Discussion Paper Series

IZA DP No. 18852

July 2026

The Fertility Reduction Effects of the Colorado Family Planning Initiative by Age and Parity

James Flynn
Miami University
and IZA@LISER

Amanda Stevenson
University of Colorado Boulder

Sara Yeatman
University of Colorado Denver

Katie Genadek
United States Census Bureau

Jane Menken
University of Colorado Boulder

Stefanie Mollborn
Stockholm University

Leslie Root
University of Colorado Boulder

IZA@LISER NETWORK
ISSN: 2365-9793

IZA DP No. 18852 July 2026

The Fertility Reduction Effects of the Colorado Family Planning Initiative by Age and Parity*

Abstract

We use restricted-access birth records from the National Vital Statistics System (NVSS) to document the full age and parity fertility effects of the Colorado Family Planning Initiative (CFPI). The CFPI provided access to every FDA approved method of contraception for free to anyone living below approximately 200% of the federal poverty line from 2009-2015. Previous research has demonstrated important effects on fertility at ages 15-29. We estimate the statewide fertility effect of the CFPI for all age groups (15-44) and for all births and for first and non-first births using the synthetic control method. We find large and statistically significant reductions in birth rates for 15-24-year-olds that largely line up with other recent studies, but we find important heterogeneity across parity. For teenagers, we find reductions in first birth rates of about 9%, but much larger reductions in non-first birth rates of 17-25%. We also find reductions in overall fertility for 20-24 and 25-29-year-olds, but these are entirely driven by reductions of 5-9% in non-first birth rates, with no significant changes in first births. For 30-39-year-olds, we find small but statistically significant reductions in fertility of 3-7% across parity levels, and we find a 6% reduction in fertility for 40-44-year-olds. We also conduct inference using synthetic difference-in-differences (SDID) and placebo-based methods. When we do this, our coefficient estimates are similar, though confidence intervals are wider, with specifications on older age groups no longer statistically significant.

JEL classification

J13, I18, I12, J16

Keywords

family planning, long-acting reversible contraception (LARC), fertility

Corresponding author

James Flynn
flynnj@miamioh.edu

* We are grateful to Tara Kay Streng Schroeter, Jessica Kiser, Christine Durrance, and participants at the American Society of Health Economists annual meeting for helpful comments

1. Introduction

The impact of changes in access to family planning services on fertility has been widely studied, looking across different types of services. Gaining and losing access to abortion, the emergence of the birth control pill, and access to free family planning clinics all shape fertility in important ways.[1] Beyond the impact on fertility, family planning access also has profound effects on women's health, education, and economic outcomes and even shapes the lives of the next generation of children.[2] Recently, access to long-acting reversible contraceptives (LARCs) has been shown to have important effects on fertility and women's economic outcomes.[3]

Specifically, the Colorado Family Planning Initiative (CFPI) has been widely studied. This program was funded by a private $23 million donation and provided over 36,000 LARCs, specifically intrauterine devices (IUDs) and hormone-releasing implants, to mostly low-income women in Colorado in 2009-2015. The funding allowed Title X clinics[4] to purchase LARCs, train healthcare providers, hire new staff and expand clinic capacity, upgrade equipment, and perform community outreach about the availability of subsidized contraceptive services in Title X clinics and the safety and effectiveness of LARCs. The program combated misinformation about LARCs, and required patient-centered care, which meant that choice of contraceptive ultimately rested with the patient.[5]

CFPI reduced the teen birth rate (Lindo and Packham, 2017; Kelly et al., 2020), increased young women's educational attainment (Stevenson et al., 2021; Yeatman et al., 2022) and improved infant health outcomes (Goldthwaite et al., 2015; Flynn, 2024). Most research on the fertility effects of the CFPI has focused on the effects on births to teens or women under 25, but less is known about how these effects vary across parity,[6] which may provide evi-

[1] Bailey, 2010; Dench et al., 2024; Fischer et al., 2018; Goldin and Katz, 2002; Ananat et al., 2007; Gamino, 2023; Lu and Slusky, 2019

[2] Bailey, 2006; Bailey, 2012; Jones and Pineda-Torres, 2024; Angrist and Evans, 1996; Clarke and Mühlrad, 2021; Farin et al., 2024; Ananat and Hungerman, 2012; Bailey et al., 2019; Browne and LaLumia, 2014; Gallen et al., 2023; Miller et al., 2023; Myers, 2017; Gardner, 2024; Packham, 2017

[3] Ricketts et al., 2014; Goldthwaite et al., 2015; McNicholas et al., 2014; Biggs et al., 2015; Birgisson et al., 2015; Yeatman et al., 2022; Stevenson et al., 2021; Flynn, 2024; Flynn, 2025

[4] A Title X clinic is a specialized healthcare provider, often a local health department or non-profit like Planned Parenthood that receives federal funding under Title X of the Public Health Service Act to offer confidential, low-cost or free family planning and preventive reproductive health services, especially to low-income and uninsured patients. These clinics provide services such as contraception, pregnancy testing, STI testing and treatment, cancer screenings, and related preventive care, but federal rules prohibit them from using Title X funds to provide abortion services.

[5] For more information about the CFPI, see CDPHE, 2017.

[6] One exception to this is Flynn (2024), which showed that the CFPI led to a reduction in non-first teen births without comparing this to first births or looking at any other age group.

dence regarding the role of LARC use at different stages of family-building. A large share of LARC use during CFPI was among young women (Ricketts et al., 2014), but the program impacted services for all ages. Older clients increased LARC use as well (Humphreys et al., 2024), and CFPI also increased the number of tubal ligations and vasectomies, which are more common at older reproductive ages, by as much as 750% (CDPHE, 2017). Therefore, the intervention likely had an important impact on unwanted pregnancies across age groups.

In this paper, we analyze age and parity-specific effects of the CFPI on fertility using natality data from the National Vital Statistics System (NVSS). For total births, first births, and non-first births in each age group (15-17, 18-19, and 5-year age groups from 20 to 44), we implement the synthetic control method (SCM) of Abadie et al. (2010) to compare changes in Colorado to other states which had similar fertility levels and trends prior to the CFPI. We then use the weights from the SCM to estimate standard difference-in-differences and event-study specifications. We find large and statistically significant reductions in fertility for 15-24-year-olds that are similar to other recent studies, but with important heterogeneity across parity. For teenagers, we find reductions in first birth rates of about 9%, but much larger reductions in non-first birth rates of 17-25%. We also find reductions in overall fertility rates for 20-24 and 25-29-year-olds, but these are entirely driven by reductions of 5-9% in non-first birth rates, with no significant changes in first birth rates. For 30-39-year-olds, we find small but statistically significant reductions in fertility of between 3-7% across parity levels, and we find a 6% reduction in fertility for 40-44-year-olds, though our results for older groups are sensitive to model specification. We build on Lindo and Packham (2017), which analyzed the teen birth rate in Colorado, by looking separately at 15-17 and 18-19 year olds, finding large and persistent reductions for 18-19 year olds across parity levels, while we only consistently find reductions in non-first births for 15-17 year olds. Overall, our findings suggest larger reductions in non-first births than first births, suggesting that women are using LARCs more to control their fertility on the intensive margin than the extensive margin.

