The Great Recession's Baby-less Recovery: The Role of Unintended Births[a]

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Abstract

U.S. fertility has reached historic lows in recent years, driven by declines among young women and unmarried women whose births are more likely to be unintended. We use a combined-survey estimation strategy that exploits the relative strengths of the National Survey of Family Growth and the Natality Detail Files to estimate unintended births consistently over time. We find that likely-unintended births fell 16% between 2007 and 2016. While both intended and unintended births declined through the Great Recession, we find that during the recovery period unintended births have continued to decline while intended births have actually rebounded.

JEL Codes: J13, J11, J10

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I. Introduction

The Great Recession that began in late 2007 was associated with a large decrease in fertility. This was not unexpected, as a great deal of research has shown fertility to be pro-cyclical over the business cycle.[1] What is surprising is that the U.S. birth rate continued to fall as the economy recovered, with birth rates falling an additional eleven percent between the end of the recession in 2009 and 2018 (see Figure 1A). Today the United States birth rate is at an historic low; provisional data for 2019 show a birth rate of 58.2 births per 1,000 women aged 15-44, and a total fertility rate of 1.705 births per woman—well below replacement rate (Hamilton, et al. 2020).[2] This downward fertility trend has received significant attention in the popular press, with articles trying to understand both the underlying causes of this baby-less recovery and the implications for policy and economic growth (e.g. Belluz 2018; The Economist 2018; Emba 2018; Howard 2019; Miller 2018).

However, aggregate trends in fertility mask substantial heterogeneity across different demographic groups. For example, the decline in birth rates since 2007 was driven by women under age thirty; for women over thirty, birth rates actually increased over this period. Looking back further, birth rates for women over thirty have been steadily increasing since at least 1980, while the rate for younger women (and especially teens) peaked in the early 1990s. Trends in birth rates also differ by marital status; from 1980 to the mid-2000s, rates for married and unmarried women converged as the nonmarital childbearing rate rose. Since then, the rate for unmarried women has started to decline, while that for married women has increased (Schneider and Gemmill 2016).[3]

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[1] See Sobotka, Skirbekk, and Philipov (2011) for a review of this literature. Buckles, Hungerman, and Lugauer (2018) show that fertility begins to fall even before the economic decline.
[2] The total fertility rate (TFR) "estimates the number of births that a hypothetical group of 1,000 women would have over their lifetimes, based on the age-specific birth rate in a given year" (Hamilton, et al. 2020).
[3] For detailed depictions of trends for different groups going back to 1980, see Buckles, Guldi, and Schmidt (2019).

Importantly, these two groups—young women and unmarried women—are the groups that have historically been most likely to have *unintended* births. Definitions of intendedness vary, but generally a birth is considered to be unintended if either the pregnancy was unwanted or it occurred earlier than the mother would have liked.

Changes in unintended births over time could have significant policy implications. Over two-thirds of unintended births in 2010 were paid for by public insurance programs, costing the government over $21 billion in that year (Sonfield & Kost 2015). So, while a falling fertility rate presents challenges for (for example) the solvency of public pension programs, there may be cost savings if the decline is coming from unintended births.[4] Policy makers who are concerned about fertility declines may therefore want to focus on strategies for increasing *intended* births.

Perhaps more importantly, unintended births reflect barriers to women's ability to effectively plan their lives—barriers that might include a lack of information or access to reproductive care. Unwanted and mistimed births are associated with worse child health and development outcomes (Hummer et al. 2004; Lin et al. 2018), including lower levels of prenatal care, low birth weight, and costly complications (Kost & Lindberg 2015; Mohllajee et al. 2007). Research from the Turnaway Study, which offers some of the best causal evidence on unintended births, has shown that women turned away from abortion clinics experience worse physical and mental health as well as worse economic outcomes compared to women who received abortions (see, for example, Biggs et al. 2017; Foster et al. 2018; Gerdts et al. 2016; Miller et al. 2020; Ralph et al. 2019).[5] Reducing barriers

[4] As fertility drops, there will be fewer working age individuals to support the elder (age 65+) dependent population, which leads to quicker depletion of the Social Security Trust Fund. Nearly all of the expected increase in Social Security program costs from 2010 to 2030 is projected to be due to the increasing aged dependency ratio (Goss 2010). The recent fertility declines will likely put further strain on the system.

[5] Women were turned away from clinics due to gestational age higher than set limits. Identification in these studies comes from comparing the women turned away to those with gestational age near but below the limit who were allowed to obtain abortions.

to family planning and increasing the share of births that are intended are likely to improve maternal and family well-being, and are among the Office of Disease Prevention and Health Promotion's Healthy People 2020 objectives.[6]

In this paper, we document changes in unintended and intended births in the U.S. since 1989, with an emphasis on the period following the Great Recession. We begin by documenting heterogeneity in fertility trends across demographic groups, using data from the National Center for Health Statistics' (NCHS) Natality Detail Files.[7] These data represent the near universe of births in the U.S., but unfortunately do not include information about pregnancy or birth intention. A number of studies have used another NCHS data set, the National Survey of Family Growth (NSFG), to estimate trends in unintended pregnancies and births (for example, Mosher et al. 2012; Finer & Zolna 2011, 2014, 2016), but there are a number of reasons why these data are poorly suited for constructing consistent trends over time. In fact, the 2013-2015 NSFG User's Guide cautions users against "interpreting estimates from combined data files because the NSFG has not been conducted with a continuous nor annual survey design that would permit valid estimation and inference for the full span of years" (p. 7). We discuss these issues in more detail in Section III, and illustrate the difficulties of using the NSFG to create trends in even well-measured concepts such as average age and marital status of mothers giving birth.

We therefore use a combined-survey estimation strategy that takes advantage of the relative strengths of both the National Survey of Family Growth and the Natality Detail Files. The method we develop allows us to consistently measure over time the proportion of the roughly four million births in the United States that are unintended each year. Because many data sets, like the Natality

[6] https://www.healthypeople.gov/2020/topics-objectives/topic/family-planning

[7] The Natality Detail Files provide information obtained from each birth certificate issued in the United States. States provide their birth certificate data to the NCHS, which compiles the data. There is some variation across states and over time in the information that is available from the birth certificates; we discuss this below where it is relevant.

Detail Files, do not contain information on intendedness, our method can be used by future researchers when studying intendedness using datasets without direct measures.

Results from our preferred specification suggest that the number of unintended births fell by 16% between 2007 and 2016. This estimate is very robust, ranging between 11 and 22% across a large number of alternative specifications. The 16% decline between these two years translates to nearly 237,000 fewer unintended births, or 64% of the total fertility decline. Importantly, our results show that while both unintended and intended births fell *during* the Great Recession, unintended births have continued to fall throughout the recovery while intended births have actually rebounded. The continued downward trend in births over the last decade resulting in a baby-less recovery has puzzled social scientists; our findings show that a key part of solving this puzzle is understanding the changes driving the declines in unintended births, and specifically why unintended births and intended births are diverging.

II. Trends in Fertility

Between 1900 and 2018, the U.S. general fertility rate fell by more than half (130 to 59.1 births per 1000 women aged 15 to 44). This decline has been non-monotonic; the rate fell to 76.3 in 1933 before rising to 122.9 in 1957 during the peak of the baby boom.[8] Figure 1A shows that the period since 1989 contains two local peaks: 1990 and 2007. The post-2007 decline has produced a total fertility rate that is at its lowest recorded level and well below replacement level.

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[8] An extensive literature explores the root causes of the baby boom and subsequent bust (see Bailey, et al. 2014, and Bailey & Hershbein 2018 for reviews). Literature examining the post-1960 decline has suggested that the birth control pill (approved by the FDA for use as a contraceptive in 1960) and legal access to abortion (beginning in 1969) are key drivers of the post-1960 decline in births (Bailey 2006; Bailey 2010; Bailey et al. 2013 a,b; Goldin and Katz 2002; Guldi 2008; Levine et al. 1999; Myers 2017). The Vietnam War also played a role in declining birth rates over the 1960s (Bitler & Schmidt 2012). Since the early 1970s, the decline has been smoother and comparatively flat (Bailey et al. 2014).

As discussed in the introduction, these aggregate trends in fertility conceal big differences in how fertility is changing for women with different characteristics. An important example is age. There has been a widely-documented decline in the birth rate for teenagers in the U.S. since the early 1990s, which has been attributed to a variety of supply and demand factors including but not limited to: reduced sexual activity (Boonstra 2014); increased and more effective use of contraceptives (Boonstra 2014) either due to affordability via Medicaid (Kearney & Levine 2009, 2015a) or to access to more reliable long-acting and reversible methods of contraception like IUDs (Lindo & Packham 2017, Kelly et al. 2019); changes in income inequality, with areas with lower income inequality experiencing lower levels of teen births (Kearney & Levine 2014); and the effect of new media (targeted television programming, social media, and the Internet) on teen fertility choices (Guldi & Herbst 2017; Kearney & Levine 2015b; Trudeau 2016).[9]

The decline in the fertility of younger women is evident in Figure 1B, which reports birth rates by five-year age groups from 1989 to 2018. To construct these rates, we use the Natality Detail Files from each year to construct the numerator, and age- and sex-specific population counts from the National Cancer Institute's SEER data to construct the denominator.[10] The teen birth rate fell from a peak of around 62 births per 1,000 women age 15 to 19 in 1991, to around 17 in 2018, for a remarkable 72 percent decline. The birth rate for women 20 to 24 also declined over this same period, with the decline accelerating in 2008. While this group had one of the highest birth rates through the mid-1990s, it now has a rate that is well below that for women 25 to 29 and even 30 to 34. Conversely, birth rates for women over 30 have increased since 1989, aided by delayed age at

[9] While the literature primarily examines the effects of these factors on teen birth rates, many of them may also have affected fertility choices of older women. For example, Kearney and Levine (2009) show that the likelihood of birth declines for both teens and older women when access to publicly funded contraception increases.
[10] The SEER population counts are not yet available for 2017 and 2018, so for those years we use birth rates from the NCHS births data for 2018 (Martin et al. 2019).

first marriage and first birth and infertility treatments that have facilitated births at later ages (Buckles 2007; Matthews & Hamilton 2009, 2016; Schmidt 2007; U.S. Census Bureau 2018). In 2016, women age 30 to 34 became the group with the highest birth rate in the U.S.

