v_t^3(\Omega_t, b, l) = \max_{a_{t+1} \geq 0} & \left\{ u(c_t) + \Psi_g(t, e, m, n, k) l + (\omega_0 + A(t) + \omega_u \mathbf{1}\{u = 2\}) b \right. \\ & + (\pi_n + \omega_y \mathbf{1}\{k \leq 5\}) n \\ & \left. + \beta \mathbb{E}_k V_{t+1}^1(\Omega'_{t+1}) \right\}, \end{aligned}$$

subject to the budget constraint, and

$$V_t^3(\Omega_t, b) = \sigma_l \log \sum_{l \in \{0, 1\}} \exp(v_t^3(\Omega_t, b, l) / \sigma_l).$$

Stage 2: exposure, contraception and abortion. For a woman with $n < 3$, let $\Delta V = V_t^3(\Omega_t, 1) - V_t^3(\Omega_t, 0)$ be the value of an additional birth, $P^{ab} = \Lambda((-\Delta V - \phi_a(t, M)) / \sigma_a)$ the abortion probability after a conception, and $G = \sigma_a \log[\exp(\Delta V / \sigma_a) + \exp(-\phi_a(t, M) / \sigma_a)]$ the value of a conception. Then

$$V_t^2(\Omega_t) = V_t^3(\Omega_t, 0) + \alpha(M, t, n) \sigma_s \log \left[\exp(p^0 G / \sigma_s) + \exp((\rho(M) p^0 G - \phi_s(t, M, n)) / \sigma_s) \right],$$

with $p^0 = p^0(t, e, k)$ from (3), $\alpha(M, t, n) = \alpha(M, t)$ for a childless woman and 1 for a mother, and $V_t^2 = V_t^3(\Omega_t, 0)$ for a woman with three children.

Stage 1: marriage. For a single woman not enrolled in school, from age 18, with $\Omega_t(m)$ the state with marital status m and $m^* = 1$ if $n_t = 0$, 2 otherwise,

$$V_t^1(\Omega_t) = \mu(e_t, t) \sigma_m \log \left[e^{V_t^2(\Omega_t(m^*)) / \sigma_m} + e^{V_t^2(\Omega_t(0)) / \sigma_m} \right] + (1 - \mu(e_t, t)) V_t^2(\Omega_t(0)),$$

and $V_t^1 = V_t^2$ otherwise. Marriage is absorbing.

C.7 College years (ages 18–21)

A single high-school graduate at 18, after the marriage stage, chooses whether to enroll; an enrolled student in each of the four years chooses, after the conception outcome, whether to continue. Students do not work, receive the allowance $a^C s(M) + g \mathbf{1}\{M = 1\}$ net of tuition TC , and face the fertility stage as above. With v^S the stage-3 value of a year as a student (no work, the student's budget) and $v^3(\cdot | e = H)$ the value of leaving and working as a high-school graduate this year,

$$V_t^3(\Omega | b) = \sigma_{CD} \log \left[\exp \left(\frac{v_t^S(\Omega | b) + \mathbf{1}\{n > 0\} \phi_{CD}^k + \mathbf{1}\{t=8\} \phi_G}{\sigma_{CD}} \right) + \exp \left(\frac{v_t^3(\Omega | b, e=H)}{\sigma_{CD}} \right) \right],$$

for the continuation years, and the entry decision at 18 replaces σ_{CD} by σ_C and the continuation cost by $\kappa_C(M, n)$ of Section 4.4. Completing the fourth year gives $e = C$ at 22.

C.8 High-school years (ages 14–17)

All women are single and enrolled at 14. In each year the order is: exposure, contraception and abortion; the schooling decision; consumption and saving. A woman who stays receives the allowance h and does not work; a woman who leaves works as a dropout from the same year. The value of each conception outcome at the fertility stage is the logsum over the schooling decision that follows it,

$$V_t^3(\Omega | b) = \sigma_H \log \left[\exp \left(\frac{v_t^S(\Omega | b) + \phi_H(M) + \mathbf{1}\{n^h > 0\} \phi_H^k + \mathbf{1}\{k = 0-1\} \phi_H^{k,0}}{\sigma_H} \right) + \exp \left(\frac{v_t^3(\Omega | b, e = D)}{\sigma_H} \right) \right],$$

so a teenager's contraceptive decision already prices the effect of a birth on her schooling. Completing the fourth year gives $e = H$ at 18 and the college-entry decision.

C.9 Functional forms and numerical solution

Utility is $u(c) = c^{1-\gamma}/(1-\gamma)$. The schooling costs $(\phi_H, \phi_H^k, \phi_H^{k,0}, \xi_C, \phi_C^k, \phi_{CD}^k$ and $\phi_G)$ are utility terms added to the value of continuing, so each is non-positive; the costs of contraception and abortion are subtracted from the value of the option. The cohort levels of both costs are restricted to be non-negative; the age and family-background terms are not, so the cost of a daughter of a college graduate can be below the cohort level. Marriage offers continue after 45 at the meeting rate of ages 34–45, once per four-year period; these marriages matter only through later-life income and are not targeted. Assets live on a 30-point grid on $[0, 1000]$ (thousands of 2016 dollars), cubically spaced toward zero, and experience on an 11-point grid of years $\{0, 1, 2, 3, 4, 6, 8, 10, 13, 16, 20\}$ with linear interpolation of continuation values. Every period is solved by grid search over next-period assets and closed-form logsums for every discrete choice; unreachable states (enrollment outside the schooling ages, experience exceeding age minus 14) are skipped. One solution of the 41 periods takes about 25 seconds on two threads (50 with the TANF time-limit state). I simulate 10,000 women per cohort with common random numbers across cohorts and across parameter vectors: the same uniform draw assigns a woman’s mother’s education under every distribution π_g , a second draw her preference type, and the same draws govern exposure, contraceptive use, conception, marriage meetings and every discrete choice. Common random numbers make the simulated moments smooth in the parameters and make the decomposition’s counterfactual economies differ only through behavior.

D The Contraception Choice

Write $W \equiv -\Delta V$ for the value of avoiding a birth, $p \equiv p^0(t, e, k)$ and $\alpha \equiv \alpha(M, t)$. An exposed childless woman uses contraception with probability $P = \Lambda(z)$, $z = [(1 - \rho)pW - \phi_s]/\sigma_s$, where ϕ_s is the total cost of use $\phi_{s,g}(t, M, n)$ of Section 4.3 and ρ the failure rate

$\rho_g(M)$, and the probability of a birth this period is $p^b = \alpha p[1 - (1 - \rho)P]$. Using $\Lambda' = P(1 - P)$:

$$\begin{aligned}\frac{\partial P}{\partial \phi_s} &= -\frac{P(1 - P)}{\sigma_s} < 0, & \frac{\partial p^b}{\partial \phi_s} &= \alpha p(1 - \rho) \frac{P(1 - P)}{\sigma_s} > 0, \\ \frac{\partial P}{\partial \rho} &= -\frac{pW P(1 - P)}{\sigma_s} < 0 \text{ if } W > 0, & \frac{\partial p^b}{\partial \rho} &= \alpha p \left[P + (1 - \rho) \frac{pW P(1 - P)}{\sigma_s} \right] > 0 \text{ if } W > 0, \\ \frac{\partial P}{\partial W} &= \frac{(1 - \rho)p P(1 - P)}{\sigma_s} > 0, & \frac{\partial p^b}{\partial \alpha} &= \frac{p^b}{\alpha} > 0.\end{aligned}$$

Three properties matter for the decomposition. First, the cost and the incentive enter use only through the index z , so a fall in ϕ_s and a rise in W of $\Delta\phi_s/[(1 - \rho)p]$ have the same effect on use and on births in a given cell; what distinguishes them is that the cost is common to every woman in the cohort while W varies across schooling, marital status, age and mother's education with the continuation values. Second, better efficacy (lower ρ) lowers births through two effects that reinforce each other when a birth is unwanted: it protects existing users, $\alpha p P$, and it draws new users in, because it raises the return to use. A cost reduction has only the second effect. This is why the effect of an efficacy gain is largest where use is already high, while the effect of a cost reduction is largest where use is near one half and most elastic. Third, exposure scales births proportionally in every cell and leaves use among exposed women unchanged, which is why it is measured outside the model and why the contraception moments are defined among sexually active women.

E Estimation: Parameters and Model Fit

This appendix reports the parameters set outside the model (Tables E.1 and E.2), the estimates (Table E.3) and the targeted moments (Table E.4). Section 5 describes the sources, the moments and the identification argument. Tables E.1 and E.4 are built from the NSFG and CPS inputs of the three cohorts and the holdout.

E.1 Parameters set outside the model

The discount factor, the interest rate and risk aversion follow [Adda et al. \(2017\)](#). The equivalence scale is the OECD-modified scale, 0.5 for a second adult and 0.3 per child ([Hagenaars](#)

et al., 1994), the scale Adda et al. (2017) start from; the Social Security replacement rates are standard. The yearly utility of a young child, ω_y , is fixed at 0.18, the value that, together with ω_0 , minimizes the criterion at the starting values of the estimation; the estimation then frees ω_0 but not ω_y . The annual conception probability of an exposed woman using no method is at most $\lambda_{\max} = 0.85$, the first-year conception rate of women using no method (Trussell, 2011), which is also the rate against which the efficacy ρ_g is defined.

The measured cohort-specific blocks are set cohort by cohort. Women’s earnings combine two sources. The CPS sets each cohort’s level and age profile by education: the median wage income of employed women of the cohort and education group, fitted as a quadratic in age. The NLSY equations (the NLSY79 for the baseline cohort, the NLSY97 for the later cohorts) supply what a cross-section cannot identify, the return to experience and the family-background premia, as deviations around that profile: a woman of average family background with the experience typical of employed women of her cohort, education and age earns the CPS median (Appendix F). Husbands’ earnings are the NLSY husband equation scaled, by the wife’s education and age, to the CPS median earnings of the husbands of married women of the cohort. At age 30 the CPS medians of employed women are \$20,200, \$29,900 and \$46,500 for dropouts, high-school graduates and college graduates in the baseline cohort and \$24,600, \$29,800 and \$51,300 in the decline cohort.

Tuition and fees are the average for all institutions in the academic years the cohort was 18–21, from the NCES Digest of Education Statistics, plus books: \$5,570, \$8,340 and \$12,600 a year.