We also estimate specifications using the synthetic difference-in-differences (SDID) approach of Arkhangelsky et al. (2021) and conduct inference using the placebo-based inference method in Abadie et al. (2010). With SDID, our estimates are similar to our main specifications, though our confidence intervals are wider, leading most of our estimates on older age groups to no longer be statistically significant at traditional thresholds. We also estimate larger p-values when we conduct placebo-based inference, though we demonstrate using a bounding procedure that this is mostly due to the concern raised in Ferman and Pinto (2021) about overfitting in the pre-period in settings like ours with a limited number of pre-treatment years.

2. Motivation for Analyzing the Age and Parity Effects of the CFPI

That the CFPI led to meaningful reductions in fertility at young ages is not surprising: the fraction of births reported to have occurred earlier than wanted is greatest among women under 25 and Title X clients are more likely to be under 25 as well (Rossen, 2023). An intervention with an informational component, like that implemented by CFPI, might also reasonably be expected to impact adolescents and younger adult women – who were, in the CFPI period, less likely than older women to use or even be aware of IUDs and implants (Fleming et al., 2010, Romero, 2015).

Nonetheless, the broad scope of the program, including its training and infrastructure components, could also have had fertility effects at ages 25 and higher, though such effects may be more difficult to observe due to higher base rates during peak childbearing years and a prevailing trend of increasing fertility rates at ages near the end of the reproductive lifespan. However, if effects are observed at older ages they may be evidence of concentrated consequences of CFPI: that individuals who switched to more effective methods or initiated effective contraception because of the program were at higher than average risk of having a birth when they did not want one.

Additionally, an under-studied aspect of the CFPI is that it led to a sharp increase in sterilizations, which are more common among older clients. According to CDPHE (2017), sterilizations, including vasectomies and tubal ligations, increased by approximately 750% in Colorado Title X clinics from 2007 to 2010. While sterilization was rare in Title X clinics prior to CFPI, there were 1,570 vasectomies, 587 tubal ligations, and 958 non-surgical tubal occlusions provided to Colorado patients in Title X clinics between 2009-2015, or roughly 450 sterilizations per year. While Title X visits increased among all age groups following the CFPI, the share of Title X clients in Colorado above age 30 actually rose slightly from 25% in 2008 to 27.3% in 2011 (Ricketts et al., 2014). Other work finds that CFPI led to a reduction in births to Coloradans over 30 who had not had a birth in several years, suggesting they had likely completed their (intended) childbearing (Root, 2024). We build on these studies by examining the fertility effect of CFPI for each age group (15-17, 18-19, and 5-year age groups from 20 to 44) in order to more fully understand how contraceptive access can shape women's reproductive choices over the entire life cycle.

We also examine the effects of the CFPI on fertility by parity, or whether a birth was a mother's first birth or not. We are able to examine whether the reduction in teen births found elsewhere is due to young women receiving LARCs and avoiding having any pregnancies or young mothers using LARCs to avoid or delay the birth of another child. For example, Groves et al. (2018) find that Medicaid expansions to pregnant women in the 1980s led to a large increase in higher parity births, but had no impact on first births. How expanded contraceptive access impacts fertility by parity has important public health consequences; both Haight et al. (2019) and Partington et al. (2009) find that the risk of preterm birth is especially high among second and higher-order pregnancies to teens. It will be important for the administrators of future interventions to understand how these effects vary across parity levels in order to successfully target their programs. Our paper also highlights the need for future research into the fertility effects of changes in family planning access to analyze results by parity, as failing to do so can miss important heterogeneity.

3. Data and Methods

We use restricted-access natality records from the National Vital Statistics System (NVSS) for 2005-2015. The dataset contains a near-complete census of all births that occurred in the United States and includes the age and parity of the mother at the time of birth. We combine these data with estimates of the population by age and gender from the National Cancer Institute SEER program to calculate birth rates (births per 1,000 women within each age group for 15-17, 18-19, and five year age groups from 20 to 44) based on the mother's state of residence. While CFPI was intended to serve Colorado residents, there was no proof of residency required, so it is possible that residents of other states traveled to Colorado to get free LARCs. To the extent that this occurred, or that there was migration out of Colorado for residents who received LARCs, it would only serve to attenuate our estimates towards zero. We use the age-parity information to split our data into fertility rates for both first births and non-first births. Summary statistics of birth rates for each age group from 2005-2008 are displayed in Table 1. We display the mean birth rates for Colorado compared with the other 49 states plus the District of Columbia. For each age group, we first report the birthrate for all births, and then report the first birthrate and non-first birthrate separately.

We implement the synthetic control method (SCM) of Abadie and Gardeazabal (2003) and Abadie et al. (2010) to assess the impact of CFPI on fertility by age and parity. This method uses a data-driven approach to find the appropriate control group for Colorado, based on the assumption that we can estimate what the untreated trajectory in fertility would have looked like if Colorado had not implemented the CFPI. It does so by finding a weighted average of the other states that most closely matches Colorado on both levels and trends of the outcome variable for each of our pre-period years, as recommended in Ferman and Pinto (2021). We then observe how fertility evolves in the post treatment period from 2010 to 2015 for both Colorado and 'Synthetic Colorado'. We define 2010 as our first treated year, even though the CFPI technically began in 2009. Nearly all births that year were conceived in 2008. The relatively few LARCs inserted via CFPI early in 2009 may have reduced births in the last months of 2009, but the effect on yearly births would have been small and, in any case, would lead to conservative estimates of program effect. The key idea behind this approach is that this convex hull of control states is likely to have similar unobservable traits which will continue to drive the evolution of fertility in the post treatment period. If this is true, and if there is no other shock to fertility in Colorado or 'Synthetic Colorado' around the time of CFPI, then this method gives us a plausible counterfactual for what would have happened in Colorado absent the CFPI.