There have also been significant changes in the marital status of women giving birth from 1989 to 2018, as shown in Figure 1C.[11] The birth rate for married women fell throughout the early 1990s, while that for unmarried women rose, so that by 1994 approximately one-third of births were to an unmarried mother (see also Curtin et al. 2014). The nonmarital rate stabilized for a few years after that, but began to increase again in the mid-2000s, reaching a peak in 2007. Since then, the nonmarital rate has declined steadily, while births to married women have remained flat.[12]

III. Unintended Births

The fact that birth rates for young and unmarried women have fallen since 2007 in the U.S. suggests that unintended births are likely falling, as these women have historically been most likely to experience unintended pregnancies (Finer & Zolna 2014; Kost & Lindberg 2015). Indeed, Finer and Zolna (2016) identified a decrease in the unintended pregnancy rate between 2008 and 2011, driven by declines among young and poor women. They report that this was the first "substantial decline" since 1981. This decrease is also documented in Finer et al. (2018), using the same data but a prospective instead of retrospective measure of unintended pregnancies.

[11] For these calculations, we use population estimates by marital status from the Current Population Survey Annual Social and Economic Supplement (CPS-ASEC) in the denominator. We are not able to use the Natality Detail Files to calculate birth rates by marital status for 2017 and 2018 because California no longer reports marital status in birth certificate data after 2016 due to statutory restrictions; for those years we use birth rates from the NCHS births data for 2018 (Martin et al. 2019).

[12] We also explored whether fertility trends varied by cohort, parity, race, and ethnicity. Relative to the trends for age and marital status, trends in race and parity are stable from 1989-2017. While data limitations make it difficult to do the same for education, trends over the past ten years suggest decreases in births to women with the lowest levels of education and increases in births to more educated women. See Buckles, Guldi, and Schmidt (2019) for this analysis.

These studies rely on data from the NSFG, which provides carefully crafted questions about pregnancy wantedness and timing.[13] However, the NSFG is poorly suited for analyzing trends over time for a number of reasons. First, the sample size of births is small, and fluctuates greatly across waves. For example, data include 1,303 births for 2011-12 but only 461 for 2003-04. Second, dividing the responses from NSFG cycles into years for an annual-level analysis is not recommended; the NSFG documentation's answer to an FAQ asking "Can I analyze the data for just one year, or just one quarter?" is an unequivocal "No." (NSFG FAQ 2015-17). Third, questions about pregnancy intentions are asked retrospectively for the births in our sample, which may introduce recall bias in responses (Rosenzweig & Wolpin 1993). Since NSFG cycles are administered at irregular intervals as many as four years apart, the degree of this bias may not be constant over time. Finally, while we use standard weighting procedures described in the 2013-2015 NSFG User's Guide[14] to attempt to create a sample that is representative of the U.S. population over time, the guide itself cautions against use of the NSFG for this purpose, as noted in the Introduction.

To demonstrate the severity of these issues, we create trends for characteristics that are observable in both the NSFG and in the Natality Detail Files. The latter contain nearly 100% of births in the U.S., so we treat the statistics obtained from them as the true population values. Figure 2 shows that even for well-measured characteristics like age at birth (2A) and marital status (2B), the NSFG trends show much more variability than those from the Natality data, which could lead to incorrect conclusions about the trends in those characteristics.

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[13] The NSFG underreports abortions, so Finer and Zolna (2014) and Finer and Zolna (2016) supplement the NSFG data with data from the Guttmancher Institute's periodic census of abortion providers. These data are collected approximately once every six years (Finer et al. 2018).

[14] Available at https://www.cdc.gov/nchs/data/nsfg/NSFG_2013-2015_UG_App2_FileManipulations_rev.pdf

To solve these issues and create reliable trends in unintended births over time, we use a combined-survey estimation strategy that takes advantage of the relative strengths of both the NSFG and the Natality Detail Files. We begin by estimating a model of unintended births in the NSFG for a specific cycle, using variables common to the NSFG and Natality data. We then use the coefficients from this model to predict the fraction and number of births in the Natality data that are likely unintended, based on the characteristics of mothers in that year.

Measures of intendedness vary with the survey used, whether the focus is solely on pregnancy intention or also birth intention, and whether the measure incorporates information about intended timing.[15] Guzzo (2017a), following earlier work by Pulley et. al. (2002), uses questions on pregnancy wantedness and timing from the NSFG to classify births as 1) unwanted (individual did not want any births or any additional births); 2) seriously mistimed (wanted but occurring more than two years earlier than desired); 3) slightly mistimed (wanted but occurring less than two years earlier than desired); and 4) wanted and on-time. Guzzo et al. (2018) show that the two-year cutoff is a meaningful threshold for defining pregnancy intention.

For our primary analysis, we focus on unintended births, not pregnancies, and construct a measure of unintended births that is similar in spirit to that used in Pulley et. al. (2002) and Guzzo (2017a) that combines responses to two questions in the NSFG Pregnancy Files. The first asks women "if you had to rate how much you wanted or didn't want a pregnancy right before you got pregnant that time, how would you rate yourself?" Respondents are asked to use a 0 to 10 scale, where zero indicates that the woman wanted to avoid the pregnancy and 10 indicates that she wanted to get pregnant. We classify a birth as unwanted if the response was below five. The NSFG

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[15] Measures of wantedness have some well-known drawbacks. Rosenzweig and Wolpin (1993) find a great deal of ex post rationalization in self-reports of wantedness based on post-birth outcomes. Mosher et al. (2012) and Campbell and Mosher (2000) provide additional discussion of measurement issues.

also asks whether the birth occurred sooner than the woman intended, and if so, by how much. We also define a birth as unintended if the woman says that it was wanted but was too soon by two years or more. Using our primary definition, nearly 36 percent of births in our sample in 2005-06 were unintended.[16,17] We examine robustness to alternative measures, including looking separately at unwantedness and mistimed births, as well as indicators for whether the mother was not trying to get pregnant, and whether she reported being unhappy to be pregnant. All four alternative measures are highly correlated with our primary measure of intention, with correlation coefficients of 0.88, 0.69, 0.67, and 0.58, respectively.

We use the NSFG to construct a model of pregnancy intention that we can use to predict the fraction of births in the Natality Detail Files that are likely to be unintended. We estimate the following model:

$$Unintended_i = a + X_i \beta + \varepsilon_i \qquad (1)$$

$Unintended_i$ is a binary variable indicating that birth *i* was unintended using our preferred measure as defined above. X_i is a vector of maternal characteristics that are common to both the NSFG and the Natality Detail Files. Birth intendedness has been shown to vary by mother's age, marital status, race and ethnicity, and parity (Guzzo 2017b; Hayford and Guzzo 2016; Pulley et. al. 2002), so our regression includes single-year-of-age dummies; separate dummies for each parity from one to nine-plus; four mutually exclusive race/ethnicity dummies (white, black non-Hispanic, Hispanic, and other); an indicator for being married at the time of the birth; an indicator for the

[16] This is very similar to the share of births reported by Mosher et al. (2012) as unintended. They use a slightly different sample constructed using the 2006-2010 NSFG and report that 37% of births are unintended.

[17] All analysis uses the NSFG final weights to produce a sample that is more representative of the U.S. population.

mother living in a metropolitan area, and pairwise interactions of all of these variables. We estimate this model separately for five NSFG cycles: 2002, 2006-2010, 2011-2013, 2013-2015, and 2015-17.

We use the coefficients from the fully interacted model to predict, using the Natality Detail Files for each year between 1989 and 2016,[18] the fraction of births that were unintended in each year, given the average characteristics of women giving birth that year (their *X*'s). This approach is similar to that developed by Baicker, Buckles, and Chandra (2006) to create a predicted probability of Caesarean birth, and used in Buckles and Guldi (2017) to understand the contribution of demographic changes to trends in preterm birth. For our preferred specification, we use the 2002 NSFG Cycle to estimate equation (1) and treat 2002 as our "base year." This combined-survey strategy captures the changes in UIB that are implied by changes in the demographic characteristics of mothers, keeping the "returns" to those characteristics constant. But, if the returns (the relationship between characteristics and the probability the birth is unintended) are changing over time, our estimates of UIB will be sensitive to the choice of the base year. To account for this, we test the robustness of our results to alternative choices of the base year. We also explore the sensitivity of our results to alternative measures of UIB.[19]

IV. Results

We begin by examining the relationship between maternal characteristics and unintendedness from the model of pregnancy intention, and how this relationship varies by survey year. To simplify the analysis we use a more parsimonious version of equation (1), with four

[18] Here again we are not able to include 2017 or 2018 in our analysis because California no longer reports marital status in its birth certificate data after 2016.