Treating every woman as at risk from her sexual debut would overstate exposure by a third to a half in the teenage years, because teenage sexual activity is intermittent, and would push the estimated fecundity below its biological level; the measure below is the NSFG’s own definition of being at risk and the one the contraception moments use. Exposure $\alpha_g(M, t)$ is the share of woman-years at risk among childless women with mother’s education M at age t , by single year of age from 14 to 45: the share who have had intercourse by the middle of the year, from the age at first intercourse in the NSFG (cells with fewer than 30 women filled from the nearest cohort), times the share of those who have initiated who report intercourse in the three months before the interview, measured by mother’s education and age in the

rounds fielded when the cohort was that age (1982 and 1988, 1995 and 2002, or 2006–2019; cells pool adjacent ages and, where thin, groups of mother’s education). At age 15, 16%, 12%, 12% and 9% of women in the four groups of mother’s education, from less than high school to a bachelor’s degree, are at risk in the baseline cohort, 17%, 19%, 17% and 12% in the peak cohort and 11%, 12%, 9% and 8% in the decline cohort; at 17 the shares are 38%, 32%, 33% and 27%; 35%, 42%, 40% and 30%; and 29%, 36%, 32% and 30%; at 21 between 53% and 71%, and 65% to 80% through the thirties. Among women who have had intercourse, the share currently active at 15–17 falls from about 80% in the baseline cohort to 50–70% in the decline cohort, so the decline cohort’s lower exposure at 15–16 comes from both later debut and less activity after it.

The postpartum reduction in fecundity δ_{pp} is 0.25 while the youngest child is aged 0–1, a state that lasts two years in expectation, so it amounts to six months of postpartum infecundity.

Efficacy ρ_g is the typical-use first-year failure rate of each cohort’s method mix relative to the 85% conception rate of women using no method. The mix is that of the cohort’s own childless current users at ages 15–21, in the NSFG rounds fielded at those ages: 1982 and 1988 for the baseline cohort (521 users), 1995 and 2002 for the peak cohort (297) and 2006–2019 for the decline cohort (867). The pill accounts for 62%, 49% and 57% of use, the condom for 19%, 36% and 21%, and injectables, implants and IUDs for 2%, 8% and 14%. Each method is weighted by its typical-use failure rate, corrected for the underreporting of abortions, from the series that begins with the 1995 NSFG, whose estimates use one methodology and are comparable over time (Sundaram et al., 2017): the 1995 rates (Fu et al., 1999) and the 2002 rates (Kost et al., 2008; Trussell, 2011) for the baseline and peak cohorts, and the 2006–10 rates of Sundaram et al. (2017) for the decline cohort. The failure rates of the three mixes are 12.0%, 12.8% and 8.7%, so $\rho_g = 0.141, 0.151$ and 0.102 . The gradient in mother’s education, $\rho_g(M) = \rho_g \mu(M)$, applies the ratio of the failure rates of poor and non-poor users of Sundaram et al. (2017) to the share of girls aged 14–17 in poverty by mother’s education in the CPS, with $\mu(M)$ normalized to a share-weighted mean of one, so that ρ_g is the cohort’s average; in the decline cohort $\rho_g(M)$ runs from 0.140 for daughters of mothers without a diploma to 0.078 for daughters of college graduates. Efficacy therefore

worsened slightly from the baseline to the peak, as the condom replaced part of the pill, and improved for the decline cohort: ρ_g falls by 0.048, of which about 0.029 is lower failure within method and 0.020 the shift toward more effective methods. The published rates are by survey period, not by age, and [Sundaram et al. \(2017\)](#) find no significant differences across age groups in 2006–10, so the same rates apply at every age. I report two robustness checks: the 1982 rates of [Jones and Forrest \(1989\)](#), chained to the 1995 series, for the baseline cohort ($\rho = 0.119$), and the rates of [Trussell \(2011\)](#) held fixed for every cohort ($\rho_g = 0.141, 0.151$ and 0.131).

Taxes and the safety net follow the rules in force when the cohort’s mean birth year turned 20 (1984, 1998 and 2014). Federal income taxes use the rate schedules, standard deductions and exemptions of that tax year, and the child tax credit and its refundable part ([Internal Revenue Service, 2014](#)); a single woman earning \$30,000 pays 18% of it in federal income and payroll taxes under the 1984 rules and 16% under the 2014 rules, at marginal rates of 25% and 23%. The EITC is the federal schedule for one and for two or more children ([Tax Policy Center, 2016](#)); its maximum credit for one child is \$1,100 in 1984 and \$3,350 in 1998 and 2014 (2016 dollars). The cash maximum $\bar{B}_g(n)$ is the median state’s AFDC/TANF maximum benefit for the family size, from the Welfare Rules Database for July 1999 and July 2014 ([Urban Institute, 2024](#)) and, for the baseline cohort, from the AFDC schedules of January 1985, the nearest date with state schedules by family size ([Office of the Assistant Secretary for Planning and Evaluation, 1998](#)): for a mother with one child it falls from \$7,070 to \$5,380 and \$4,090 a year. The rate χ_g and the flat disregard D_g are those of the median state after the first year of work, when time-limited disregards have expired: a rate of one and \$1,950 a year under AFDC, 0.74 in 1998 and 0.51 in 2014 as TANF states extended their disregards. Food stamps follow the federal allotments, deductions and income limits of the same fiscal years; the earned-income deduction is 18% in 1985 and 20% afterwards. The TANF lifetime limit $\bar{\tau}_g$ is the federal five years, the limit of the median state, for the peak and decline cohorts; in July 2014, 13 states had shorter limits, of 21 to 48 months, and Massachusetts and New York had none ([Urban Institute, 2024](#)). Years of receipt are counted from age 18 for the peak cohort as well, although it turned 18 in 1994–1998, partly before the TANF clock started. The minor-parent rules follow the years

each cohort was 14–17, not the reference year: the baseline cohort’s teenage mothers could head their own AFDC unit before the 1984 law that deemed co-resident parents’ income to it ([Social Security Administration, 1984](#)); the peak cohort’s were subject to deeming; and the decline cohort’s to deeming and the school-attendance requirement of the 1996 reform ([U.S. Congress, 1996](#)); its living-arrangement requirement is not modeled. The share $\varsigma_g(M)$ is the share of CPS families with a child aged 14–17 whose income is below the deeming threshold, the poverty guideline for four persons plus a \$90 monthly disregard: 0.43 for daughters of mothers without a diploma and 0.04 for daughters of college graduates at the peak.

The claiming cost η_g^w is estimated from the share of single mothers who claim ([Low et al., 2022](#)): the share of unmarried women with an own child under 18 who report AFDC/TANF income for the previous year in the CPS, at ages 18–21, 22–25, 26–29 and 30–33 (unmarried women include the divorced and separated, whom the model, in which marriage is absorbing, does not have). At 18–21 it falls from 0.49 in the baseline cohort to 0.24 at the peak and 0.07 in the decline cohort, and at 26–29 from 0.39 to 0.10 and 0.05. With no claiming cost the model predicts that about half of single mothers aged 18–21 claim in every cohort, so the rules alone, including the fall in real benefits, do not account for the decline in claiming; a single cost common to all cohorts cannot fit it. The CPS understates welfare receipt, and increasingly so over time ([Meyer et al., 2015](#)), which η_g^w also absorbs.

The distribution of mother’s education $\pi_g(M)$ comes from the NSFG: 0.28, 0.43, 0.15 and 0.14 in the baseline cohort, 0.22, 0.33, 0.23 and 0.22 at the peak and 0.16, 0.28, 0.29 and 0.27 in the decline cohort. The family-income profile $s_g(M)$ is the income of the CPS families of girls aged 14–17, by the co-resident mother’s education, relative to the cohort mean: the gap between daughters of college graduates and of mothers without a diploma widens from 1.56/0.68 in the baseline cohort to 1.62/0.43 in the decline cohort.

Money amounts of each cohort are divided by an index of aggregate real income, real nonfarm-business hourly compensation averaged over the years the cohort was 18–35 (1.00, 1.18 and 1.33 relative to the baseline cohort; the index is normalized to one over 1979–1995, so the baseline cohort’s own value is 1.03), so that utility costs are in consumption-equivalent units and level growth common to all incomes does not by itself move choices. Tables [E.1](#) and [E.2](#) report all the measured inputs.

E.2 Moments, weights and incomplete life cycles

For each cohort I build the same moments, with identical definitions, from the NSFG and the CPS (Appendix A). From the NSFG: high-school dropout (no diploma or GED by age 20) and college attendance by teen birth; college attendance by mother’s education; a bachelor’s degree by 25 by birth at 18–21; the stock of first births by mother’s education at each age from 17 to 41; the share married by schooling and age; contraceptive use among sexually active, childless, non-pregnant women not relying on sterilization at ages 15–17 and 18–21, overall and by mother’s education, and, by schooling, at each four-year age group from 22; and, for the quantity margin, births per woman at each single year of age from 14 to 24 (all births, and first births), children ever born by ages 25, 30 and 35 by mother’s education, the share of mothers with a second birth within four years of the first by age at first birth, and the share of births at 15–19 that are second or higher order. From the CPS: employment by schooling and age from 22, and, by schooling and age, employment of women without children, of mothers whose youngest child is 0–1, 2–5 and 6–17, and of married women. The abortion share of first pregnancies at 15–17 and 18–21 combines the Guttmacher series with the NSFG pregnancy histories, and so does its ratio across groups of mother’s education at 15–21. Ages in the NSFG are completed ages at dated events, the convention of the vital statistics and of the model: a conception at age a in the model is a birth at $a + 1$, and a stock “by age a ” counts births at completed ages up to a in the model as in the data; the NSFG birth rates at 15–17 and 18–19 are 28 and 72 per 1,000 for the baseline cohort, 35 and 77 at the peak and 13 and 48 in the decline cohort, against 32 and 79, 36 and 84, and 18 and 49 in the vital statistics for the same years. Teen cells by mother’s education pool the two highest groups (some college and a bachelor’s degree or more), which are thin at 15–17 and 18–21. The employment cells condition on current education, as the CPS records it; the marriage and use cells on final education. A cell is targeted when it has at least 30 observations and ends at or before the cohort’s last observed age, which leaves 250 targeted moments for the baseline cohort, 240 for the peak and 153 for the decline cohort. The criterion is the sum over cohorts and cells of squared proportional deviations with equal weight on every cell, $\sum_g \sum_j [(m_j^{\text{model}} - m_j^{\text{data}})/s_j]^2$, where the scale s_j is the Bernoulli standard deviation

$\sqrt{d_j(1-d_j)}$ of a share d_j , floored at 0.10, the level $|d_j|$ of a birth rate or a first-birth stock, floored at 0.02, and the level of a count, floored at 0.10; a 20% miss of a birth rate of 0.05 therefore counts as much as a 20% miss of a share of one half. A targeted cell that the model leaves empty, for instance because no simulated woman drops out of high school, is charged as a miss of its full value, so the optimizer cannot improve the fit by emptying a conditioning group. The bootstrap standard errors of the moments are not used in the criterion; they enter the sandwich standard errors of Appendix Table E.3, with a floor of 0.005 (0.01 for the CPS employment cells). The intended and use-at-conception moments are computed in the model among first births conceived at the cell’s ages: a birth is intended when the conception occurred without a method to a woman for whom the value of an additional birth, before the abortion option, was positive, and a conception is under a method when the woman used one that year. The abortion-response moment is computed for the peak cohort: the proportional change in its births at 15–17 when the minors’ abortion cost rises by 25%, with a target of zero and a scale of 0.10. The parameter vector has 65 common parameters and 24 cohort-specific ones per cohort (eleven marriage-meeting rates, the two allowances and the need-based aid, three child penalties, three shifts in the taste for work, the cost of contraception and its premium for minors, the cost of abortion, and the cost of claiming cash welfare); the shifts in the taste for work are zero for the baseline cohort. The marriage-meeting rates of age bands that start after a cohort’s observation window, or for which the cohort has no targeted marriage moment, are held at the previous cohort’s values rather than estimated, so fewer parameters are free.