We then use the weights from the SCM for each age-parity cell to estimate difference-in-differences (DiD) specifications of the following form:

$$BirthRate_{st} = \beta_1 Treat_s x Post_t + \delta_s + \gamma_t + \epsilon_{st} \tag{1}$$

where $BirthRate_{st}$ measures the number of live births per 1,000 women in the population of a given age in state s in year t. $Treat_s$ is an indicator variable that an observation is from Colorado and $Post_t$ indicates an observation occurs between 2010-2015. δ_s and γ_t represent state and year fixed effects. The SCM graphs allow us to see the evolution of the treatment effect over time, and the DiD specification returns a single coefficient estimate for how the CFPI altered fertility for that age group over the entire period, under the assumption that the treatment effect is constant over the period 2010-2015.

While this approach allows us to create a control group that is more likely to satisfy the parallel trends assumption, it creates a challenge in regards to statistical inference. When we use the weights from the SCM, we often end up with a relatively small number of control states and only one treated state. This means that although there is likely serial correlation within states over time, we do not have enough clusters to reliably cluster our standard errors at the state level (Cameron et al., 2008; Cameron and Miller, 2015). Therefore, instead of clustering at the state level, we begin by using Huber-White standard errors, which correct for heteroscedasticity but not serial correlation. We then perform a number of additional procedures to address the possibility that our Huber-White standard errors are biased downward.

In the appendix, we also conduct inference using the method of Abadie et al. (2010), where we estimate placebo specifications where each non-treated state is assigned treated status. We then calculate the root mean squared predicted error (RMSPE) ratio for pre-vs-post treatment for each iteration and calculate the p-value for Colorado as $\frac{Rank_{Colorado}}{51}$. It is worth pointing out that Ferman and Pinto (2021) and Ferman and Pinto (2017) raise concerns about placebo inference in settings like ours with a relatively small number of pre-periods. This can lead to overfitting in the pre-period, which often leads to near-perfect fits. When this happens, it causes the RMSPE ratio, which has the pre-treatment RMSPE in the denominator, to tend towards infinity as the pre-treatment RMSPE tends toward zero. We demonstrate that this is a concern in our setting by conducting a bounding exercise, where we restrict placebo specifications to have a pre-period RMSPE ratio at least as large as Colorado.

We also display estimates using the synthetic difference-in-differences (SDiD) method of Arkhangelsky et al. (2021). Finally, we also display DiD and event-study estimates using the entire US as a control group, which are consistent with our main estimates. When we use the entire US as a control group, we display estimates with standard errors clustered at the state level, as well as Huber-White standard errors, which turn out to be more conservative in our setting. When we restrict the sample to be less than the full US, we report Huber-White standard errors due to concerns about having too few clusters (Abadie et al., 2023), though we typically also present results with standard errors clustered at the state level in the appendix.

4. Results

SCM estimates of the effect of the CFPI on total birth rates by age are displayed in Figure 1. The SCM weights for all specifications are displayed in Appendix Tables A.1 through A.3 in descending order. We display weights for up to the top ten weight-receiving states for each specification, though we use all states which receive positive weights in our empirical specifications. There is variation across specifications in which states receive weight, but the states which receive the most total weight are Oregon, Wyoming, and Michigan. Across age groups, there is a close match between Colorado and its synthetic version throughout the pretreatment period. Following the launch of the CFPI, the birthrate in Colorado experiences a relative decline in each age group. The difference is small among 15-17-year-olds, though the effect shows up more clearly in both the 18-19 and 20-24-year-old groups. There is similar separation in the 25-29, 30-34, 35-39, and 40-44-year-old age groups, in part because Colorado did not match the increases in the control group that reflect the nationwide fertility increase among women over 30 in 2010-2015 (Driscoll and Hamilton, 2025).

Table 2 displays the point estimate for each age group and parity level from the DiD specification, the baseline birthrate in Colorado in 2008, and the percentage change implied by the point estimate. In each age group except for 15-17-year-olds, there are statistically significant decreases in total birth rates. The largest point estimate is for 20-24-year-olds, where there is a reduction of 6.22 births per 1,000 women per year, followed by 18-19-year-olds at 5.29. The 18-19 year old group displays the largest reductions in percentage terms for all births, first births, and non-first births. Because this simple DiD coefficient masks heterogeneity in the evolution of the treatment effect over time, we also convert these estimates into event-studies in Appendix Figures A.1 through A.3, again using the weights from the synthetic control method. This exercise allows us to add confidence intervals to put the magnitude of the differences from the synthetic control graphs into perspective. The results are qualitatively consistent with the SCM figures and Table 2, showing overall reductions in fertility that are mainly driven by reductions in non-first births.

Figures 2 and 3 display the SCM estimates for first birth rates and non-first birth rates, respectively. The reductions in non-first births appear to be larger in almost all cases. For first births, only the 18-19-year-old age group displays a compelling treatment effect. For 15-17, 20-24, and 25-29-year-olds, Colorado mirrors its synthetic control quite closely throughout the CFPI years. 30-34-year-olds display a reduction, though with some noise, and the estimates for 35-39 and 40-44-year-olds are noisier still, partially because first births are rarer in these older age groups.

Figure 3 on the other hand, displays clear reductions in Colorado relative to its synthetic control in each age group, suggesting that increased access to fertility control methods lead to larger fertility effects on the intensive margin than on the extensive margin. Table 2 shows the estimates from the DiD versions of these specifications, which use the weights from the SCM to create the control group. For first births, only the estimates on 18-19, 30-34, and 35-39-year-olds are statistically significant, and the implied percentage reductions are mostly smaller in magnitude than the estimates for overall fertility. For non-first births, there are large and statistically significant reductions in the birthrate in every age group except for 40-44-year-olds.[7] Histograms comparing the estimates from

[7] It is important to note that a new 'Synthetic Colorado' is created for each specification, which means that

Figures 1 through 3 to the distribution of placebo estimates are displayed in Appendix Figures A.4 through A.6. The placebo distributions line up closely with the main estimates for the 18-19 year old age group across parity levels, though the other results are less robust to this approach.

For overall birth rates, only the 18-19 year old group is significant at the 5% level, while the rest of the age groups have placebo-based p-values greater than .1. For first births, two of the age groups (25-29 and 30-34) are significant at 5%, while 18-19 year olds are significant at 10%. For non-first births, only the 18-19 and 25-29 year old groups are significant at 5%. The fact that estimates are less significant using placebo-based inference raises concerns that the Huber-White standard errors from our main approach may be too small. However, this is mainly due to the fact that in this setting with relatively few pre-periods, it is possible for the placebo SCM specifications to have incredibly close fits in the pre-period. This causes the pre-treatment RMSPE to tend towards zero, subsequently causing the pre-post RMSPE ratio, which inference is based on, to tend towards infinity. This means that placebo specifications which may not display more of a treatment effect than our Colorado estimate may still have a higher ratio, making our estimates less likely to return a significant p-value.