[19] One weakness of our approach is that we are unable to examine the role of cohabitation, as it is not included in the Natality Detail Files. Tapales and Finer (2015) suggests that changes in cohabitation were associated with changes in the overall rate of unintended pregnancies between 1987 and 2008.

mutually exclusive age group dummies (15-19, 20-29, over 30 (omitted)); parity; four mutually exclusive race/ethnicity dummies (white (omitted), black non-Hispanic, Hispanic, and other); an indicator for being unmarried at the time of the birth; and an indicator for the mother living in a metropolitan area. Online Appendix Table 1 provides these estimates. Each column presents the coefficients from a different wave of NSFG data. Conditional on the other variables in the model, the characteristics that most strongly predict that a birth was unintended across the five cycles are being a teenager and being unmarried at birth. For example, in 2002, women who were teenagers at the time of the birth were 39 percentage points more likely to have a birth that was unintended, ceteris paribus, relative to a mean of 32.6%. Other characteristics that are consistently associated with an unintended birth are births at age 20 to 29, higher parity, and race. While the level of statistical significance varies across the five cycles for some of the variables, the models consistently reveal that women with lower socio-economic status are more likely to have unintended births. The R-squareds for these models range between 0.19 and 0.20, indicating that even a simple model can explain a substantial amount of the variation in pregnancy intention.

Next, Figure 3 reports trends in intended and unintended births over 1989 to 2016, using the characteristics in the NSFG to predict intendedness in the Natality Detail File data using the fully interacted model described in Section III. Appendix Table 2 shows the coefficients from this model for our main specification; the R-squared for this model is 0.37. Figure 3A shows how the predicted proportion of births that are unintended (PPU) using this model evolved between 1989 and 2016. We observe three distinct periods. First, the PPU was stable through the 1990s, at just under 33%. Second, the PPU declined a bit before beginning to increase again in 2004, reaching a peak in 2008 when we predict that 34% of births were unintended. Third, since 2008, the PPU has declined steadily, reaching 31% in 2016.

Figure 3A includes 95% confidence intervals for each year's predicted UIB rate. The confidence interval for each prediction is roughly four percentage points wide, and almost all predictions fall within the interval for the other years. However, it is important to keep in mind that all of the uncertainty reflected in the confidence intervals comes from using the NSFG data and model to estimate the β in Equation (1). Because the average characteristics used to generate the PPU are calculated using the population of births from the Natality Detail File and therefore represent their true values, there is no additional prediction error associated with those averages. Thus, while the confidence intervals tell us that the *level* of the actual trend line for UIB might be a little higher or lower than we predict, *changes* in the predicted UIB over time—which are our focus—are entirely driven by changes in mothers' actual characteristics and not by model uncertainty.

Figure 3B shows trends in the number of unintended births (on the left axis) and intended births (on the right axis). To generate these trends, we multiplied the PPU by the number of births in each year to get the number of UIB, and by (1-PPU) to get the number of intended births. Based on our primary specification, the number of unintended births fell by 16% between 2007 and 2016, resulting in nearly 237,000 fewer unintended births. This accounts for 64% of the decline in total births over this period. Trends in unintended births tracked trends in intended births quite closely over most of this time period, including during the Great Recession-induced decrease in fertility beginning in 2007. But strikingly, after the recession, the two series diverge. Unintended births continue to decline, while intended births begin to rebound, suggesting that the forces that were driving fertility changes over this most recent period were affecting intended and unintended births differently.

Given the way the PPU is constructed, its fluctuations are driven by changes in the age, race, parity, and marital status of women giving birth each year. We can decompose the PPU into its component parts to better understand the relative contribution of each of these characteristics to changes in the trend. To do this, we again use the coefficients from the 2002 NSFG model and multiply by the average characteristics of mothers in each year from the Natality Detail Files, but for one set of characteristics at a time while setting the others at their 2002 levels. For example, to isolate the contribution of changes in the age distribution of women giving birth, we calculate the PPU for each year using the coefficients from the 2002 NSFG model and the average race, parity, and marital status from 2002, but allow the age profile to vary year-by-year. Thus, we are able to see how the PPU would have changed if only the age profile of women giving birth had changed, but all other characteristics and their returns had remained constant at 2002 levels.

The results are in Figure 4; the line with triangles shows the total change in PPU using this method.[20] We draw several conclusions from this figure. First, the decline in the PPU from 2008 to 2016 is almost entirely due to changes in the age distribution of women giving birth (recall from Figure 1B that this period saw large decreases in the birth rate for women under thirty). Changes in marital status contributed only slightly, as there was a small shift away from nonmarital childbearing (Figure 1C).[21] Conversely, the increase in the PPU between 2004 and 2008 is due entirely to increases in births to unmarried women. Continuing backward, the flat PPU of the 1990s and early 2000s is the result of off-setting increases in nonmarital childbearing and declining fertility rates for young women—especially those under 25. Throughout the period, changes in race (and also parity, though those results are omitted for brevity) are relatively small and gradual—the changing racial composition of mothers contributed to slight decreases in the PPU over time.

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[20] Note that we are unable to include the interaction terms in the model when decomposing the PPU because it is not possible to hold one element of the interaction constant while changing the other given that the characteristics used for the predictions are population averages. Using a prediction model without interactions results in small differences in the estimated trend in the PPU as shown in Online Appendix Figure 6. A benefit of using a model without interactions is that it allows us to estimate a PPU for 2017 and 2018 using imputed values of marital and metropolitan area status for those years from the NCHS annual reports. See the notes for Online Appendix Figure 6 for details. The results of this exercise suggest that unintended births continued to fall through 2018.

[21] This suggests that changes in births to cohabitating couples is not likely to be a large factor in explaining the most recent decline.

As noted above, a potential drawback of our method of constructing the PPU is that if the "returns" to the characteristics that we use to predict unintended births change over time, our estimates could be sensitive to the choice of 2002 as the index year.[22] Results could also be sensitive to our measure of pregnancy intention, or to our use of a linear probability model. In Figure 5, we illustrate the percent change in the number of unintended births between 2007-2016 from fifty different specifications of our prediction model (five waves of the NSFG, five measures of unintendedness, and two functional forms—linear probability model and probit). The results are reassuringly stable across specifications, in most cases implying a decrease in unintended births ranging between 11 and 18% over this period. The estimates using "too soon" as the measure of pregnancy intention yield slightly larger percent decreases, with estimates of the decline ranging around 20%. This implies that the decline in UIB is coming disproportionately from those who do want a birth at some point, suggesting that women may be finding it easier to correctly time their births. Overall, our main result—that there was a decline in unintended births of around 16% over this period—is quite insensitive to many different modeling choices.

V. Discussion and Conclusion

The last ten years have seen U.S. fertility decline to record lows, as aggregate birth rates failed to rebound after the Great Recession. This decline masks diverging fertility patterns by both age and marital status, with the declines coming from those groups most likely to have unintended births. In this paper, we combine data from the NSFG and the Natality Detail Files to create a consistent trend in unintended births over time. Our key finding is that the number of births that were likely unintended declined by about 16% between 2007 and 2016, accounting for nearly two-

[22] Online Appendix Table 7 shows estimates similar to those reported in Figure 4, but where we use alternative base years. While the exact estimates change, in every case the key takeaway is the same: the decline in the PPU from 2008 to 2016 is almost entirely due to changes in the age distribution of women giving birth.

thirds of the fertility decline over that period. Trends in unintended births tracked trends in intended births closely from 1989 through 2007 and throughout the fertility decline during the Great Recession. During the recovery period, however, we show that while unintended births have continued to fall, intended births have actually risen. These results are robust to a wide range of alternate specifications and show that the recovery was not baby-less for all.

Our results raise the question: what explains these changes in birth intendedness over the last decade? Previous work has speculated that changes in unintended births could be due to better access to contraception, or more effective types of contraception (Finer & Zolna 2016; Snyder et al. 2018). It is unlikely that the reduction in unintendedness is due to changes in abortion, as the abortion rate has been falling over time, and is now at its lowest rate since Roe v. Wade (Jones & Jerman 2014, 2017). Birth rates vary dramatically across states,[23] and Kost (2015) shows that there is substantial variation across states and time in the rate of unintended pregnancies. It is possible that policies, including state-level differences in contraceptive access due to the Affordable Care Act, could explain some of the decline in unintended births. Financial difficulties in the aftermath of the Great Recession may have raised the cost of fertility and unintended births in particular (Schneider and Hastings 2015; Stone 2018). Finally, changes in other technology (new media) have been shown to decrease teen fertility (Guldi & Herbst 2017; Kearney & Levine 2015b; Trudeau 2016), which in aggregate could have also increased birth intendedness.