The cost of abortion is estimated from the share of the births and abortions of women aged 15–17 and 18–21 that end in abortion, cohort by cohort (Chiu et al., 2024), and κ_a from the abortion share of first pregnancies at 15–21 by mother’s education. The model moment is computed among childless women, whose pregnancies are first pregnancies, over the conceptions whose outcome falls at those ages (conceived at 14–16 and 17–20); the published series covers all pregnancies, so each level is rescaled by the ratio of the nulliparous to the all-pregnancy abortion share measured in the NSFG pregnancy files for the same ages and years.

The NSFG observes the baseline and peak cohorts to their mid-forties and the decline

cohort to about age 27, and the CPS observes them to 63, 49 and 33, so the later wages, marriages and completed fertility of the younger cohorts are not in the data. I follow the practice of cohort studies in three parts ([Attanasio et al., 2008](#); [Eckstein et al., 2019](#); [Keane and Wolpin, 2010](#)). First, each cohort is scored only on the ages it is observed at: cells ending after a cohort’s observation window are untargeted. Second, later-life primitives are extrapolated with a common age profile and cohort-specific levels: beyond its window, a cohort’s earnings profile follows the baseline cohort’s age profile from its own level; and the marriage-meeting rates of age bands that start after the window, or that no marriage moment of the cohort covers (the decline cohort’s at 26–33), are held at the previous cohort’s estimates rather than estimated. Third, women are assumed to know their cohort’s primitives over the whole life cycle, with uncertainty only over idiosyncratic shocks, as in every paper above; beliefs formed on the previous cohort’s profile are a robustness check. Completed fertility beyond the window is therefore a forecast of the model, reported as such and never targeted.

Table E.1. Parameters Set Outside the Model

<i>A. Common to all cohorts</i>				
Discount factor β (annual)	0.959			
Interest rate r (annual)	0.040			
Risk aversion γ	1.98			
Maximum conception probability $\lambda_{\max}$ (annual)	0.85			
Equivalence scale ν_a, ν_k (OECD-modified)	0.5, 0.3			
Social Security replacement, $D/H/C$	0.548, 0.408, 0.336			
<i>B. Cohort-specific, measured</i>				
	Baseline	Peak	Decline	Holdout
Women born in	1962–66	1976–80	1992–96	1984–88
Tuition and fees TC_g	5.57	8.34	12.60	10.48
Efficacy of the method mix ρ_g	0.141	0.151	0.102	0.135
Exposure at 15–17, $\alpha_g(M, 15\text{--}17)$, by mother’s education				
no diploma	0.27	0.26	0.20	0.29
high school	0.21	0.30	0.23	0.29
some college	0.22	0.29	0.20	0.24
college degree	0.17	0.20	0.19	0.17
Shares $\pi_g(M)$, by mother’s education				
no diploma	0.28	0.22	0.16	0.18
high school	0.43	0.33	0.28	0.31
some college	0.15	0.23	0.29	0.26
college degree	0.14	0.22	0.27	0.25
Family income $s_g(M)$ (mean = 1), by mother’s education				
no diploma	0.68	0.52	0.43	0.50
high school	1.02	0.90	0.74	0.80
some college	1.23	1.10	0.94	1.02
college degree	1.56	1.60	1.62	1.59
Earnings equations	NLSY79	NLSY97	NLSY97	NLSY97
Women’s earnings at 30, D/H/C	20.2/29.9/46.5	20.1/29.7/49.5	24.6/29.8/51.3	20.3/28.4/49.7
Husbands’ earnings at 30, D/H/C	27.4/45.7/58.1	28.8/45.2/61.3	32.8/45.1/67.0	29.0/43.0/60.8
Aggregate income index (baseline = 1)	1.00	1.18	1.33	1.28
Last age observed, NSFG / CPS	44 / 63	43 / 49	27 / 33	35 / 41

Notes: Thousands of 2016 dollars a year; D/H/C: dropout, high school, college. Tuition: mean tuition and fees, all institutions, when the cohort was 18–21, plus books (NCES). Efficacy: the cohort’s method mix at 15–21 times typical-use failure rates; the gradient by mother’s education is in Appendix E.1. Exposure: share of childless women sexually active in the three months before the interview, averaged over ages 15–17 (NSFG; the model uses the single-age table from 14 to 45). Family income: CPS families of girls aged 14–17 by the co-resident mother’s education, relative to the cohort mean. Earnings: the CPS median wage income of employed women (of the husbands of married women) by own (wife’s) education at age 30, thousands of 2016 dollars; the fitted CPS age profile sets the level and shape of the earnings functions at every age, the NLSY equations the returns to experience and the family-background gradient (Appendix F). $\lambda_{\max}$ is the first-year conception rate of women using no method (Trussell, 2011). Income index: real nonfarm-business hourly compensation over the years the cohort was 18–35; each cohort’s money amounts are divided by it. Taxes and the safety net are in Table E.2. The holdout is not targeted.

Table E.2. Taxes and the Safety Net by Cohort

	Baseline 1962–66	Peak 1976–80	Decline 1992–96	Holdout 1984–88
Women born in				
Safety-net rules of	Jan. 1985	July 1998	July 2014	July 2006
Federal tax year	1984	1998	2014	2006
Tax at \$30k, single: average/marginal	0.18/0.25	0.18/0.23	0.16/0.23	0.16/0.23
AFDC/TANF maximum $\bar{B}_g(1)/\bar{B}_g(2)$	7.07/8.64	5.38/6.87	4.09/5.21	4.52/5.77
Rate on earnings χ_g ; disregard D_g	1.00; 1.95	0.74; 1.59	0.51; 1.10	0.60; 1.29
TANF lifetime limit $\bar{\tau}_g$ (years)	none	5	5	5
Food stamps, maximum for 1/2 persons	2.03/3.72	2.16/3.97	2.30/4.22	2.18/3.98
Minor mothers: deeming/school rule	no/no	yes/no	yes/yes	yes/yes
Minor mothers below deeming threshold $\varsigma_g(M)$				
no diploma	1.00	0.43	0.44	0.38
high school	1.00	0.17	0.23	0.17
some college	1.00	0.12	0.15	0.10
college degree	1.00	0.04	0.05	0.03
EITC phase-in rate, 1/2+ children	0.10/0.10	0.34/0.40	0.34/0.40	0.34/0.40
EITC maximum credit, 1/2+ children	1.10/1.10	3.35/5.54	3.35/5.54	3.28/5.41
EITC phase-out start	13.2	18.1	18.1	17.7
EITC phase-out rate, 1/2+ children	0.125/0.125	0.160/0.211	0.160/0.211	0.160/0.211
Single mothers claiming, 18–21/26–29	0.49/0.39	0.24/0.10	0.07/0.05	0.12/0.07
Claiming cost η_g^w		estimated		

Notes: Thousands of 2016 dollars a year. Rules: those in force when the cohort’s mean birth year turned 20 (federal taxes and EITC: that tax year; AFDC/TANF and food stamps: the nearest date with state schedules by family size). Taxes: federal income tax (rate schedules, standard deduction, exemptions, child tax credit and its refundable part) and employee payroll tax (IRS); state taxes not modeled. AFDC/TANF: median state’s maximum for a mother with one (two) children, and its rate on earnings and flat disregard after the first year of work (Welfare Rules Database; ASPE). TANF lifetime limit: federal 60 months, the median state’s, counted from age 18 (42 U.S.C. 608(a)(7)). Food stamps: federal maximum allotments (USDA). Minor-parent rules: those in force when the cohort was 14–17; ς_g : share of CPS families with a child aged 14–17 whose income is below the deeming threshold (all minors eligible before the 1984 deeming rule). EITC: Tax Policy Center. Claiming: share of unmarried women with an own child under 18 who report AFDC/TANF income for the previous year (CPS ASEC).