Appendix Figures A.7 through A.9 display adjusted versions of the placebo histograms from Appendix Figures A.4 through A.6 to account for this issue. For each placebo specification, we make no adjustment to the post-treatment RMSPE, which indicates how much the placebo state varies away from its synthetic control in the post-period. For the placebo pre-treatment RMSPEs, we set the minimum RMSPE to be equal to the estimated Colorado RMSPE. In other words, we make no adjustment to placebos that had a worse fit than Colorado, but we prevent states that have a vanishingly small pre-period RMSPE from having a larger pre-post RMSPE ratio unless they also had more variation than Colorado in the post-period. This exercise is justified by the fact that all of the Colorado synthetic control specifications fit reasonably well in the pre-treatment period, as demonstrated by the complete lack of pre-trends in the SCM-weighted event-studies in Appendix Figures A.1 through A.3. This adjustment will only cause our estimates to have lower p-values to the extent that these vanishingly small pre-treatment RMSPE fits were inflating our p-values in the first place.

Appendix Figures A.7 through A.9 demonstrate that our precision is substantially improved when we address this issue. Now, four of the seven estimates on overall birth rates are significant at 10%, while two other estimates have p-values of .137. For first births,

estimates for first and non-first births are not a weighted average of the estimates for all births.

precision is improved, but not nearly as much as for overall births. Previously, two of the estimates were significant at 5%, while one was significant at 10%. Now, three of the estimates are significant at 5%. For non-first births, our estimates are now much more precise across the board. Previously, only the 18-19 and 25-29 year old groups were significant at 10%, but now five of the seven estimates are significant at 10%, and the other two p-values are both less than .2. Since this exercise will only impact p-values to the extent that vanishingly small pre-treatment RMSPE fits were causing them to be arbitrarily high, the fact that our estimates become much more precise suggests that this was a major problem in Appendix Figures A.4 through A.6. This does not suggest that the new p-values in Appendix Figures A.7 through A.9 are correct, per se, as the choice of setting the lower bound at the level of Colorado's estimate is somewhat arbitrary. This exercise does clearly demonstrate, on the other hand, that overfitting in the pre-period for the placebo estimates is the main reason why the p-values from the placebo-based inference approach are so much higher than from our traditional difference-in-difference estimates.

We also estimate these same specifications for the log of the birthrate, with the corresponding SCM figures displayed in Appendix Figure A.10 through A.12. Figure 4 displays the DiD coefficient estimates from these log specifications. Once again, the reduction in non-first births is significantly larger than the reduction in first births for 15-17 through 25-29-year-olds. Appendix B further explores these findings outside of the SCM setting, by estimating event-study and DiD specifications with various alternative control groups. As might be expected, the pretreatment trends don't match as closely as they do with the SCM, and the older age groups show evidence that fertility in Colorado was declining relative to the rest of the country prior to the CFPI, but the general findings from this section are largely consistent with our main results.

Our estimates imply reductions in the log birthrate of 9.6% and 9.4% for 15-17 and 18-19-year-olds, respectively, consistent with the 6-9% reductions from Lindo and Packham (2017). For first birth rates, there are reductions of 7.4% and 13.2% for these ages, compared with reductions of 25.4% and 17.9% for non-first birth rates. For 20-24-year-olds there is a 8.1% overall reduction, with a borderline significant 1.8% reduction in the first birthrate compared with a 12.3% reduction in the non-first birthrate. Similarly, for 25-29-year-olds, there are insignificant reductions for the overall and first birth rates, but with a significant reduction of 5.7% in the non-first birthrate. For 30-34 and 35-39-year-olds we find similar reductions across parity levels of between 3-5%, with the exception of a 7.4% reduction in the first birthrate for 35-39-year-olds. Finally, we find a reduction in the overall birthrate of around 6.2% for 40-44-year-olds, which is similar across parities.

Appendix Figure A.13 recreates Figure 4 using estimates from the SDiD method, using the placebo method of inference with 1,000 repetitions. The estimates are all similar in magnitude, though less precisely estimated. All 21 of the coefficient estimates are negative, but the wider confidence intervals mean that most of the estimates are no longer statistically significant. For all births, none of the coefficients are significant at 5%, though the coefficients on births to 18-19 and 35-39 year-olds are significant at 10%. For first births, not only are none of the coefficients significant, but none of them has a p-value less than .15. For non-first births, coefficients are significant at 10% for the 15-17, 18-19, and 30-34 year-old groups. Overall, while our SDID results are less precisely-estimated than our main specifications, they also show suggestive reductions in fertility across age and parity groups which are larger for teenagers and for non-first births.

Appendix Figures A.14 and A.15 reestimate our main specifications using the entire US as the control group, which means we have enough states to cluster our standard errors at the state level. The estimates are once again similar to Figure A.13, but are much more precisely estimated. Appendix Figure A.14 clusters standard errors at the state level, while Appendix Figure A.15 uses Huber-White standard errors as a point of comparison, which turn out to be more conservative in this case. Finally, Appendix Figure A.16 recreates our main coefficient figure, Figure 4, only including 2009 as a treated year. The estimates are qualitatively similar to our main results, suggesting that our findings are not dependent on our choice to count 2010 as the first treated year in our main specifications.