Future work should seek to understand the proximate causes of the decline in unintended births since 2007; the divergence of unintended and intended births after the Great Recession; and whether the decline in unintendedness reflects births that are temporarily postponed, or births that are permanently foregone. Knowing the causes underlying these shifts is particularly important in

[23] Mathews & Hamilton (2019) document 2017 total fertility rates that range from 2,227.5 in South Dakota to 1,421.0 in the District of Columbia.

light of the recent coronavirus pandemic, which is likely to impact fertility more broadly and might further perturb this divergence in intendedness.[24] The observed reductions in unintended births are likely to have reduced public expenditures in the short run (Sonfield and Kost, 2015; Hummer et al., 2004).[25] Research from the Turnaway Study implies that they also may have improved maternal health (both physical and mental) and family economic circumstances. Ultimately, our results suggest that a greater proportion of women giving birth are achieving their desired fertility outcomes, which may be improving their well-being.

[24] Lindberg et al. (2020) shows additional divergence in reported fertility preferences due to the pandemic, with some women reporting wanting children later/wanting fewer children, while others reported wanting more children.

[25] However, if births are permanently foregone, this could cause long-run financial strain on programs like Social Security that rely on intergenerational transfers.

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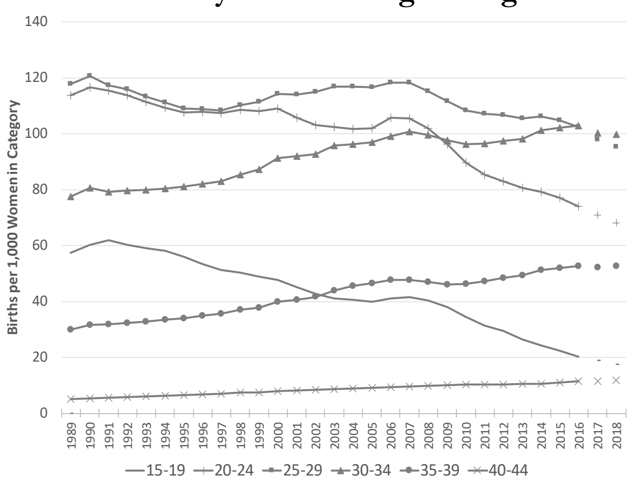
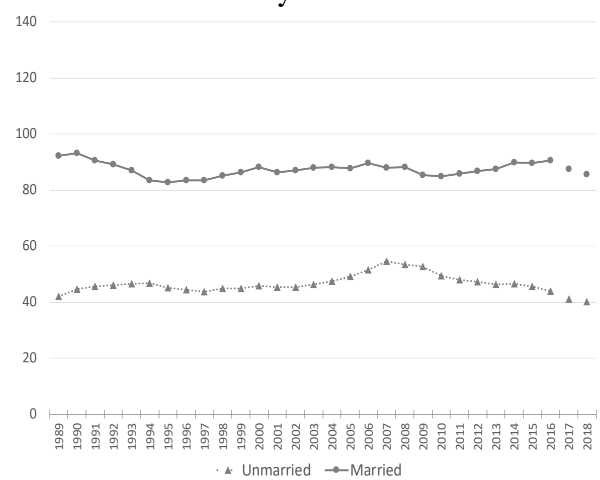
Figure 1: Birth Rates in the United States, 1989-2018

Panel A. Total Number of Births and Birth Rates

Panel B. By Five-Year Age Categories



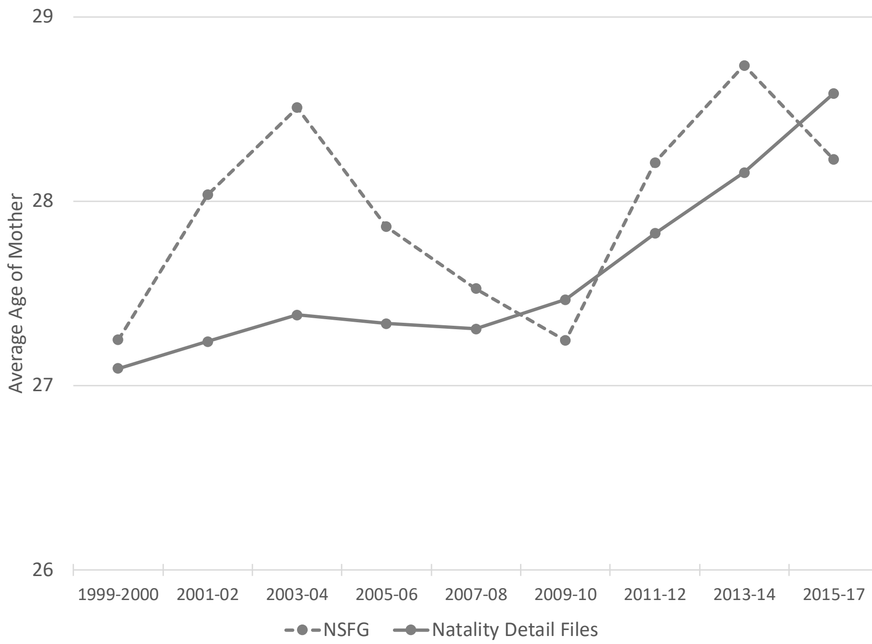
Panel C. By Marital Status



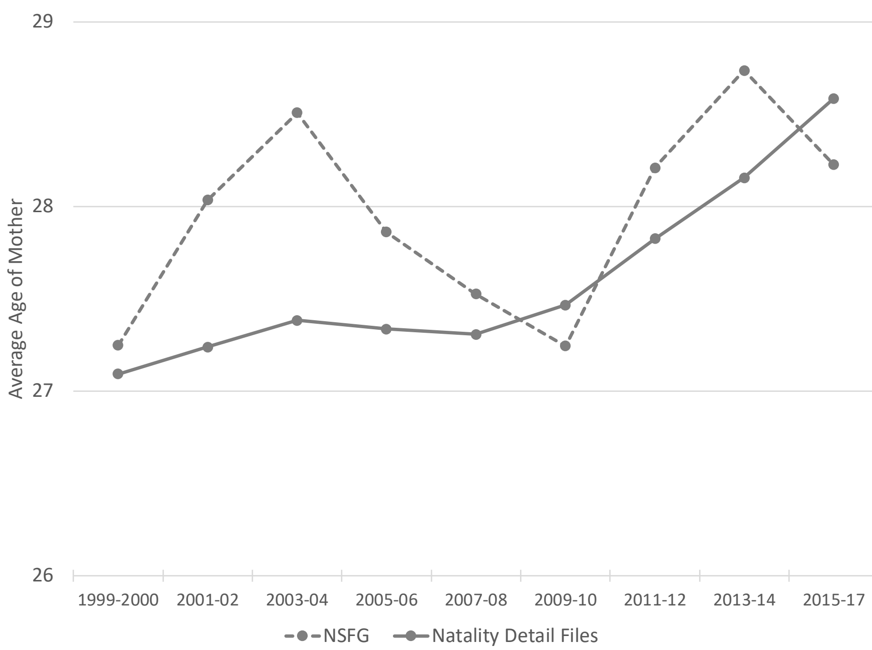
Notes: Birth rates are calculated as the number of births per 1,000 women in the category. Age- and sex-specific population counts used in the denominators for Panel A are from SEER; population counts by marital status used in the denominators for Panel B are calculated from the Current Population Survey Annual Social and Economic Supplement. SEER population counts are not yet available for 2017 and 2018, and marital status is not available in the restricted use Natality Files for California in 2017and 2018, so data points for those years are from Martin et al. (2019) (indicated by data points disconnected from the main series).