Table E.3. Estimated Parameters

Parameter	Common	1962–66	1976–80	1992–96
<i>Fecundity</i>				
Fecundity index θ_0 (intercept)	0.239			
θ_{26-33} (ages 26–33)	0.584			
θ_{34-45} (ages 34–45)	-0.898			
θ_H (high-school graduate or less)	0.860			
θ_D (dropout, ages 14–25)	0.136			
<i>Preferences over children</i>				
ω_0 (value of a birth)	-0.745			
π_n (parity taste, per child-year)	-0.041			
ω_u (value of a birth, preference type 2)	1.522			
q_0 (type-2 probability, intercept)	-0.490			
q_1 (type-2 probability, slope in M)	-0.495			
$\omega_{a,1}$ (value of a birth, age term z)	-0.075			
$\omega_{a,2}$ (value of a birth, age term z^2)	0.022			
$\omega_{a,3}$ (value of a birth, age term z^3)	-0.147			
$\omega_{a,4}$ (value of a birth, age term z^4)	0.631			
ω_y (<i>young child, per year</i>), <i>fixed</i>	0.181			
<i>Schooling</i>				
ϕ_H^k (stay in high school with a child)	-0.020			
ϕ_{CD}^k (continue college with a child)	-0.845			
ϕ_C^k (enter college with a child)	-0.347			
ϕ_G (college graduation)	-0.153			
ξ_C (college entry cost, mother < HS)	-1.004			
ξ_M (college cost slope in M)	0.522			
$\phi_{H,0}$ (high-school continuation cost)	-0.206			
$\phi_{H,M}$ (slope in M)	-0.003			
σ_C (college entry)	0.843			
σ_{CD} (college continuation)	0.770			
σ_H (high-school continuation)	0.515			
$\phi_H^{k,0}$ (stay in high school with a child aged 0–1)	-0.367			

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Table E.3, continued

Parameter	Common	1962–66	1976–80	1992–96
High-school allowance h_g		27.345	34.445	33.874
College allowance a_g^C		34.428	25.739	65.326
Need-based aid g_g (mother < HS)		3.082	8.956	40.366
<i>Contraception and abortion</i>				
κ_M (use-cost slope in M)	-0.030			
σ_s (contraceptive use)	0.057			
$\Delta\phi_a$ (abortion cost, ages 18 and older)	0.281			
σ_a (abortion)	0.602			
κ_a (abortion-cost slope in M , through age 21)	-0.219			
$\Delta\phi_s^{mom}$ (use cost, mothers aged ≤ 21)	-0.071			
$\phi_{s,1}$ (use cost, linear in age – 14)	-5.00e-04			
$\phi_{s,2}$ (use cost, quadratic in age – 14)	-3.25e-05			
Cost of contraception $\phi_{s,g}$		0.052	0.056	0.030
Cost of contraception of minors $\Delta\phi_{s,g}^m$ (ages 14–17)		0.015	0.043	0.028
Cost of abortion $\phi_{a,g}$		0.754	1.014	1.252
<i>Marriage market</i>				
σ_m (accepting a marriage offer)	0.065			
μ_g , D 18–21		0.146	0.086	0.058
μ_g , D 22–25		0.090	0.094	0.145
μ_g , D 26–33		0.061	0.067	0.056
μ_g , D 34–45		0.006	0.070	0.084
μ_g , H 18–21		0.252	0.162	0.023
μ_g , H 22–25		0.094	0.063	0.128
μ_g , H 26–33		0.094	0.092	0.133
μ_g , H 34–45		0.036	0.011	0.041
μ_g , C 22–25		0.159	0.121	0.021
μ_g , C 26–33		0.112	0.098	0.102
μ_g , C 34–45		0.114	0.088	0.040
<i>Labor supply</i>				
ψ_l D, ages 14–25	-0.134			
ψ_l D, ages 30–37	-0.084			

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Table E.3, continued

Parameter	Common	1962–66	1976–80	1992–96
ψ_l D, ages 50–53	-0.082			
ψ_l D, ages 54–65	-0.112			
ψ_l H, ages 14–25	-0.039			
ψ_l H, ages 30–37	-0.013			
ψ_l H, ages 50–53	-0.024			
ψ_l H, ages 54–65	-0.030			
ψ_l C, ages 14–25	-0.003			
ψ_l C, ages 30–37	0.033			
ψ_l C, ages 50–53	0.037			
ψ_l C, ages 54–65	0.013			
ψ_{ret} (per four-year period from 58)	-0.003			
σ_l (work)	0.050			
ψ_l D, ages 26–29	-0.098			
ψ_l H, ages 26–29	-0.020			
ψ_l C, ages 26–29	0.022			
ψ_l D, ages 38–45	-0.068			
ψ_l H, ages 38–45	-0.008			
ψ_l C, ages 38–45	0.033			
ψ_l D, ages 46–49	-0.069			
ψ_l H, ages 46–49	0.005			
ψ_l C, ages 46–49	0.033			
ψ_{lm} , D (married)	0.020			
ψ_{lm} , H (married)	0.025			
ψ_{lm} , C (married)	0.018			
$\psi_{lc,g}$, D (cohort shift)		0.000	-0.002	-0.025
$\psi_{lc,g}$, H (cohort shift)		0.000	-0.006	-0.002
$\psi_{lc,g}$, C (cohort shift)		0.000	0.001	0.023
<i>Child penalty</i>				
ϱ_{2-5} (child penalty, youngest 2–5, relative to 0–1)	0.746			
ϱ_{6-17} (child penalty, youngest 6–17, relative to 0–1)	0.403			
v_2 (child penalty, two or more children)	1.333			

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Table E.3, continued

Parameter	Common	1962–66	1976–80	1992–96
$\psi_{lk,g}(D)$		-0.028	-0.047	-0.052
$\psi_{lk,g}(H)$		-0.048	-0.032	-0.037
$\psi_{lk,g}(C)$		-0.070	-0.052	-0.057
<i>Safety net</i>				
$\Delta\eta^w$ (claiming cost, ages ≤ 21)	0.001			
Cost of claiming cash welfare η_g^w		0.019	0.023	0.019

Notes: Pooled SMM estimates on the three cohorts. “Common” parameters are shared by all cohorts; the cohort columns report the estimated cohort-specific primitives of Table 3. Utility parameters are in the units of $u(c)$ with c in thousands of 2016 dollars a year in balanced-growth units; allowances in thousands of 2016 dollars a year. Marriage-meeting rates of age bands that start after a cohort’s observation window are held at the previous cohort’s values. Standard errors are not yet computed. Preliminary: nsfgI (job 9226) at 34.9 of 60 hours, 13 October 2026.

Table E.4. Targeted Moments: Data and Model

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
<i>Schooling</i>								
HS dropout, no birth at 14–17	0.131	0.153	0.143	0.140	0.081	0.070	0.129	0.091
HS dropout, birth at 14–17	0.563	0.530	0.472	0.428	0.358	0.302	0.505	0.334
College attendance, no birth at 14–17	0.568	0.551	0.673	0.599	0.710	0.741	0.711	0.684
College attendance, birth at 14–17	0.168	0.140	0.343	0.141	0.379	0.271	0.319	0.212
College attendance, mother < HS	0.304	0.308	0.398	0.357	0.548	0.503	0.408	0.439
College attendance, mother HS	0.510	0.509	0.587	0.511	0.586	0.653	0.615	0.590
College attendance, mother some college	0.783	0.691	0.774	0.696	0.711	0.801	0.796	0.747
College attendance, mother BA+	0.839	0.836	0.855	0.717	0.891	0.861	0.857	0.806
College graduation, no birth by 21	0.463	0.403	0.525	0.470	0.566	0.528	0.580	0.501
College graduation, birth at 18–21	0.107	0.108	0.099	0.117	0.252	0.148	0.056	0.146
<i>First births by mother's education</i>								
First birth by 17, mother < HS	0.138	0.135	0.156	0.135	0.095	0.076	0.128	0.122
First birth by 21, mother < HS	0.472	0.475	0.486	0.447	0.479	0.351	0.495	0.423
First birth by 25, mother < HS	0.651	0.649	0.672	0.646	0.612	0.521	0.691	0.613
First birth by 29, mother < HS	0.796	0.757	0.815	0.778	—	—	0.803	0.742
First birth by 33, mother < HS	0.872	0.842	0.868	0.867	—	—	0.824	0.834
First birth by 37, mother < HS	0.901	0.905	0.912	0.923	—	—	—	—
First birth by 41, mother < HS	0.907	0.947	0.976	0.952	—	—	—	—
First birth by 17, mother HS	0.066	0.058	0.101	0.093	0.036	0.049	0.080	0.077
First birth by 21, mother HS	0.288	0.305	0.354	0.364	0.225	0.264	0.320	0.325
First birth by 25, mother HS	0.493	0.504	0.501	0.553	0.272	0.447	0.492	0.515
First birth by 29, mother HS	0.641	0.643	0.672	0.678	—	—	0.656	0.646
First birth by 33, mother HS	0.762	0.754	0.782	0.782	—	—	0.733	0.745
First birth by 37, mother HS	0.807	0.831	0.826	0.852	—	—	—	—
First birth by 41, mother HS	0.779	0.880	0.827	0.901	—	—	—	—
First birth by 17, mother some college or BA+	0.039	0.033	0.068	0.044	0.025	0.016	0.045	0.026
First birth by 21, mother some college or BA+	0.167	0.189	0.224	0.208	0.156	0.135	0.201	0.162
First birth by 25, mother some college	0.390	0.406	0.457	0.424	0.371	0.321	0.369	0.377
First birth by 29, mother some college	0.579	0.529	0.642	0.575	—	—	0.656	0.525
First birth by 33, mother some college	0.714	0.657	0.760	0.702	—	—	0.731	0.653
First birth by 37, mother some college	0.781	0.748	0.802	0.779	—	—	—	—
First birth by 41, mother some college	0.837	0.808	0.839	0.833	—	—	—	—
First birth by 25, mother BA+	0.299	0.323	0.307	0.350	0.191	0.270	0.295	0.296
First birth by 29, mother BA+	0.462	0.473	0.468	0.482	—	—	0.510	0.435
First birth by 33, mother BA+	0.667	0.592	0.667	0.613	—	—	0.598	0.571
First birth by 37, mother BA+	0.752	0.682	0.763	0.706	—	—	—	—