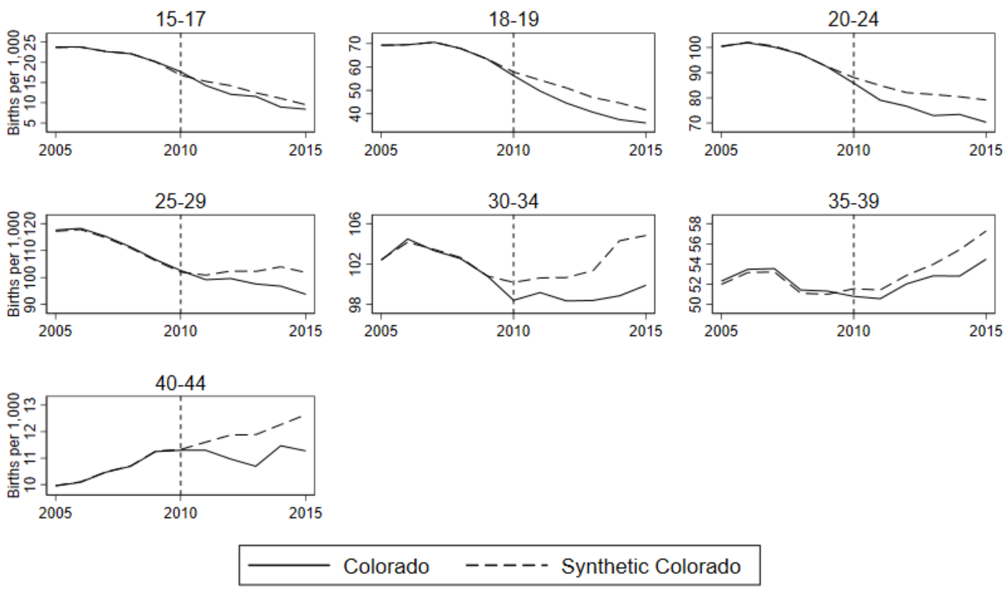
Taken together, the results from this section underscore that while the statistical inference from different specifications are sensitive to the choice of method, point estimates are not. Across our various approaches, including using Huber-White standard errors from the SCM-weighted DiD, SDID with placebo-based inference, RMSPE-ratio placebo tests, and DiD using the full US as a control group and standard errors clustered at the state level, the point estimates are consistently negative and similar in magnitude. We find the largest impacts on fertility among teenagers and for non-first births. However, the precision of our estimates, and therefore which coefficients cross conventional significance thresholds, varies substantially. This is most pronounced for the older age groups (30-44) and for first births, where the SDID and unadjusted placebo-based approaches sometimes fail to reach significance even though the corresponding point estimates are of similar magnitude to our main specifications. The 18-19-year-old age group and the reductions in non-first births are the most robust results in the paper, remaining statistically significant across nearly every inferential approach we employ.

5. Discussion and Conclusion

Previous work by Stevenson et al. (2021) and Yeatman et al. (2022) found that the CFPI increased educational attainment for young women in Colorado. One might expect an unintended first birth to cause a greater disruption in educational progress than a higher parity birth. However, somewhat surprisingly, we find a greater effect of CFPI on later births. We believe that these findings are not incompatible for two reasons. First, although we find bigger percentage changes in non-first births, base rates of first births are much higher for young women. For example, over 90% of births to 15-17 year olds are first births. Nearly 3/4 of the overall fertility reduction implied by our estimates would be coming from first births. It could still be the case that the first birth pathway is more likely to lead to better educational outcomes. Second, Yeatman et al. (2022) argued that the educational effect of the CFPI was too large to have been completely driven by avoided births, and that part of the effect was likely due to "increasing confidence in young women that investments in higher education would not be derailed by an unanticipated pregnancy."

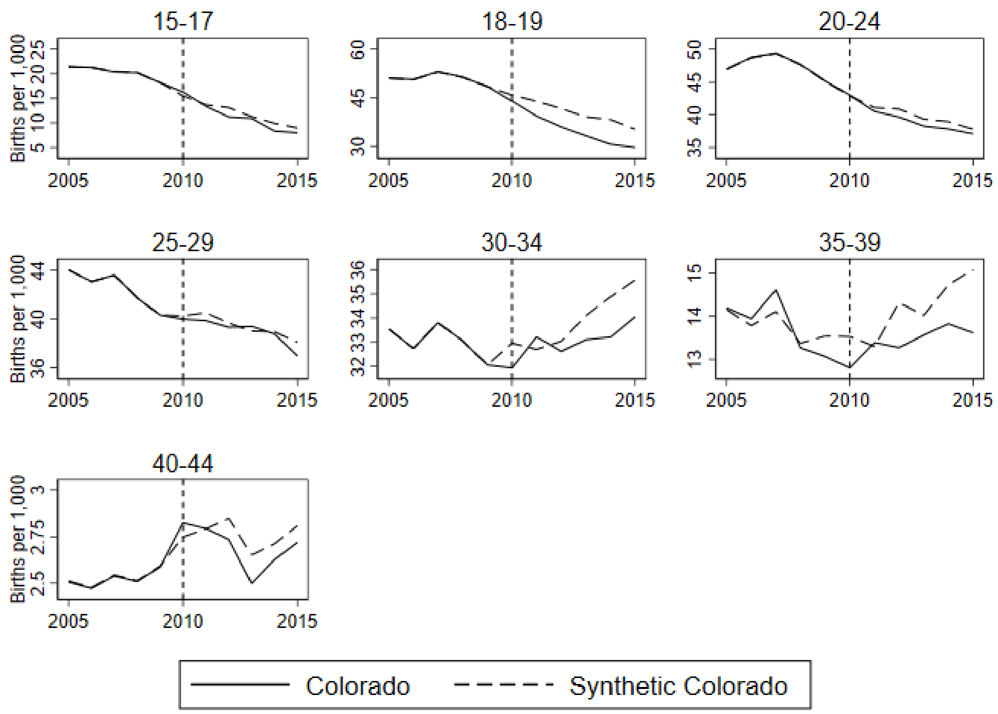
This paper makes two important contributions to the literature investigating the impacts of expanded LARC access on fertility. First, while several recent papers have focused on the effects of programs like the CFPI on births to teenagers or young women, we look at these effects separately for each age group from 15-17 to 40-44-year-olds. In addition to looking at all age groups, we estimate effects by parity, looking at whether these reductions were larger for first or later births. Generally, we find large reductions in fertility across age groups, with reductions for young women driven disproportionately by non-first births. In older age groups we find smaller but significant reductions that differ little across parities, but are less robust to alternative specifications. These findings are important because the economic and health implications of avoiding motherhood entirely are quite different than the effect of avoiding an additional birth for someone who is already a mother. Our results also have important implications for how the administrators of future programs should consider targeting interventions designed to expand LARC access.