Figure 2: Trends in Mother's Characteristics in NSFG and Natality Detail Files

Panel A: Average Age of Mother



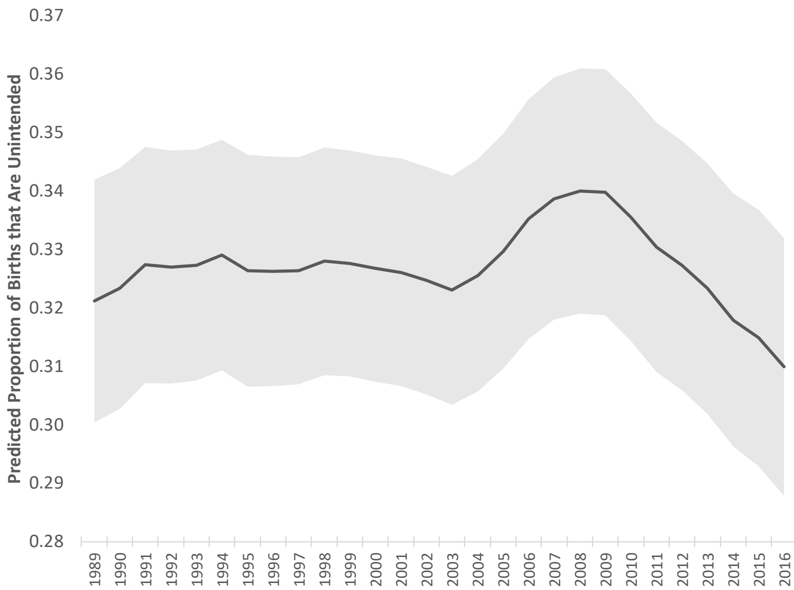
Panel B: Fraction Married



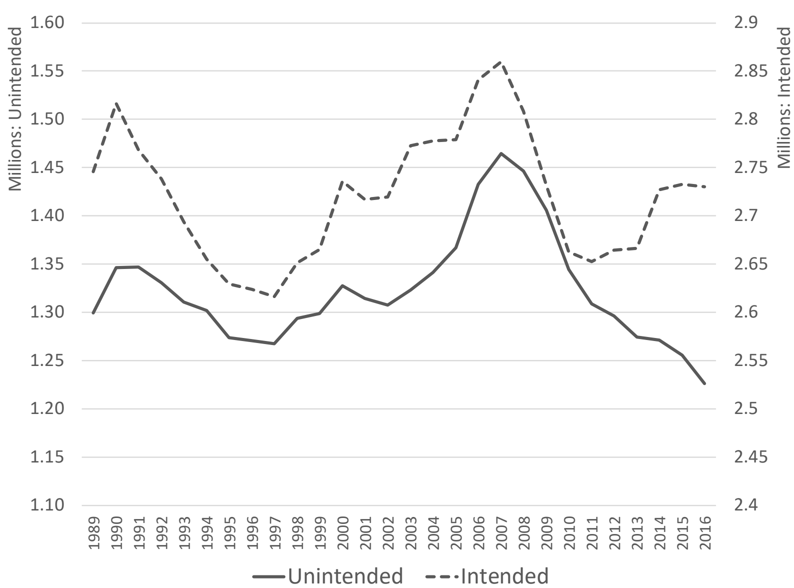
Notes: Figures show the trends in the indicated characteristic in both the NSFG data and the Natality Detail Files. Birth years are collapsed into two-year bins (or three in the case of 2015-17) to increase the number of observations in each data point. Results are weighted using the 2011-17 combined weights for birth years 2009-2017, the 2006-2010 cycle weights for birth years 2003-2008, and the 2002 cycle weights for birth years 1999-2002.

Figure 3: Trends in Intended and Unintended Births, 1989-2016

Panel A: The Predicted Proportion of Births that Are Unintended

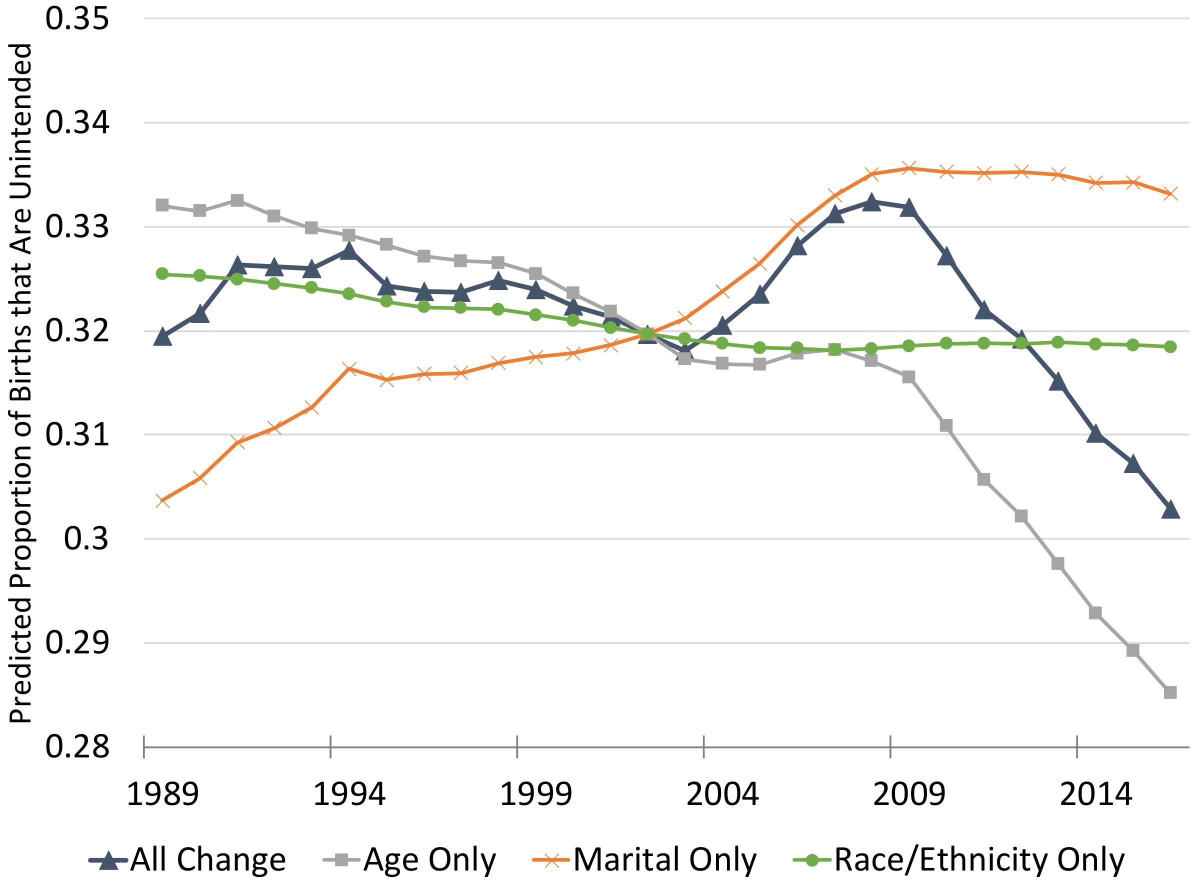


Panel B: The Predicted Number of Unintended and Intended Births



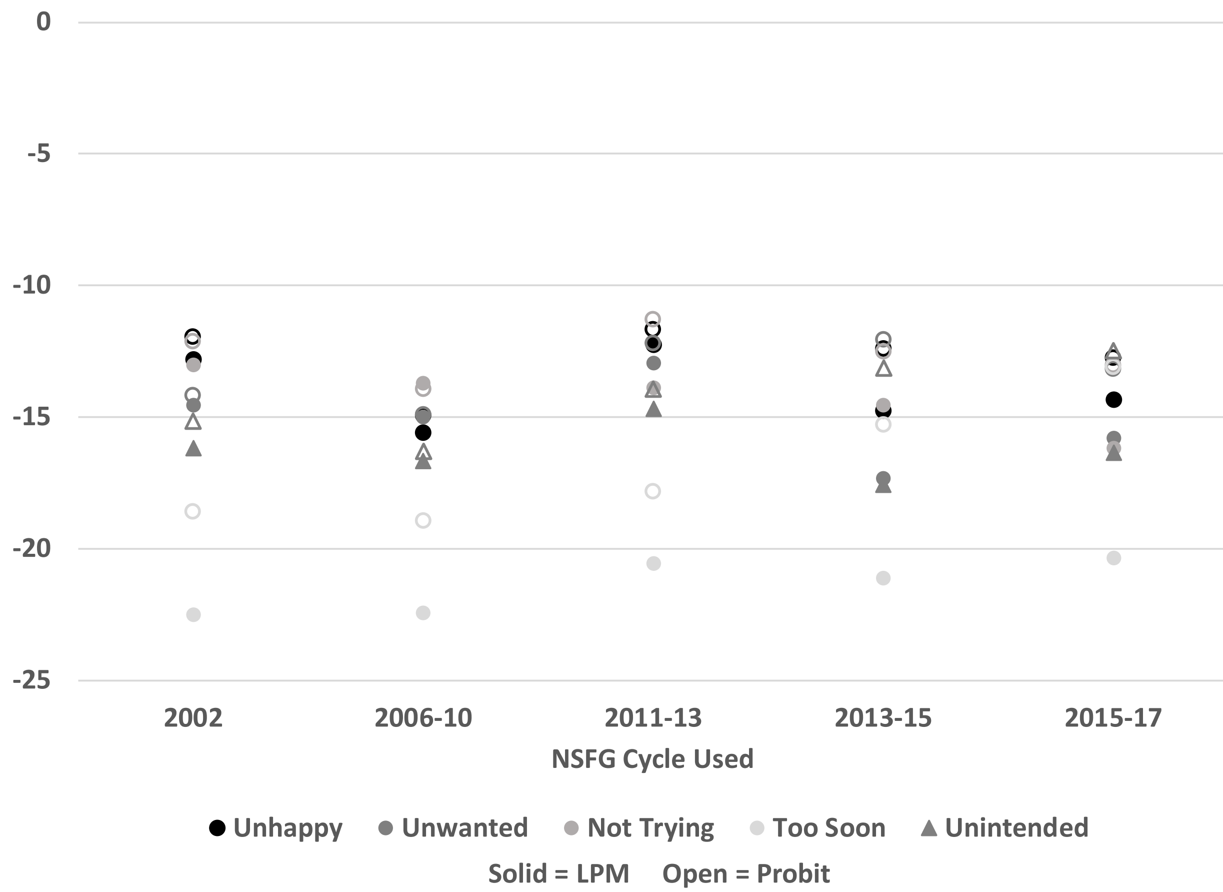
Notes: The predicted fraction and number of unintended births in each year are estimated using the characteristics of women giving birth in that year in the Natality Detail Files and holding the "returns" to each characteristic constant at the level estimated using the 2002 NSFG. Here, unintended is defined as a birth in which the pregnancy was unwanted or occurred two years or more before the woman intended. See the text for a detailed description. The shaded areas in Panel A represent 95% confidence intervals for the prediction.