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
First birth by 41, mother BA+	0.751	0.738	0.819	0.770	—	—	—	—
<i>Birth rates</i>								
Births per woman at age 14	0.003	0.000	0.004	0.000	0.002	0.000	0.004	0.000
Births per woman at age 15	0.011	0.015	0.019	0.016	0.006	0.006	0.011	0.011
Births per woman at age 16	0.028	0.024	0.028	0.027	0.017	0.011	0.023	0.019
Births per woman at age 17	0.046	0.041	0.058	0.046	0.017	0.020	0.040	0.033
Births per woman at age 18	0.067	0.070	0.069	0.076	0.035	0.042	0.058	0.060
Births per woman at age 19	0.078	0.076	0.086	0.073	0.061	0.043	0.088	0.057
Births per woman at age 20	0.097	0.091	0.107	0.087	0.076	0.059	0.094	0.070
Births per woman at age 21	0.114	0.099	0.101	0.089	0.064	0.066	0.101	0.079
Births per woman at age 22	0.095	0.099	0.098	0.097	0.094	0.076	0.089	0.089
Births per woman at age 23	0.119	0.106	0.110	0.106	0.082	0.075	0.093	0.089
Births per woman at age 24	0.109	0.108	0.108	0.107	0.075	0.079	0.096	0.094
First births per woman at age 14	0.003	0.000	0.004	0.000	0.002	0.000	0.003	0.000
First births per woman at age 15	0.011	0.015	0.017	0.016	0.006	0.006	0.010	0.011
First births per woman at age 16	0.025	0.022	0.026	0.026	0.016	0.011	0.022	0.018
First births per woman at age 17	0.037	0.036	0.049	0.040	0.016	0.018	0.035	0.029
First births per woman at age 18	0.055	0.057	0.053	0.059	0.028	0.036	0.047	0.050
First births per woman at age 19	0.054	0.058	0.057	0.054	0.051	0.035	0.063	0.043
First births per woman at age 20	0.060	0.067	0.070	0.062	0.060	0.049	0.059	0.052
First births per woman at age 21	0.060	0.067	0.047	0.058	0.036	0.052	0.054	0.056
First births per woman at age 22	0.044	0.064	0.038	0.062	0.041	0.059	0.040	0.062
First births per woman at age 23	0.052	0.044	0.049	0.045	0.033	0.041	0.039	0.044
First births per woman at age 24	0.042	0.043	0.042	0.044	0.046	0.039	0.040	0.043
<i>Parity</i>								
Children ever born by 25, mother < HS	1.155	1.071	1.136	1.091	0.826	0.802	1.174	1.003
Children ever born by 30, mother < HS	1.768	1.671	1.794	1.731	—	—	1.792	1.602
Children ever born by 35, mother < HS	2.251	2.114	2.152	2.175	—	—	—	—
Children ever born by 25, mother HS	0.729	0.700	0.801	0.809	0.502	0.589	0.781	0.720
Children ever born by 30, mother HS	1.256	1.188	1.341	1.332	—	—	1.319	1.223
Children ever born by 35, mother HS	1.676	1.653	1.728	1.789	—	—	—	—
Children ever born by 25, mother some college	0.488	0.495	0.731	0.536	0.542	0.364	0.534	0.450
Children ever born by 30, mother some college	1.118	0.873	1.291	0.949	—	—	1.198	0.833
Children ever born by 35, mother some college	1.570	1.289	1.657	1.406	—	—	—	—
Children ever born by 25, mother BA+	0.403	0.353	0.417	0.393	0.267	0.278	0.386	0.313
Children ever born by 30, mother BA+	0.797	0.675	0.890	0.726	—	—	0.846	0.627
Children ever born by 35, mother BA+	1.443	1.043	1.488	1.116	—	—	—	—

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Second birth within 4 years, first birth at 14–17	0.549	0.563	0.598	0.551	0.448	0.469	0.624	0.516
Second birth within 4 years, first birth at 18–21	0.603	0.499	0.567	0.494	0.544	0.406	0.533	0.464
Second birth within 4 years, first birth at 22–25	0.595	0.403	0.522	0.403	—	—	0.521	0.359
Share of births at 15–19 of order 2 or higher	0.213	0.172	0.215	0.183	0.133	0.130	0.199	0.164
<i>Contraceptive use (sexually active, childless)</i>								
Contraceptive use at 15–17	0.670	0.606	0.735	0.705	0.845	0.856	0.828	0.790
Contraceptive use at 18–21	0.783	0.767	0.829	0.833	0.852	0.885	0.825	0.871
Contraceptive use at 22–25, HS graduates	0.866	0.903	0.891	0.919	0.845	0.930	0.890	0.932
Contraceptive use at 26–29, HS graduates	0.824	0.933	0.759	0.951	0.859	0.964	0.867	0.961
Contraceptive use at 30–33, HS graduates	0.853	0.863	0.845	0.889	—	—	0.773	0.910
Contraceptive use at 34–37, HS graduates	—	—	0.724	0.734	—	—	—	—
Contraceptive use at 38–41, HS graduates	0.594	0.710	0.673	0.718	—	—	—	—
Contraceptive use at 22–25, college	0.902	0.904	0.879	0.917	0.898	0.939	0.910	0.931
Contraceptive use at 26–29, college	0.959	0.943	0.874	0.952	0.993	0.979	0.939	0.969
Contraceptive use at 30–33, college	0.936	0.939	0.929	0.950	—	—	0.954	0.973
Contraceptive use at 34–37, college	—	—	0.932	0.820	—	—	—	—
Contraceptive use at 38–41, college	0.866	0.830	0.787	0.850	—	—	—	—
Contraceptive use at 15–17, mother < HS	0.593	0.547	0.640	0.604	0.802	0.712	—	—
Contraceptive use at 18–21, mother < HS	0.774	0.719	—	—	0.887	0.821	0.814	0.810
Contraceptive use at 15–17, mother HS	0.738	0.649	0.772	0.701	0.818	0.831	0.809	0.778
Contraceptive use at 18–21, mother HS	0.758	0.782	0.835	0.829	0.785	0.867	0.788	0.857
Contraceptive use at 15–17, mother some college or BA+	0.679	0.613	0.752	0.763	0.863	0.915	0.895	0.852
Contraceptive use at 18–21, mother some college or BA+	0.836	0.783	0.826	0.868	0.871	0.910	0.845	0.897
Contraceptive use at 15–17, mother some college	—	—	0.759	0.794	0.905	0.908	0.923	0.859
Contraceptive use at 18–21, mother some college	0.812	0.803	0.803	0.879	0.844	0.905	0.883	0.896
Contraceptive use at 15–17, mother BA+	—	—	—	—	0.782	0.923	0.860	0.839
Contraceptive use at 18–21, mother BA+	0.866	0.759	0.861	0.854	0.903	0.916	0.807	0.897
<i>Abortion</i>								
Abortions per first pregnancy, ages 15–17	0.527	0.428	0.385	0.374	0.314	0.324	0.358	0.345
Abortions per first pregnancy, ages 18–21	0.459	0.335	0.354	0.271	0.259	0.206	0.291	0.247
Abortions per first pregnancy, ages 15–21, mother < HS	0.247	0.251	0.196	0.191	0.121	0.138	0.163	0.173

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Abortions per first pregnancy, ages 15–21, mother HS	0.553	0.351	0.343	0.277	0.275	0.205	0.336	0.250
Abortions per first pregnancy, ages 15–21, mother some college	0.633	0.492	0.466	0.405	0.389	0.290	0.312	0.353
Abortions per first pregnancy, ages 15–21, mother BA+	0.773	0.621	0.675	0.466	0.397	0.354	0.537	0.411
<i>Marriage</i>								
Married by 21, dropouts	0.479	0.518	0.327	0.344	0.135	0.296	0.271	0.310
Married by 25, dropouts	0.615	0.658	0.465	0.532	—	—	0.378	0.551
Married by 29, dropouts	0.684	0.737	0.538	0.631	—	—	0.502	0.637
Married by 33, dropouts	0.744	0.785	0.576	0.711	—	—	—	—
Married by 37, dropouts	0.776	0.790	0.562	0.771	—	—	—	—
Married by 41, dropouts	0.856	0.794	—	—	—	—	—	—
Married by 21, HS graduates	0.426	0.473	0.287	0.341	0.188	0.160	0.214	0.248
Married by 25, HS graduates	0.649	0.640	0.522	0.503	0.443	0.494	0.424	0.492
Married by 29, HS graduates	0.777	0.751	0.649	0.660	—	—	0.556	0.653
Married by 33, HS graduates	0.821	0.816	0.722	0.746	—	—	0.603	0.741
Married by 37, HS graduates	0.852	0.840	0.726	0.758	—	—	—	—
Married by 41, HS graduates	0.858	0.863	0.686	0.767	—	—	—	—
Married by 25, college	0.439	0.540	0.410	0.460	0.156	0.175	0.361	0.322
Married by 29, college	0.650	0.708	0.664	0.634	—	—	0.617	0.547
Married by 33, college	0.798	0.820	0.776	0.748	—	—	0.825	0.690
Married by 37, college	0.850	0.880	0.819	0.811	—	—	—	—
Married by 41, college	0.892	0.927	0.898	0.871	—	—	—	—
<i>Employment</i>								
Employed at 22–25, dropouts	0.231	0.233	0.286	0.313	0.232	0.319	0.204	0.324
Employed at 26–29, dropouts	0.271	0.300	0.309	0.331	0.304	0.301	0.243	0.320
Employed at 30–33, dropouts	0.294	0.336	0.285	0.320	0.345	0.279	0.299	0.300
Employed at 34–37, dropouts	0.402	0.337	0.292	0.271	—	—	0.317	0.257
Employed at 38–41, dropouts	0.425	0.417	0.324	0.305	—	—	0.379	0.267
Employed at 42–45, dropouts	0.386	0.431	0.380	0.287	—	—	—	—
Employed at 46–49, dropouts	0.349	0.398	—	—	—	—	—	—
Employed at 50–53, dropouts	0.333	0.351	—	—	—	—	—	—
Employed at 54–57, dropouts	0.299	0.231	—	—	—	—	—	—
Employed at 58–61, dropouts	0.339	0.232	—	—	—	—	—	—
Employed at 62–65, dropouts	0.199	0.193	—	—	—	—	—	—
Employed at 22–25, HS graduates	0.548	0.553	0.517	0.506	0.457	0.492	0.447	0.495
Employed at 26–29, HS graduates	0.569	0.597	0.572	0.591	0.573	0.590	0.524	0.588
Employed at 30–33, HS graduates	0.564	0.581	0.544	0.581	0.591	0.591	0.556	0.588
Employed at 34–37, HS graduates	0.595	0.569	0.553	0.573	—	—	0.573	0.577