Figure 1 — Synthetic Control Estimates of the Effect of the Colorado Family Planning Initiative on Age-Specific Fertility



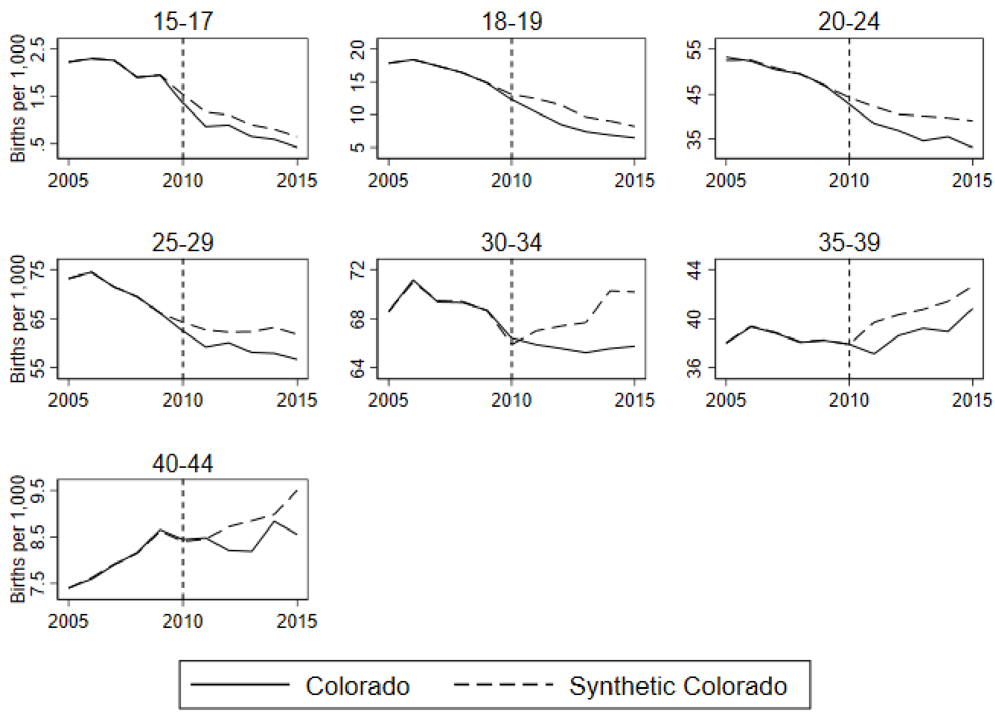
Note: This figure displays synthetic control estimates of the effect of the Colorado Family Planning Initiative on the birthrate for women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each figure, the solid black line represents the trend in Colorado, while the dashed line displays trends in the synthetic version of Colorado, which is calculated as a weighted average of the other 49 states which is designed to minimize the difference in the pretreated outcome between Colorado and Synthetic Colorado.

Figure 2 — Synthetic Control Estimates of the Effect of the Colorado Family Planning Initiative on Age-Specific Fertility - First Births



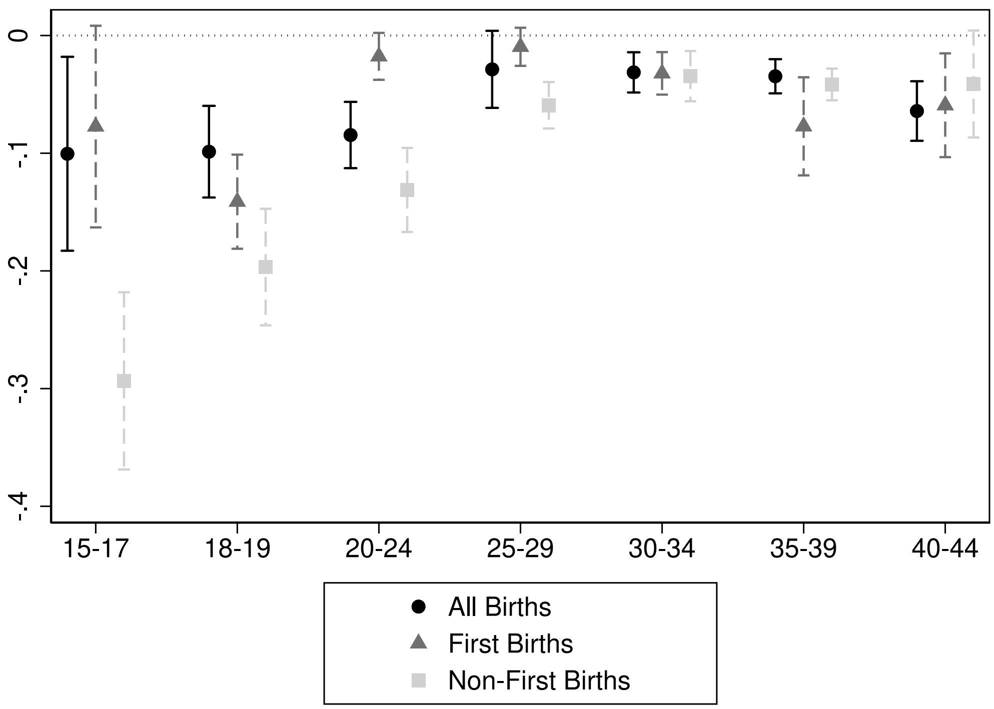
Note: This figure displays synthetic control estimates of the effect of the Colorado Family Planning Initiative on the birthrate for first births for women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each figure, the solid black line represents the trend in Colorado, while the dashed line displays trends in the synthetic version of Colorado, which is calculated as a weighted average of the other 49 states which is designed to minimize the difference in the pretreated outcome between Colorado and Synthetic Colorado.

Figure 3 — Synthetic Control Estimates of the Effect of the Colorado Family Planning Initiative on Age-Specific Fertility - Non-First Births



Note: This figure displays synthetic control estimates of the effect of the Colorado Family Planning Initiative on the number of non-first births per 1,000 women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each figure, the solid black line represents the trend in Colorado, while the dashed line displays trends in the synthetic version of Colorado, which is calculated as a weighted average of the other 49 states which is designed to minimize the difference in the pretreated outcome between Colorado and Synthetic Colorado.

Figure 4 — Comparison of Difference-in-Differences Estimates on the Effect of the Colorado Family Planning Initiative on the Log of Births per 1,000 Women



Note: This figure displays coefficient estimates from difference-in-differences specifications on the effect of the Colorado Family Planning Initiative on the log of the birthrate in each age group, using the weights from the synthetic control method to select the control group. Within each age group, the first coefficient represents the effect on all births, along with 95% confidence intervals calculated using Huber-White standard errors. The second coefficient represents the effect on first births, while the third coefficients represents the effect on non-first births.

Table 1 — Summary Statistics Comparing 2005-2008 Fertility in Colorado to the Rest of the United States by Age and Parity.