Figure 4: Decomposition of Changes in the Predicted Proportion of Births that Are Unintended, 1989-2016



Notes: Figure shows the predicted fraction of births that were unintended in each year, based on the characteristics of women giving birth in that year in the Natality Detail Files and holding the "returns" to each characteristic constant at the level estimated using the 2002 NSFG. For the "All Change" estimate, all characteristics are allowed to fluctuate across years. For each of the other estimates, only one of the characteristics (age, marital status, or race/ethnicity) is allowed to fluctuate while the others are held constant at their 2002 levels. Here, unintended is defined as a birth in which the pregnancy was unwanted or occurred two years or more before the woman intended.

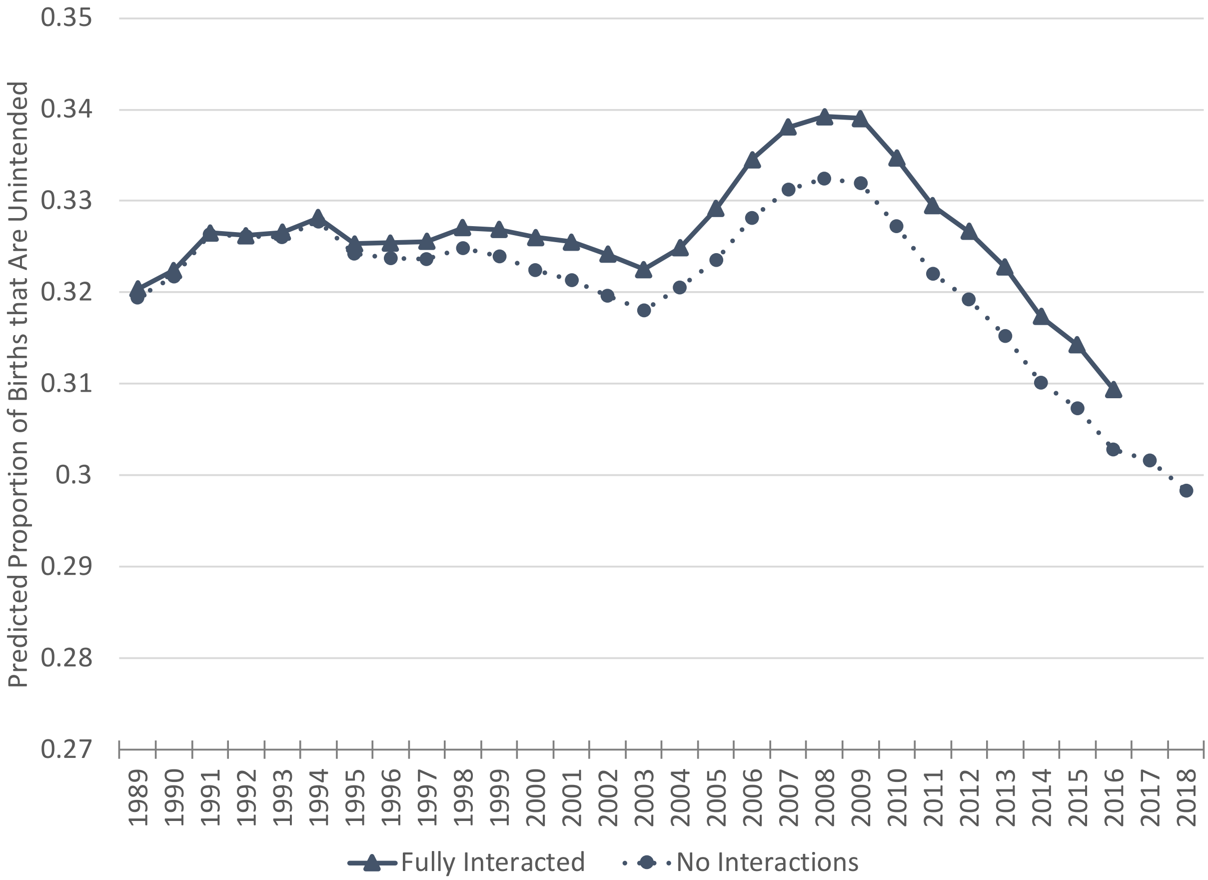
Figure 5: Percent Change in Unintended Births from 2007-2016, Under Fifty Different Specifications of the Prediction Model



Notes: Figure shows the percent change in the predicted number of unintended births between 2007 and 2016, using different specifications of the prediction model. There are fifty different specifications in total—five definitions of pregnancy intendedness x five different NSFG cycles x two model choices (linear probability or probit). Throughout the paper, our preferred specification uses the 2002 NSFG to estimate a linear probability model, where a birth is defined as unintended if it was unwanted or the pregnancy occurred at least two years sooner than desired; this specification is represented by a solid triangle. See Appendix Table 3 for the R-squared or Pseudo R-squared for each model.

Online Appendix

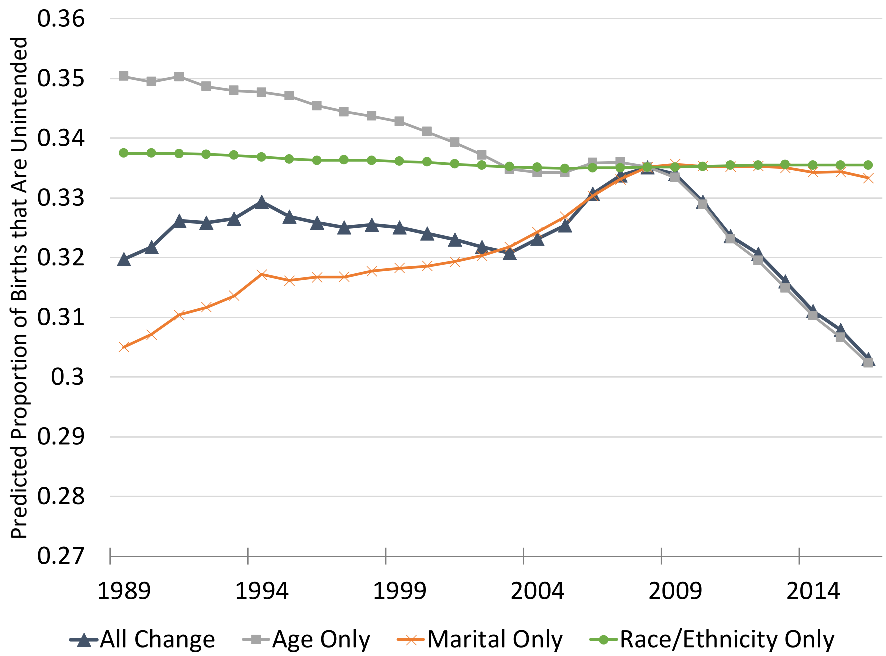
Online Appendix Figure 6: Predicted Births that are Unintended, 1989-2018



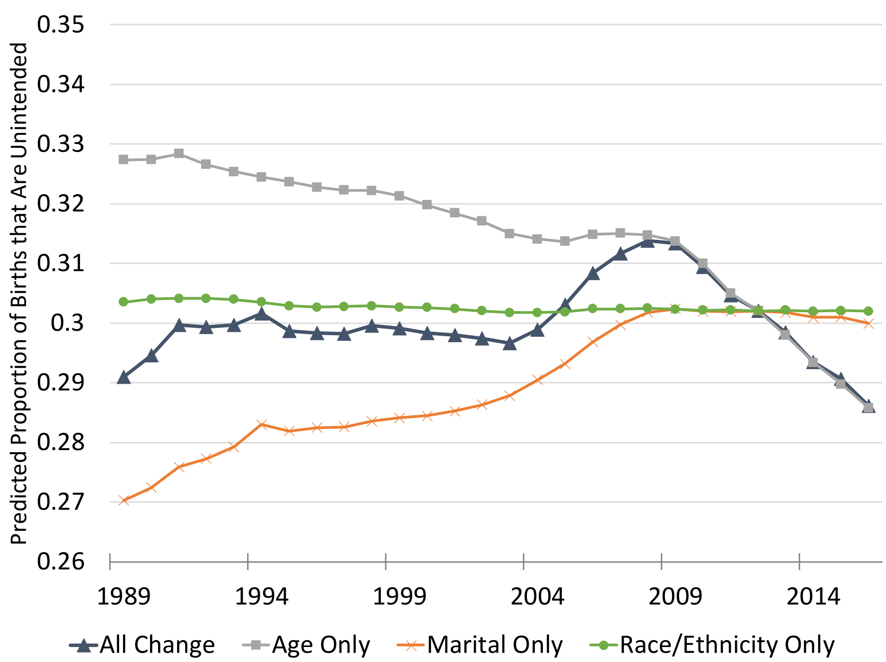
Notes: The predicted fraction and number of unintended births in each year are estimated using the characteristics of women giving birth in that year in the Natality Detail Files and holding the "returns" to each characteristic constant at the level estimated using the 2002 NSFG. This figure is analogous to Figure 3A, but allows a PPU to be constructed for 2017 and 2018 by imputing the missing percent married and percent in a metropolitan area for those years. For marital status, we use the National Center for Vital Statistics' estimates of the percent of births that are married in 2017 and 2018. For metropolitan status in 2018, we assume that the percent of births in a metropolitan area was the same in 2017 and 2018.