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Employed at 38–41, HS graduates	0.621	0.594	0.583	0.599	—	—	0.606	0.604
Employed at 42–45, HS graduates	0.623	0.581	0.613	0.595	—	—	—	—
Employed at 46–49, HS graduates	0.589	0.613	—	—	—	—	—	—
Employed at 50–53, HS graduates	0.594	0.530	—	—	—	—	—	—
Employed at 54–57, HS graduates	0.556	0.508	—	—	—	—	—	—
Employed at 58–61, HS graduates	0.521	0.518	—	—	—	—	—	—
Employed at 62–65, HS graduates	0.453	0.528	—	—	—	—	—	—
Employed at 22–25, college	0.657	0.651	0.619	0.678	0.615	0.676	0.584	0.673
Employed at 26–29, college	0.768	0.723	0.743	0.755	0.775	0.791	0.726	0.775
Employed at 30–33, college	0.693	0.716	0.712	0.755	0.794	0.814	0.744	0.789
Employed at 34–37, college	0.654	0.681	0.696	0.714	—	—	0.735	0.767
Employed at 38–41, college	0.643	0.683	0.713	0.711	—	—	0.746	0.760
Employed at 42–45, college	0.675	0.660	0.736	0.699	—	—	—	—
Employed at 46–49, college	0.679	0.624	—	—	—	—	—	—
Employed at 50–53, college	0.707	0.701	—	—	—	—	—	—
Employed at 54–57, college	0.690	0.629	—	—	—	—	—	—
Employed at 58–61, college	0.624	0.652	—	—	—	—	—	—
Employed at 62–65, college	0.532	0.664	—	—	—	—	—	—
Employed at 22–25, childless, dropouts	0.356	0.385	0.358	0.440	0.243	0.425	0.244	0.439
Employed at 26–29, childless, dropouts	0.355	0.445	0.403	0.476	0.399	0.427	0.305	0.464
Employed at 30–33, childless, dropouts	0.347	0.416	0.323	0.456	0.401	0.358	0.299	0.408
Employed at 34–37, childless, dropouts	0.406	0.414	0.288	0.373	—	—	0.365	0.348
Employed at 38–41, childless, dropouts	0.407	0.459	0.277	0.405	—	—	0.395	0.365
Employed at 22–25, childless, HS graduates	0.647	0.644	0.558	0.566	0.464	0.534	0.471	0.542
Employed at 26–29, childless, HS graduates	0.739	0.702	0.676	0.668	0.642	0.654	0.603	0.656
Employed at 30–33, childless, HS graduates	0.700	0.704	0.612	0.669	0.658	0.668	0.631	0.672
Employed at 34–37, childless, HS graduates	0.705	0.673	0.609	0.642	—	—	0.615	0.644
Employed at 38–41, childless, HS graduates	0.682	0.695	0.598	0.674	—	—	0.633	0.679
Employed at 22–25, childless, college	0.669	0.696	0.628	0.711	0.618	0.711	0.587	0.712
Employed at 26–29, childless, college	0.842	0.796	0.802	0.806	0.802	0.840	0.769	0.829
Employed at 30–33, childless, college	0.841	0.811	0.821	0.823	0.855	0.867	0.825	0.854
Employed at 34–37, childless, college	0.836	0.785	0.789	0.792	—	—	0.807	0.832
Employed at 38–41, childless, college	0.796	0.787	0.803	0.782	—	—	0.821	0.818
Employed at 22–25, youngest child 0–1, dropouts	0.135	0.148	0.177	0.202	0.163	0.196	0.125	0.200

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Employed at 26–29, youngest child 0–1, dropouts	0.166	0.232	0.177	0.225	0.168	0.207	0.146	0.202
Employed at 30–33, youngest child 0–1, dropouts	0.195	0.279	0.170	0.223	0.234	0.207	0.183	0.219
Employed at 34–37, youngest child 0–1, dropouts	0.224	0.237	0.141	0.172	—	—	0.148	0.178
Employed at 38–41, youngest child 0–1, dropouts	0.254	0.320	0.156	0.202	—	—	0.251	0.189
Employed at 22–25, youngest child 0–1, HS graduates	0.361	0.386	0.388	0.411	0.374	0.385	0.354	0.402
Employed at 26–29, youngest child 0–1, HS graduates	0.417	0.471	0.420	0.509	0.436	0.482	0.417	0.500
Employed at 30–33, youngest child 0–1, HS graduates	0.428	0.453	0.439	0.508	0.482	0.495	0.431	0.502
Employed at 34–37, youngest child 0–1, HS graduates	0.443	0.421	0.443	0.483	—	—	0.456	0.478
Employed at 38–41, youngest child 0–1, HS graduates	0.433	0.447	0.437	0.499	—	—	0.462	0.488
Employed at 22–25, youngest child 0–1, college	0.510	0.415	0.460	0.519	0.530	0.458	0.566	0.475
Employed at 26–29, youngest child 0–1, college	0.568	0.536	0.581	0.623	0.645	0.641	0.586	0.636
Employed at 30–33, youngest child 0–1, college	0.530	0.513	0.602	0.608	0.675	0.667	0.648	0.654
Employed at 34–37, youngest child 0–1, college	0.487	0.479	0.610	0.564	—	—	0.671	0.615
Employed at 38–41, youngest child 0–1, college	0.488	0.476	0.642	0.577	—	—	0.665	0.624
Employed at 22–25, youngest child 2–5, dropouts	0.200	0.193	0.297	0.245	0.242	0.255	0.229	0.263
Employed at 26–29, youngest child 2–5, dropouts	0.276	0.273	0.310	0.285	0.257	0.245	0.236	0.285
Employed at 30–33, youngest child 2–5, dropouts	0.270	0.318	0.258	0.279	0.338	0.262	0.311	0.265
Employed at 34–37, youngest child 2–5, dropouts	0.325	0.305	0.253	0.226	—	—	0.277	0.206
Employed at 38–41, youngest child 2–5, dropouts	0.351	0.365	0.282	0.248	—	—	0.221	0.208
Employed at 22–25, youngest child 2–5, HS graduates	0.427	0.457	0.507	0.450	0.478	0.434	0.457	0.446

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Employed at 26–29, youngest child 2–5, HS graduates	0.459	0.536	0.533	0.556	0.489	0.548	0.472	0.554
Employed at 30–33, youngest child 2–5, HS graduates	0.485	0.523	0.497	0.542	0.516	0.544	0.496	0.548
Employed at 34–37, youngest child 2–5, HS graduates	0.485	0.509	0.489	0.535	—	—	0.506	0.534
Employed at 38–41, youngest child 2–5, HS graduates	0.464	0.512	0.489	0.544	—	—	0.521	0.546
Employed at 22–25, youngest child 2–5, college	0.520	0.508	0.625	0.560	0.608	0.495	0.560	0.527
Employed at 26–29, youngest child 2–5, college	0.553	0.609	0.622	0.691	0.671	0.689	0.622	0.697
Employed at 30–33, youngest child 2–5, college	0.544	0.624	0.610	0.713	0.694	0.757	0.635	0.732
Employed at 34–37, youngest child 2–5, college	0.513	0.572	0.636	0.639	—	—	0.684	0.703
Employed at 38–41, youngest child 2–5, college	0.509	0.553	0.635	0.630	—	—	0.689	0.687
Employed at 22–25, youngest child 6–17, dropouts	0.308	0.212	0.414	0.353	0.347	0.327	0.238	0.350
Employed at 26–29, youngest child 6–17, dropouts	0.285	0.336	0.371	0.379	0.340	0.324	0.295	0.341
Employed at 30–33, youngest child 6–17, dropouts	0.320	0.371	0.345	0.356	0.366	0.293	0.351	0.335
Employed at 34–37, youngest child 6–17, dropouts	0.452	0.345	0.347	0.267	—	—	0.370	0.259
Employed at 38–41, youngest child 6–17, dropouts	0.459	0.410	0.365	0.279	—	—	0.408	0.247
Employed at 42–45, youngest child 6–17, dropouts	0.413	0.430	0.393	0.255	—	—	—	—
Employed at 22–25, youngest child 6–17, HS graduates	0.534	0.560	0.623	0.512	0.593	0.534	0.460	0.515
Employed at 26–29, youngest child 6–17, HS graduates	0.579	0.619	0.617	0.614	0.622	0.608	0.528	0.608
Employed at 30–33, youngest child 6–17, HS graduates	0.604	0.623	0.583	0.612	0.615	0.613	0.592	0.621
Employed at 34–37, youngest child 6–17, HS graduates	0.626	0.604	0.579	0.589	—	—	0.611	0.596
Employed at 38–41, youngest child 6–17, HS graduates	0.640	0.624	0.605	0.614	—	—	0.618	0.623

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Employed at 42–45, youngest child 6–17, HS graduates	0.619	0.601	0.608	0.603	—	—	—	—
Employed at 22–25, youngest child 6–17, college	0.584	0.674	0.705	0.650	0.735	0.664	0.555	0.568
Employed at 26–29, youngest child 6–17, college	0.677	0.705	0.711	0.767	0.720	0.747	0.685	0.764
Employed at 30–33, youngest child 6–17, college	0.778	0.735	0.710	0.762	0.730	0.795	0.737	0.786
Employed at 34–37, youngest child 6–17, college	0.703	0.692	0.723	0.731	—	—	0.731	0.772
Employed at 38–41, youngest child 6–17, college	0.647	0.687	0.712	0.722	—	—	0.750	0.763
Employed at 42–45, youngest child 6–17, college	0.652	0.663	0.736	0.713	—	—	—	—
Employed at 22–25, married, dropouts	0.242	0.149	0.237	0.177	0.214	0.145	0.171	0.163
Employed at 26–29, married, dropouts	0.289	0.245	0.240	0.230	0.234	0.191	0.177	0.210
Employed at 30–33, married, dropouts	0.311	0.289	0.249	0.237	0.232	0.184	0.272	0.200
Employed at 34–37, married, dropouts	0.390	0.291	0.258	0.212	—	—	0.270	0.188
Employed at 38–41, married, dropouts	0.392	0.368	0.300	0.267	—	—	0.347	0.227
Employed at 42–45, married, dropouts	0.389	0.377	0.342	0.263	—	—	—	—
Employed at 46–49, married, dropouts	0.342	0.347	—	—	—	—	—	—
Employed at 22–25, married, HS graduates	0.527	0.475	0.491	0.428	0.450	0.442	0.449	0.430
Employed at 26–29, married, HS graduates	0.528	0.538	0.526	0.513	0.521	0.533	0.466	0.518
Employed at 30–33, married, HS graduates	0.525	0.537	0.502	0.519	0.538	0.534	0.501	0.526
Employed at 34–37, married, HS graduates	0.543	0.533	0.512	0.528	—	—	0.527	0.524
Employed at 38–41, married, HS graduates	0.577	0.567	0.553	0.557	—	—	0.574	0.559
Employed at 42–45, married, HS graduates	0.604	0.558	0.593	0.556	—	—	—	—
Employed at 46–49, married, HS graduates	0.585	0.594	—	—	—	—	—	—
Employed at 22–25, married, college	0.700	0.603	0.644	0.613	0.679	0.673	0.587	0.642
Employed at 26–29, married, college	0.727	0.675	0.692	0.700	0.733	0.763	0.690	0.734
Employed at 30–33, married, college	0.624	0.686	0.660	0.715	0.744	0.789	0.690	0.753
Employed at 34–37, married, college	0.581	0.660	0.656	0.687	—	—	0.702	0.742
Employed at 38–41, married, college	0.577	0.668	0.673	0.692	—	—	0.724	0.743
Employed at 42–45, married, college	0.626	0.650	0.708	0.684	—	—	—	—
Employed at 46–49, married, college	0.643	0.617	—	—	—	—	—	—
<i>Welfare claiming</i>								
Single mothers claiming AFDC/TANF at 18–21	0.493	0.476	0.235	0.178	0.069	0.108	0.119	0.126
Single mothers claiming AFDC/TANF at 22–25	0.465	0.473	0.142	0.182	0.054	0.091	0.100	0.115