Variable	Colorado	Rest of U.S.	St. Dev.	P-value
15-17 - All	23.05	20.61	13.98	.55
15-17 - First	20.85	18.66	9.63	.51
15-17 - Nonfirst	2.18	1.94	0.98	.63
18-19 - All	69.14	68.47	19.93	.95
18-19 - First	51.59	52.47	13.03	.90
18-19 - Nonfirst	17.55	16.00	6.40	.69
20-24 - All	99.66	104.35	23.68	.63
20-24 - First	48.23	50.66	9.08	.58
20-24 - Nonfirst	51.44	53.69	14.68	.67
25-29 - All	115.30	120.99	19.66	.57
25-29 - First	43.11	42.78	6.18	.95
25-29 - Nonfirst	72.19	78.21	16.67	.48
30-34 - All	102.90	95.79	12.77	.27
30-34 - First	33.29	25.97	7.18	.04
30-34 - Nonfirst	69.61	69.82	10.48	.96
35-39 - All	52.58	43.81	9.25	.02
35-39 - First	14.21	9.66	3.75	.06
35-39 - Nonfirst	38.57	34.15	6.36	.17
40-44 - All	10.27	8.52	2.64	.20
40-44 - First	2.51	1.79	0.95	.14
40-44 - Nonfirst	7.76	6.73	1.84	.27

Note: This table displays summary statistics for fertility measures by age and parity for Colorado compared with the rest of the United States for 2005-2008. The first column displays the mean for Colorado. The second column display the mean for the rest of the United States. The third column displays the standard deviation of the variable, while the fourth column displays the p-value from a t-test comparing the mean in Colorado to the mean in the rest of the United States. The table displays the birthrate, or the number of births per 1,000 women in each age range, followed by the birthrate for all first and then nonfirst births. This is repeated for each age group from 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44.

Table 2 — CFPI Effects on Fertility by Age and Parity

	All Births			First Births			Non-First Births		
Age	Coef.	Base	%	Coef.	Base	%	Coef.	Base	%
15-17	-1.09	22.13	-4.90	-0.72	20.24	-3.56	-0.23**	1.90	-11.7
	(1.33)			(.745)			(.079)		
18-19	-5.29***	67.92	-7.79	-5.31***	51.42	-10.32	-2.01***	16.42	-12.24
	(0.74)			(0.99)			(0.39)		
20-24	-6.22***	97.35	-6.39	-0.82	47.70	-1.72	-4.15***	49.53	-8.38
	(1.52)			(0.46)			(0.74)		
25-29	-4.36***	111.36	-3.92	-0.36	41.74	-0.86	-3.67***	69.52	-5.28
	(1.09)			(0.40)			(0.59)		
30-34	-3.15***	102.53	-3.07	-0.85**	33.06	-2.57	-2.33**	69.32	-3.36
	(0.89)			(0.31)			(0.74)		
35-39	-1.83***	51.43	-3.56	-0.78*	13.27	-5.88	-1.63***	38.08	-4.28
	(0.44)			(0.29)			(0.29)		
40-44	-0.75***	10.70	-7.01	-0.06	2.51	-2.39	0.01	8.16	0.12
	(0.16)			(0.07)			(0.14)		

Note: This table summarizes our main findings from our difference-in-differences estimates of the effect of the Colorado Family Planning Initiative on fertility across age and parity groups, where the weights from the synthetic control method are used to construct the control group. Column one displays the age group being analysed in each row. The next three sets of columns display the coefficient estimate of the effect of the CFPI on the birthrate, the the 2008 birthrate for comparison, and then the percentage change that estimate represents against the base rate. Beneath each coefficient estimate is its standard error in parentheses Columns two through four do this for all births, columns five through seven do this for only first births, and columns eight through ten do this for non-first births. Because these control groups use a limited subsample of states, we use Huber-White standard errors instead of clustering at the state level. * $p < .05$, ** $p < .01$, *** $p < .001$.

References

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller (2010). "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program". In: *Journal of the American Statistical Association* 105.490, pp. 493–505.

Abadie, Alberto and Javier Gardeazabal (Mar. 2003). "The Economic Costs of Conflict: A Case Study of the Basque Country". In: *American Economic Review* 93.1, pp. 113–132.

Abadie, Alberto et al. (2023). "When Should You Adjust Standard Errors for Clustering?" In: *The Quarterly Journal of Economics* 138.1, pp. 1–35.

Ananat, Elizabeth Oltmans, Jonathan Gruber, and Phillip Levine (2007). "Abortion Legalization and Life-Cycle Fertility". In: *Journal of Human Resources* 42.2.

Ananat, Elizabeth Oltmans and Daniel M. Hungerman (Feb. 2012). "The Power of the Pill for the Next Generation: Oral Contraception's Effects on Fertility, Abortion, and Maternal and Child Characteristics". In: *The Review of Economics and Statistics* 94.1, pp. 37–51. ISSN: 0034-6535.

Angrist, Joshua D and William N Evans (Jan. 1996). *Schooling and Labor Market Consequences of the 1970 State Abortion Reforms*. Working Paper 5406. National Bureau of Economic Research.

Arkhangelsky, Dmitry et al. (Dec. 2021). "Synthetic Difference-in-Differences". In: *American Economic Review* 111.12, pp. 4088–4118.

Bailey, Martha J. (Feb. 2006). "More Power to the Pill: The Impact of Contraceptive Freedom on Women's Life Cycle Labor Supply*". In: *The Quarterly Journal of Economics* 121.1, pp. 289–320. ISSN: 0033-5533.

— (Mar. 2010). ""Momma's Got the Pill": How Anthony Comstock and Griswold v. Connecticut Shaped US Childbearing". In: *American Economic Review* 100.1, pp. 98–129.

— (Apr. 2012). "Reexamining the Impact of Family Planning Programs on US Fertility: Evidence from the War on Poverty and the Early Years of Title X". In: *American Economic Journal: Applied Economics* 4.2, pp. 62–97.

Bailey, Martha J., Olga Malkova, and Zoë M. McLaren (2019). "Does Access to Family Planning Increase Children's Opportunities?: Evidence from the War on Poverty and the Early Years of Title X". In: *Journal of Human Resources* 54.4, pp. 825–856.

Biggs, M.A. et al. (2015). "Did increasing use of highly effective contraception contribute to declining abortions in Iowa?" In: *Contraception* 91.2, pp. 167–173.

Birgisson, Natalia E. et al. (2015). "Preventing Unintended Pregnancy: The Contraceptive CHOICE Project in Review". In: *Journal of Women's Health* 24.5. PMID: 25825986, pp. 349–353.

Browne, Stephanie P. and Sara LaLumia (2014). "The Effects of Contraception on Female Poverty". In: *Journal of Policy Analysis and Management* 33.3, pp. 602–622. ISSN: 02768739, 15206688.

Cameron, A. Colin, Jonah B. Gelbach, and Douglas L. Miller (2008). "Bootstrap-based improvements for inference with clustered errors". In: *Review of Economics and Statistics* 90.3, pp. 414–427.

Cameron, A. Colin and Douglas L. Miller (2015). "A practitioner's guide to cluster-robust inference". In: *Journal of Human Resources* 50.2, pp. 317–372.