Online Appendix Figure 7: Decomposition of Changes in the Predicted Proportion of Births that Are Unintended, 1980-2016, Using Alternative Reference Years

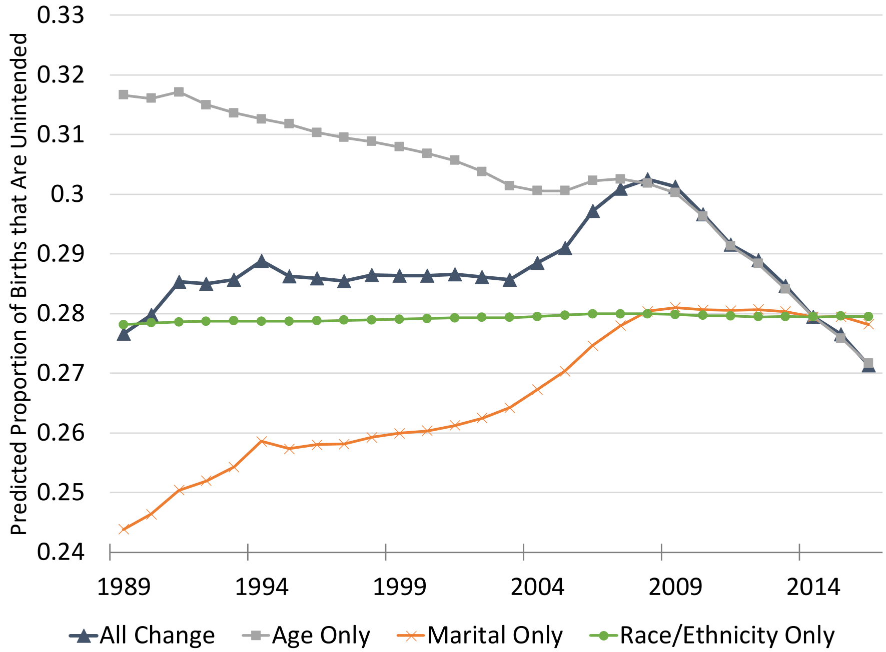
Panel A: Using 2008 as Base Year, Coefficients from 2006-2010 NSFG



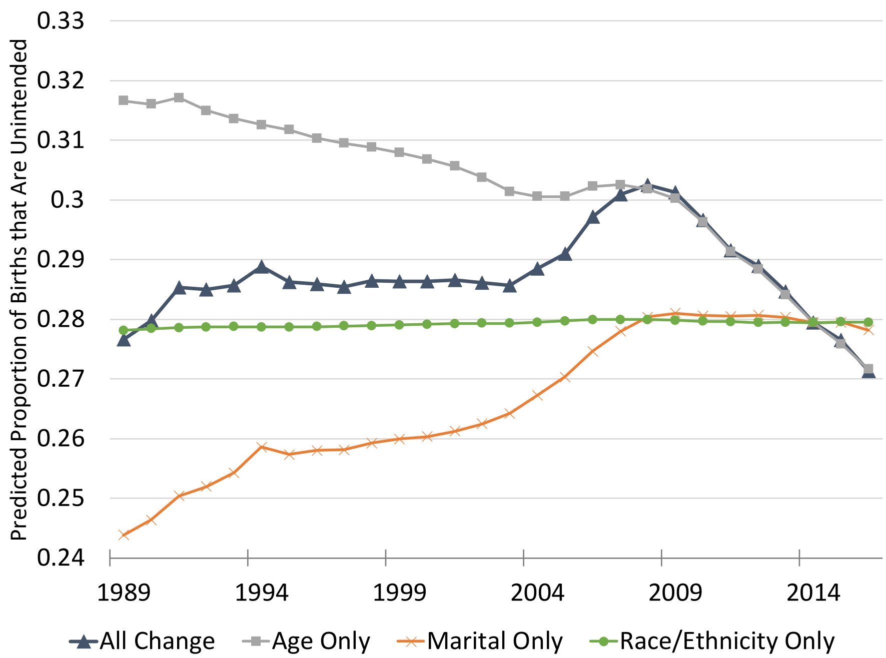
Panel B: Using 2012 as Base Year, Coefficients from 2011-2013 NSFG



Panel C: Using 2014 as Base Year, Coefficients from 2013-2015 NSFG



Panel D: Using 2016 as Base Year, Coefficients from 2015-2017 NSFG



Notes: See Figure 8. Here, the base year is changed to either 2008, 2012, 2014, or 2016, where the predicted fraction of births that were unintended in each year is calculated using the characteristics of women giving birth in that year in the Natality Detail Files and holding the "returns" to each characteristic constant at the level estimated using the indicated cycle of the NSFG.

Online Appendix Table 1: Linear Probability Models of Likelihood that the Birth was Unintended, Using Variables Common to NSFG and Natality Detail Files

	NSFG Cycle				
	2002	2006-10	2011-13	2013-15	2015-17
Age 15-19	0.3903***	0.3625***	0.3207***	0.2840***	0.3751***
	-0.0417	-0.0394	-0.0651	-0.0732	-0.0787
Age 20-29	0.0807***	0.0866***	0.0918***	0.1153***	0.1369***
	-0.0237	-0.0229	-0.0325	-0.0293	-0.0384
Unmarried	0.2668***	0.2658***	0.2657***	0.3042***	0.2759***
	-0.0307	-0.0275	-0.0365	-0.0363	-0.0438
Black	0.0683*	0.0547*	0.1336***	0.0292	0.1031*
	-0.0361	-0.0309	-0.0438	-0.0439	-0.0539
Hispanic	-0.0424	0.0047	0.0158	0.0377	0.0005
	-0.0295	-0.0296	-0.0447	-0.0373	-0.0433
Other Non-White	-0.0305	0.0081	-0.0426	-0.0282	0.0044
	-0.0474	-0.0468	-0.0475	-0.0413	-0.0734
Parity	0.0610***	0.0449***	0.0542***	0.0392***	0.0380**
	-0.0129	-0.0095	-0.0141	-0.0121	-0.016
Metro	0.0104	0.0018	0.0099	0.023	0.0326
	-0.0333	-0.0282	-0.041	-0.0364	-0.0482
Constant	0.0158	0.0341	-0.0259	-0.0268	-0.0552
	-0.0403	-0.0352	-0.053	-0.0447	-0.058
Fraction Unintended	0.3256	0.3426	0.3162	0.2918	0.2747
Observations	2,047	3,134	1,387	1,390	1,213
R-squared	0.1986	0.1893	0.195	0.1976	0.1897

Notes: Coefficients are from OLS regressions using data from five cycles of the NSFG. For all regressions, the dependent variable is a binary variable indicating that the pregnancy was either unwanted or occurred two years or more before the woman intended. The sample is limited to pregnancies ending in a live birth. Results are weighted by the NSFG final weights. Robust standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Online Appendix Table 2:
Model Used to Predict Unintended Births in Main Specification

	Coefficient	Standard Error	Significance
Age			
16	-0.29630762	(0.329)	
17	0.14861973	(0.147)	
18	-0.01904884	(0.196)	
19	0.16013741	(0.182)	
20	-0.30439553	(0.176)	*
21	-0.25500390	(0.200)	
22	-0.34625518	(0.209)	*
23	-0.22749132	(0.208)	
24	-0.57283258	(0.229)	**
25	-0.67663801	(0.203)	***
26	-0.63630593	(0.189)	***
27	-0.26852053	(0.213)	
28	-0.09141662	(0.221)	
29	-0.35330534	(0.204)	*
30	-0.16574039	(0.242)	
31	-0.73559332	(0.175)	***
32	-0.12424993	(0.303)	
33	-0.42765811	(0.299)	
34	-0.06159627	(0.255)	
35	-0.57073045	(0.261)	**
36	-0.42729795	(0.340)	
37	-0.03850709	(0.399)	
38	-0.60266221	(0.420)	
39	-0.65244031	(0.221)	***
40	0.00217201	(0.308)	
41	0.20488353	(0.318)	
42	-0.14479572	(0.335)	
43	0.12480457	(0.252)	
Married	-0.25334057	(0.343)	
Black Non-Hispanic	0.61917406	(0.345)	*
Hispanic	-0.66416013	(0.258)	**
Other	0.10646714	(0.120)	
Metro Area	-0.74180824	(0.210)	***
Parity			
2	-0.84041768	(0.106)	***