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
Single mothers claiming AFDC/TANF at 26–29	0.393	0.364	0.095	0.210	0.052	0.092	0.072	0.128
Single mothers claiming AFDC/TANF at 30–33	0.260	0.314	0.074	0.194	0.050	0.093	0.053	0.119
<i>Validation: abortion response</i>								
Births at 15–17 under a 25% higher minors' abortion cost (proportional change)	—	—	0.000	-0.007	—	—	—	—
<i>Wantedness and use at conception</i>								
First births at 14–17 reported wanted at conception	0.287	0.381	0.250	0.243	0.183	0.178	0.205	0.156
First births at 18–21 reported wanted at conception	0.476	0.340	0.434	0.324	0.374	0.407	0.409	0.332
First births at 14–17 reported wanted at conception, mother < HS	0.340	0.534	0.351	0.271	0.215	0.373	0.179	0.318
First births at 18–21 reported wanted at conception, mother < HS	0.438	0.374	0.491	0.459	0.385	0.528	0.498	0.435
First births at 14–17 reported wanted at conception, mother HS	0.273	0.271	0.257	0.302	0.190	0.097	0.253	0.077
First births at 18–21 reported wanted at conception, mother HS	0.533	0.357	0.426	0.310	0.310	0.393	0.385	0.328
First births at 14–17 reported wanted at conception, mother some college or BA+	—	—	0.102	0.105	0.143	0.051	0.161	0.046
First births at 18–21 reported wanted at conception, mother some college or BA+	0.419	0.251	0.394	0.237	0.410	0.360	0.374	0.277
First births at 14–17 reported wanted at conception, mother some college	—	—	0.105	0.070	—	—	0.051	0.028
First births at 18–21 reported wanted at conception, mother some college	—	—	0.397	0.234	0.416	0.327	0.393	0.269
First births at 18–21 reported wanted at conception, mother BA+	—	—	—	—	0.400	0.405	0.344	0.290
First births at 14–17 conceived while using a method	0.167	0.138	0.331	0.198	0.391	0.294	0.409	0.256
First births at 18–21 conceived while using a method	0.158	0.258	0.334	0.367	0.363	0.367	0.338	0.404
First births at 14–17 conceived while using a method, mother < HS	0.142	0.150	0.251	0.198	0.235	0.242	0.376	0.235
First births at 18–21 conceived while using a method, mother < HS	0.098	0.268	0.153	0.344	0.368	0.347	0.335	0.415

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Table E.4, continued

Moment	Born 1962–66		Born 1976–80		Born 1992–96		1984–88 (holdout)	
	Data	Model	Data	Model	Data	Model	Data	Model
First births at 14–17 conceived while using a method, mother HS	0.126	0.132	0.347	0.192	0.501	0.291	0.343	0.259
First births at 18–21 conceived while using a method, mother HS	0.199	0.260	0.399	0.378	0.389	0.338	0.298	0.384
First births at 14–17 conceived while using a method, mother some college or BA+	—	—	0.404	0.208	0.474	0.362	0.542	0.282
First births at 18–21 conceived while using a method, mother some college or BA+	0.215	0.236	0.434	0.375	0.346	0.398	0.378	0.417
First births at 14–17 conceived while using a method, mother some college	—	—	0.387	0.253	—	—	0.608	0.317
First births at 18–21 conceived while using a method, mother some college	—	—	0.412	0.399	0.302	0.409	0.458	0.433
First births at 18–21 conceived while using a method, mother BA+	—	—	—	—	0.409	0.384	0.268	0.393

Notes: Targeted moments of each estimation cohort and their simulated counterparts at the pooled estimates; the holdout cohort (born 1984–88) is not targeted and its model column borrows the estimated cohort-specific primitives interpolated between the peak and decline cohorts. Schooling is final schooling; first births are stocks by the stated age (the two highest groups of mother’s education pooled where cells are thin); contraceptive use is among sexually active women with no prior birth; employment is by current education. — marks a cell the cohort does not reach or that has fewer than 30 observations. Preliminary: nsfGI (job 9226) at 34.9 of 60 hours, 13 October 2026.

F Wage Process Estimation

The earnings opportunities that enter the model are measured outside the model in two parts. The returns to experience and the family-background premia require a panel, and come from equations estimated on the NLSY79 (used for the baseline cohort) and the NLSY97 (used for the later cohorts). The level and age profile of earnings by education are cohort-specific and come from the CPS, which observes every cohort.

The regression coefficients of this appendix ($\alpha, \beta, \gamma, \delta, \rho, \kappa, \lambda, \zeta$ with subscripts) are local to it and unrelated to the model's parameters of the same letters.

Samples and measures. The dependent variable is the log of real annual wage-and-salary income (2016 dollars), the Mincer form of [Keane and Wolpin \(2010\)](#), [Eckstein et al. \(2019\)](#) and [Adda et al. \(2017\)](#), with returns to experience that differ by education as in [Blundell et al. \(2016\)](#). The women's samples include woman-years meeting the employment definition in Appendix A. The husbands' samples are married women with a spouse present and positive spouse earnings; husbands' earnings are indexed by the woman's education to capture assortative mating.

Cohort levels and age profiles (CPS). For each cohort g and education group e , let $\widehat{W}_g^{\text{CPS}}(e, a)$ be the fitted value of a weighted quadratic in age for the log median wage income of employed women aged a in the CPS, estimated on the cells with at least 30 workers and weighted by cell size (medians rather than means keep the thin dropout cells of the young cohorts from driving the level). The NLSY log-earnings equation (12) without its age terms, $\widehat{g}^{\text{NLSY}}(M, e, x)$, carries the return to experience and the family-background premia. Women's earnings in the model are

$$\begin{aligned} \ln w_g(M, e, x, a) &= \widehat{g}^{\text{NLSY}}(M, e, x) + \delta_g(e, a), \\ \delta_g(e, a) &= \ln \widehat{W}_g^{\text{CPS}}(e, a) - \ln \sum_M \pi_g(M) \exp \widehat{g}^{\text{NLSY}}(M, e, \bar{x}_g(e, a)), \end{aligned} \tag{11}$$

where $\bar{x}_g(e, a)$ is the experience of a typical employed woman of the cohort, education and age: the cumulative CPS employment rate of the group from age 16 to $a - 1$, capped at

the model’s twenty years. The offset δ_g makes the average woman of the cohort, over family background, with typical experience earn the CPS median at every age; the NLSY equation sets how earnings differ, proportionally, by experience and family background around it. Husbands’ earnings are the NLSY husband equation (13) multiplied, by the wife’s education and age, by the ratio of the fitted CPS median earnings of the husbands of married women of the cohort to the equation’s prediction for a woman who married before her first birth. Beyond the last age at which a cohort is observed in the CPS (63 for the baseline, 49 at the peak, 41 for the holdout and 33 for the decline cohort) the CPS profile follows the baseline cohort’s fitted profile from the cohort’s own level at that age, the convention of Section 5; the baseline’s own profile is held flat after 63. The NLSY age quadratic, estimated on panels observed to their mid-fifties, is not used: it peaks at 23 and would put the earnings of a high-school graduate without experience at zero by 55, while the CPS medians of the same cohort rise from 30 to 60. Table E.1 reports the CPS medians at age 30. The cell statistics are in `Code/Julia/data/wages/cps_wage_cells.csv` and the offsets and factors in `data/wages/wage_rebase_log-<cohort>.csv` (`cps_wage_rebase.jl`).

Experience and family background (NLSY). On the NLSY79 I estimate

$$\begin{aligned}
\ln w_{it} = & \alpha_t + \beta_1 \text{Age}_{it}^f + \beta_2 (\text{Age}_{it}^f)^2 + \rho_1 \text{CumExp}_{it} + \rho_2 \text{CumExp}_{it}^2 \\
& + \sum_{e \in \{\text{HSG}, \text{COL}\}} (\gamma_e + \delta_e \text{CumExp}_{it}) \mathbf{1}\{\text{Educ}_i^f = e\} \\
& + \sum_{q=2}^4 (\gamma_q + \delta_q \text{CumExp}_{it}) \mathbf{1}\{\text{MomEd}_i = q\} \\
& + \sum_{e \in \{\text{HSG}, \text{COL}\}} \sum_{q=2}^4 (\gamma_{eq} + \delta_{eq} \text{CumExp}_{it}) \mathbf{1}\{\text{Educ}_i^f = e\} \mathbf{1}\{\text{MomEd}_i = q\} + \varepsilon_{it},
\end{aligned} \tag{12}$$

with calendar-year fixed effects α_t , where MomEd_i is the woman’s mother’s education. The equation is estimated on the NLSY79 women of the teen sample, weighted (`Code/Stata/Moments/T3_wages_log_nlsy79.do`); the return to experience is quadratic, and the $\text{CumExp} \times \text{Educ} \times \text{MomEd}$ interactions let it vary across education and family

background. The same equation, without the age terms, is estimated on the NLSY97 women (`T3_wages_log_nlsy97.do`), whose panel is too young to identify an age profile. The baseline cohort uses the NLSY79 experience and family-background coefficients and the later cohorts the NLSY97 ones; the age profile of either equation is replaced by the cohort's CPS profile through (11).

Husbands (NLSY). The premium for marrying before the first birth is estimated on the NLSY husbands,

$$\begin{aligned}
\ln w_{it}^m &= \alpha_t^m + \zeta_{\text{HSG}}^m \mathbf{1}\{\text{Educ}_i^f = \text{HSG}\} + \zeta_{\text{COL}}^m \mathbf{1}\{\text{Educ}_i^f = \text{COL}\} \\
&+ \beta_1^m \text{Age}_{it}^m + \beta_2^m (\text{Age}_{it}^m)^2 \\
&+ \sum_{e \in \{\text{HSG}, \text{COL}\}} (\beta_{1e}^m \text{Age}_{it}^m + \beta_{2e}^m (\text{Age}_{it}^m)^2) \mathbf{1}\{\text{Educ}_i^f = e\} \\
&+ \lambda^m \mathbf{1}\{\text{MarryBeforeBirth}_i = 1\} \\
&+ \sum_{e \in \{\text{HSG}, \text{COL}\}} \kappa_e^m \mathbf{1}\{\text{Educ}_i^f = e\} \mathbf{1}\{\text{MarryBeforeBirth}_i = 1\} + u_{it},
\end{aligned} \tag{13}$$

in logs, with year fixed effects and an indicator for marrying before first birth, estimated on each NLSY cohort; conditioning the husband's earnings on the wife's characteristics follows Van der Klaauw (1996) and Sheran (2007). The indicator is why the model tracks whether a married woman had a child before marrying (Section 4.5): on the NLSY79, the husbands of high-school and college graduates who married before their first birth earn about 23 and 28 log points more a year than those of women who married after a birth. The CPS-scaled profiles of women's and husbands' earnings are what changes across cohorts in the labor-market and marriage-market blocks of the decomposition (Section 6).

G Decomposition: Method and Additional Results

G.1 The Shapley decomposition

Let N be the set of the $n = 10$ blocks of Table 3 and $v(S)$ the simulated outcome when the blocks in $S \subseteq N$ take the later cohort's values and the others the earlier cohort's, with the

same simulated women and random draws in every economy. The contribution of block i is its Shapley value,

$$\varphi_i = \sum_{S \subseteq N \setminus \{i\}} \frac{|S|! (n - |S| - 1)!}{n!} [v(S \cup \{i\}) - v(S)],$$

the marginal effect of switching block i , averaged over all $n!$ orders in which the blocks can be switched. The contributions add up to the total change, $\sum_i \varphi_i = v(N) - v(\emptyset)$, and do not depend on the order of the switches, which is the reason [Shorrocks \(2013\)](#) proposes them as the path-independent solution to sequential decompositions; [Fortin et al. \(2011\)](#) discuss the same problem in decompositions of differences between groups. Recent applications to counterfactuals of structural models include [Paz-Pardo \(2024\)](#), [Kwon et al. \(2024\)](#) and [Audoly et al. \(2025\)](#). Computing all φ_i requires the $2^n = 1,024$ economies of each phase.

Two properties matter for reading the results. The interaction between two blocks is split equally between them, so a block’s contribution includes half of each of its interactions with the others. The contributions also depend on how primitives are grouped into blocks ([Sastre and Trannoy, 2002](#)), which is why each block collects the primitives of one mechanism rather than one parameter. A sequential accounting in a fixed order, the approach of [Eckstein et al. \(2019\)](#), attributes each interaction entirely to the block switched later; a one-at-a-time accounting attributes it to neither, so its contributions need not add up to the total.

G.2 One-at-a-time and sequential accountings

Table [G.1](#) reports the one-at-a-time accounting of both phases, which needs $2 + 2 \times 10$ solved economies per phase rather than the 2^{10} of the Shapley table: each block is moved alone from the earlier to the later cohort’s primitives (“first”), or moved last, with the other nine already at the later cohort’s (“last”). The gap between the two is the interaction the Shapley value averages over; the table reports the “first” contributions. Two patterns are worth recording. In the decline phase the two measured fertility-control blocks, exposure and efficacy, account for two-thirds of the fall in first births before 18 (-3.1 of -4.6 percentage points when moved first), and the improvement in family background for 0.7 of a point; in the rise phase exposure and the cost of contraception push first births before 18 up by 1.8

points, while family background, the child penalty and the safety net push them down by 1.2, so the net rise of 0.8 points hides offsetting forces, as the composition and within-group changes do in the data (Table 2).

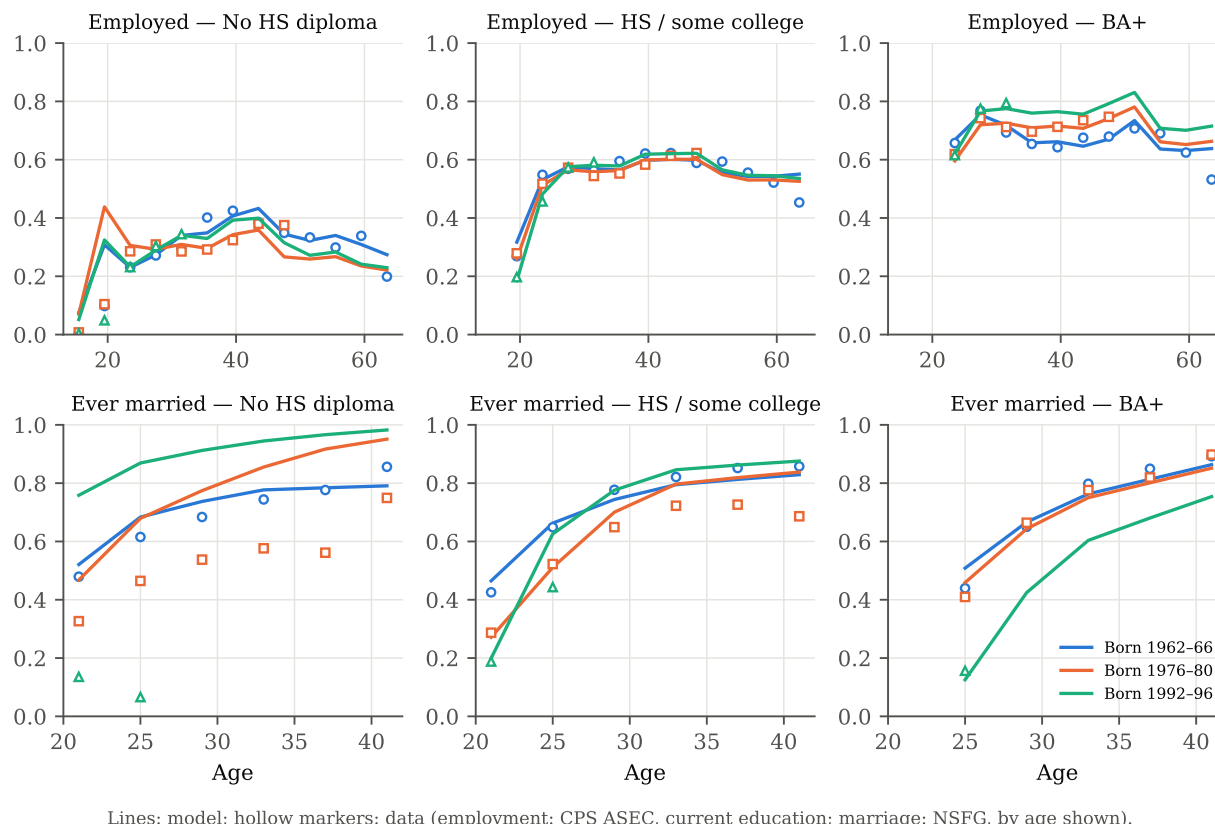


Figure G.1. Employment and Marriage by Age and Education: Data and Model

Notes: Employment: CPS ASEC, women by current education (worked 26 or more weeks, more than 20 hours a week and earned at least \$10,500 of 2016), four-year age bins. Ever married: NSFG, by final education. Markers: data; lines: model. Lines beyond a cohort's last observed age are model forecasts and are not targeted.

Table G.1. One-at-a-Time Cohort Accounting, Both Phases

	Births 15–19		FB < 18		FB < 22		College	
	Rise	Decline	Rise	Decline	Rise	Decline	Rise	Decline
Women’s labor market	-0.2	-2.1	-0.1	-0.9	+0.0	-2.5	-0.2	+6.2
Schooling costs and support	+0.5	-1.4	+0.1	-0.5	+0.6	-1.1	-1.7	+4.3
Cost of contraception	+1.1	-2.2	+0.3	-0.5	+0.8	-1.7	-0.3	+0.5
Efficacy	+0.4	-2.1	+0.1	-0.5	+0.6	-2.5	-0.1	+0.5
Exposure	+2.4	-4.0	+1.5	-2.6	+0.8	-1.6	-0.6	+1.0
Marriage market	+0.0	+0.0	-0.0	+0.1	-0.4	+0.1	+1.5	+0.7
Safety net	-0.4	-0.2	-0.2	-0.1	-0.2	-0.2	+0.3	+0.1
Child penalty	-0.5	-0.2	-0.3	-0.0	-0.1	-0.3	+1.6	-0.1
Family background (composition)	-2.6	-1.9	-0.7	-0.7	-2.7	-1.8	+5.2	+2.9
Cost of abortion	+0.1	+0.1	+0.1	+0.0	-1.1	-0.2	+0.3	+0.1
Total change, model	+1.2	-11.5	+0.8	-4.6	-0.7	-10.7	+4.1	+16.3

Notes: Each entry is the change in the outcome when the block named is switched alone from the earlier cohort’s values to the later cohort’s. Births per 100 women over ages 15–19; the other outcomes in percentage points.

Table G.2. The Model's Causal Effect of a Birth Before 18

	Born 1962–66		Born 1976–80		Born 1992–96	
	Miscarriage	Effect	Miscarriage	Effect	Miscarriage	Effect
High-school diploma	0.710	-0.109	0.732	-0.076	0.655	-0.121
College attendance	0.412	-0.192	0.453	-0.180	0.463	-0.192
Bachelor's degree	0.178	-0.169	0.199	-0.180	0.209	-0.192
Employed, 20–24	0.422	-0.081	0.412	-0.043	0.370	-0.024
Employed, 25–29	0.501	-0.063	0.506	-0.054	0.492	-0.088
Employed, 30–34	0.527	+0.009	0.538	-0.029	0.532	-0.060
Earnings, 25–34 (thousand \$, detrended)	15.00	-2.65	13.34	-2.65	12.37	-3.12
Cash welfare, 18–24	0.105	+0.286	0.058	+0.140	0.017	+0.050
Cash welfare, 25–29	0.082	+0.070	0.045	+0.027	0.009	+0.012
Married by 25	0.585	+0.040	0.486	+0.055	0.613	+0.124
Children ever born by 35	2.07	+0.88	2.21	+0.74	1.92	+1.02
Women with a first birth at 15–17	844		749		354	

Notes: Women whose first birth follows a conception at 14–16 (a birth at 15–17). “Miscarriage”: the same simulated women, with the same draws, when that pregnancy ends in a miscarriage; later pregnancies proceed normally. “Effect”: outcome with the birth minus outcome with the miscarriage, averaged over these women. Employment and cash welfare are shares of years in the age band.