3	0.10429513	(0.284)	
4	0.16031113	(0.286)	
5	0.28643727	(0.285)	
6	0.36196315	(0.319)	
7	-0.20291086	(0.356)	
8	0.18700753	(0.388)	
9	0.12308785	(0.436)	
Married x Age Category			
16	0.00395051	(0.610)	
17	-0.38122368	(0.359)	
18	0.16616821	(0.373)	
19	-0.24074981	(0.350)	
20	-0.31742933	(0.343)	
21	-0.28200641	(0.344)	
22	-0.28094202	(0.347)	
23	-0.44437924	(0.342)	
24	-0.36257449	(0.351)	
25	0.04054082	(0.343)	
26	-0.04095369	(0.341)	
27	-0.40064850	(0.348)	
28	-0.52229470	(0.348)	
29	-0.28995714	(0.353)	
30	-0.53757149	(0.358)	
31	-0.09862825	(0.348)	
32	-0.56043929	(0.369)	
33	-0.17978761	(0.367)	
34	-0.39833340	(0.378)	
35	-0.14622593	(0.374)	
36	-0.41789252	(0.420)	
37	-0.07188244	(0.361)	
38	0.12291488	(0.470)	
39	-0.15497345	(0.349)	
40	-		
Married x Parity			
2	0.05451738	(0.070)	
3	0.34739649	(0.079)	***
Black x Age Category			
16	-0.18531182	(0.396)	
17	-0.85481548	(0.359)	**
18	-0.41484419	(0.354)	
19	-0.78826046	(0.359)	**

20	-0.76821738	(0.359)	**
21	-0.40569216	(0.354)	
22	-0.38258624	(0.364)	
23	-0.73352242	(0.356)	**
24	-0.46263224	(0.371)	
25	-0.01612565	(0.359)	
26	-0.36531913	(0.363)	
27	-0.28317708	(0.358)	
28	-0.46885222	(0.373)	
29	-0.54224360	(0.368)	
30	-0.35460675	(0.380)	
31	-0.22094247	(0.366)	
32	-0.50026762	(0.360)	
33	-0.43034956	(0.380)	
34	-0.69826961	(0.382)	*
35	-0.40676463	(0.429)	
36	-0.59051263	(0.419)	
37	-0.31595424	(0.385)	
38	0.38199532	(0.369)	
39	-0.18841070	(0.404)	
40	-0.85156912	(0.443)	*
Black x Parity			
2	0.05101810	(0.084)	
3	-0.02367523	(0.089)	
Hispanic x Age Category			
16	0.67691422	(0.375)	*
17	0.24383561	(0.292)	
18	0.43273330	(0.312)	
19	0.31279859	(0.294)	
20	0.44384992	(0.294)	
21	0.48341662	(0.302)	
22	0.51917946	(0.304)	*
23	0.32702839	(0.289)	
24	0.56398958	(0.299)	*
25	0.60362327	(0.290)	**
26	0.43912965	(0.296)	
27	0.16760634	(0.297)	
28	0.39331031	(0.295)	
29	0.58219457	(0.298)	*
30	0.53174508	(0.320)	*
31	0.50745833	(0.282)	*

32	0.52178377	(0.303)	*
33	0.48775864	(0.328)	
34	0.57937741	(0.318)	*
35	0.79652542	(0.338)	**
36	0.23609507	(0.309)	
37	0.80513835	(0.340)	**
38	0.93561512	(0.380)	**
39	0.41129428	(0.298)	
40	0.68632829	(0.372)	*
Hispanic x Parity			
2	0.16079697	(0.070)	**
3	0.08834905	(0.078)	
Other x Age Category			
16	-0.29576561	(0.401)	
17			
18	-0.29343960	(0.261)	
19	-0.56038791	(0.325)	*
20	-0.36173436	(0.254)	
21	-0.07241481	(0.232)	
22	0.06641641	(0.265)	
23	0.09758026	(0.441)	
24	0.43110564	(0.298)	
25	0.28853130	(0.276)	
26	-0.27619016	(0.233)	
27	-0.07029783	(0.201)	
28	-0.03175689	(0.228)	
29	0.10445122	(0.225)	
30	0.11261244	(0.204)	
31	0.18278016	(0.264)	
32	0.01816838	(0.262)	
33	-0.19292492	(0.251)	
34	-0.25533050	(0.267)	
35	0.11939384	(0.220)	
36	0.19916449	(0.349)	
37			
38			
39	0.14896376	(0.235)	
40	0.05122471	(0.289)	
Other x Parity			
2	-0.15958233	(0.106)	
3	-0.09863383	(0.122)	

Metro x Age Category			
16	0.79957682	(0.364)	**
17	0.76019365	(0.244)	***
18	0.71219206	(0.251)	***
19	0.69446689	(0.257)	***
20	0.93930656	(0.248)	***
21	0.84459662	(0.254)	***
22	0.84603983	(0.259)	***
23	0.82423180	(0.256)	***
24	0.76454711	(0.256)	***
25	0.75602984	(0.240)	***
26	0.73513025	(0.243)	***
27	0.63712770	(0.237)	***
28	0.63631064	(0.265)	**
29	0.67529488	(0.232)	***
30	0.56643885	(0.249)	**
31	0.76137006	(0.229)	***
32	0.56783497	(0.321)	*
33	0.52636057	(0.291)	*
34	0.27513370	(0.246)	
35	0.58646137	(0.243)	**
36	0.86436272	(0.269)	***
37	0.04779081	(0.437)	
38	0.35915959	(0.282)	
39	0.63860607	(0.240)	***
40	-0.22592646	(0.421)	
Metro x Parity			
2	-0.16077363	(0.063)	**
3	-0.06310333	(0.077)	
Parity 2 x Age Category			
16	1.06795156	(0.576)	*
17	0.97513992	(0.214)	***
18	0.76980227	(0.185)	***
19	0.84921926	(0.169)	***
20	0.84671366	(0.155)	***
21	0.86145908	(0.157)	***
22	0.84744072	(0.171)	***
23	1.00931406	(0.154)	***
24	1.20499623	(0.169)	***
25	0.82661080	(0.157)	***
26	0.94872701	(0.155)	***

27	1.00891793	(0.145)	***
28	0.88472813	(0.143)	***
29	0.81607264	(0.161)	***
30	1.05839276	(0.137)	***
31	0.93021250	(0.138)	***
32	1.00926733	(0.157)	***
33	0.90385413	(0.148)	***
34	1.25753558	(0.171)	***
35	0.96777076	(0.131)	***
36	1.14582419	(0.191)	***
37	0.89443219	(0.155)	***
38	0.75351280	(0.190)	***
39	1.01346087	(0.142)	***
40	1.21627414	(0.274)	***
Parity 3 x Age Category			
16	-0.40165541	(0.496)	
17	0.05042136	(0.279)	
18	-0.09037544	(0.290)	
19	-0.68308491	(0.357)	*
20	0.03695840	(0.312)	
21	-0.01006975	(0.288)	
22	-0.10854153	(0.301)	
23	-0.25340998	(0.289)	
24	0.01813391	(0.300)	
25	-0.13384181	(0.293)	
26	-0.16874014	(0.293)	
27	0.04065979	(0.281)	
28	-0.24604352	(0.279)	
29	-0.39475378	(0.278)	
30	-0.02111073	(0.281)	
31	-0.16004947	(0.277)	
32	-0.02298241	(0.287)	
33	-0.06358178	(0.285)	
34	0.10897955	(0.276)	
35	-0.30107972	(0.269)	
36	-0.07972424	(0.310)	
37	-0.18809687	(0.303)	
38	-0.26949221	(0.278)	
39	-0.28447014	(0.266)	
40			
Married x Black	-0.03868573	(0.077)	

Married x Hispanic	0.07538962	(0.071)	
Married x Other	-0.22705242	(0.130)	*
Married x Metro	0.20273784	(0.078)	***
Metro x Black	-0.09445468	(0.103)	
Metro x Hispanic	0.02144015	(0.085)	
Metro x Other	0.13210271	(0.109)	
Constant	0.89353287	(0.120)	***
Observations	2047.000		
R-squared	0.371		

Notes: Table shows coefficients used to create the predicted fraction unintended in Figure 3A. Coefficients are from an OLS regression using data from the 2002 NSFG. The dependent variable is a binary indicator indicating that the pregnancy was either unwanted or occurred two years or more before the woman intended. The sample is limited to pregnancies ending in a live birth. Results are weighted by the NSFG final weights for the 2002 cycle. Standard errors are robust to heteroskedasticity. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Online Appendix Table 3:
R-Squareds and Pseudo R-Squareds for Models in Figure 5

Panel A: R-squared from OLS Models

	NSFG Cycle				
	2002	2006-10	2011-13	2013-15	2015-17
Unhappy	0.2969	0.2647	0.3359	0.3234	0.4289
Unwanted	0.3211	0.2689	0.3712	0.3597	0.4012
Not Trying	0.3023	0.2630	0.3509	0.3142	0.3935
Too Soon	0.3562	0.3073	0.3852	0.4241	0.4693
Unintended	0.3711	0.3144	0.4022	0.3904	0.4435

Panel B: Pseudo R-squared from Probit Models

	NSFG Cycle				
	2002.0000	2006-10	2011-13	2013-15	2015-17
Unhappy	0.2221	0.1668	0.2291	0.2160	0.2778
Unwanted	0.2545	0.1671	0.2432	0.2397	0.2424
Not Trying	0.2258	0.1552	0.2317	0.2140	0.2215
Too Soon	0.2652	0.2101	0.2753	0.2848	0.2551
Unintended	0.2818	0.2067	0.2790	0.2573	0.2517

Notes: Table shows the R-squared or pseudo R-squared for fifty different models used to predicted birth intendedness in the NSFG—five definitions of pregnancy intendedness x five different NSFG cycles x two model choices (linear probability or probit).