CDPHE (2017). *Taking the Unintended out of Pregnancy: Colorado's Success with Long-Acting Reversible Contraceptives*. Tech. rep. Colorado Department of Public Health and Environment.

Clarke, Damian and Hanna Mühlrad (2021). "Abortion laws and women's health". In: *Journal of Health Economics* 76, p. 102413. ISSN: 0167-6296.

Dench, Daniel, Mayra Pineda-Torres, and Caitlin Myers (2024). "The effects of post-Dobbs abortion bans on fertility". In: *Journal of Public Economics* 234, p. 105124. ISSN: 0047-2727.

Driscoll, Anne and Brady Hamilton (2025). "Effects of Age-Specific Fertility Trends on Overall Fertility Trends: United States, 1990-2023". In: *National Vital Statistics Reports* 64.3.

Farin, Sherajum Monira, Lauren Hoehn-Velasco, and Michael F. Pesko (Aug. 2024). "The Impact of Legal Abortion on Maternal Mortality". In: *American Economic Journal: Economic Policy* 16.3, pp. 174–216.

Ferman, Bruno and Cristine Pinto (2017). *Placebo Tests for Synthetic Controls*. MPRA Paper 78079. University Library of Munich, Germany.

— (2021). "Synthetic controls with imperfect pretreatment fit". In: *Quantitative Economics* 12.4, pp. 1197–1221.

Fischer, Stefanie, Heather Royer, and Corey White (2018). “The impacts of reduced access to abortion and family planning services on abortions, births, and contraceptive purchases”. In: *Journal of Public Economics* 167, pp. 43–68. ISSN: 0047-2727.
Fleming, K.L., T.R. Sokoloff, and T.R. Raine (2010). “Attitudes and beliefs about the intrauterine device among teenagers and young women.” In: *Contraception* 82, pp. 178–182.
Flynn, James (2024). “Can Expanding Contraceptive Access Reduce Adverse Infant Health Outcomes?” In: *Journal of Human Resources*. ISSN: 0022-166X.
— (2025). “Contraceptive access and infant health outcomes”. In: *Journal of Health Economics* 104, p. 103081. ISSN: 0167-6296.
Gallen, Yana et al. (2023). *The Labor Market Returns to Delaying Pregnancy*. Tech. rep.
Gamino, Aaron M. (2023). “The Effect of a Free Family Planning Program on Fertility: Evidence from Louisiana”. In: *American Journal of Health Economics* 9.2, pp. 127–147.
Gardner, Graham (2024). “The maternal and infant health consequences of restricted access to abortion in the United States”. In: *Journal of Health Economics* 98, p. 102938. ISSN: 0167-6296.
Goldin, Claudia and Lawrence F. Katz (2002). “The Power of the Pill: Oral Contraceptives and Women’s Career and Marriage Decisions”. In: *Journal of Political Economy* 110.4, pp. 730–770.
Goldthwaite, Lisa M. et al. (2015). “Adverse Birth Outcomes in Colorado: Assessing the Impact of a Statewide Initiative to Prevent Unintended Pregnancy”. In: *American Journal of Public Health* 105.9. PMID: 26180990, e60–e66.
Groves, Lincoln H., Sarah Hamersma, and Leonard M. Lopoo (2018). “Pregnancy Medicaid Expansions and Fertility: Differentiating Between the Intensive and Extensive Margins”. In: *Population Research and Policy Review* 37.3, pp. 461–484. ISSN: 01675923, 15737829.
Haight, Sarah C. et al. (2019). “Short interpregnancy intervals and adverse pregnancy outcomes by maternal age in the United States”. In: *Annals of Epidemiology* 31, pp. 38–44. ISSN: 1047-2797.
Humphreys, Abigail, Amanda Jean Stevenson, and Sara Yeatman (2024). “Changes in contraceptive method mix following the Colorado Family Planning Initiative”. In: *Contraception* 134, p. 110422. ISSN: 0010-7824.
Jones, Kelly M. and Mayra Pineda-Torres (2024). “TRAP’d Teens: Impacts of abortion provider regulations on fertility education”. In: *Journal of Public Economics* 234, p. 105112. ISSN: 0047-2727.
Kelly, Andrea, Jason M. Lindo, and Analisa Packham (2020). “The power of the IUD: Effects of expanding access to contraception through Title X clinics”. In: *Journal of Public Economics* 192, p. 104288. ISSN: 0047-2727.
Lindo, Jason M. and Analisa Packham (Aug. 2017). “How Much Can Expanding Access to Long-Acting Reversible Contraceptives Reduce Teen Birth Rates?” In: *American Economic Journal: Economic Policy* 9.3, pp. 348–76.
Lu, Yao and David J. G. Slusky (2019). “The Impact of Women’s Health Clinic Closures on Fertility”. In: *American Journal of Health Economics* 5.3, pp. 334–359.
McNicholas, Colleen et al. (Dec. 2014). “The Contraceptive CHOICE Project Round Up”. In: *Clinical Obstetrics and Gynecology* 57.4, pp. 635–643.
Miller, Sarah, Laura R. Wherry, and Diana Greene Foster (Feb. 2023). “The Economic Consequences of Being Denied an Abortion”. In: *American Economic Journal: Economic Policy* 15.1, pp. 394–437.
Myers, Caitlin Knowles (2017). “The Power of Abortion Policy: Reexamining the Effects of Young Women’s Access to Reproductive Control”. In: *Journal of Political Economy* 125.6, pp. 2178–2224.
Packham, Analisa (2017). “Family planning funding cuts and teen childbearing”. In: *Journal of Health Economics* 55, pp. 168–185. ISSN: 0167-6296.
Partington, Susan N. et al. (2009). “Second Births to Teenage Mothers: Risk Factors For Low Birth Weight and Preterm Birth”. In: *Perspectives on Sexual and Reproductive Health* 41.2, pp. 101–109.
Ricketts, Sue, Greta Klingler, and Renee Schwalberg (2014). “Game Change in Colorado: Widespread Use Of Long-Acting Reversible Contraceptives and Rapid Decline in Births Among Young, Low-Income Women”. In: *Perspectives on Sexual and Reproductive Health* 46.3, pp. 125–132.
Romero, L. et al. (2015). “Vital signs: trends in use of long-acting reversible contraception among teens aged 15-19 years seeking contraceptive services—United States, 2005-2013”. In: *MMWR Morb Mortal Wkly Rep* 64, pp. 363–369.

Root, L. et al. (2024). “Access to family planning services and fertility over age 30: evidence from the Colorado Family Planning Initiative”. In: *Annual Meeting of the Population Association of America*.

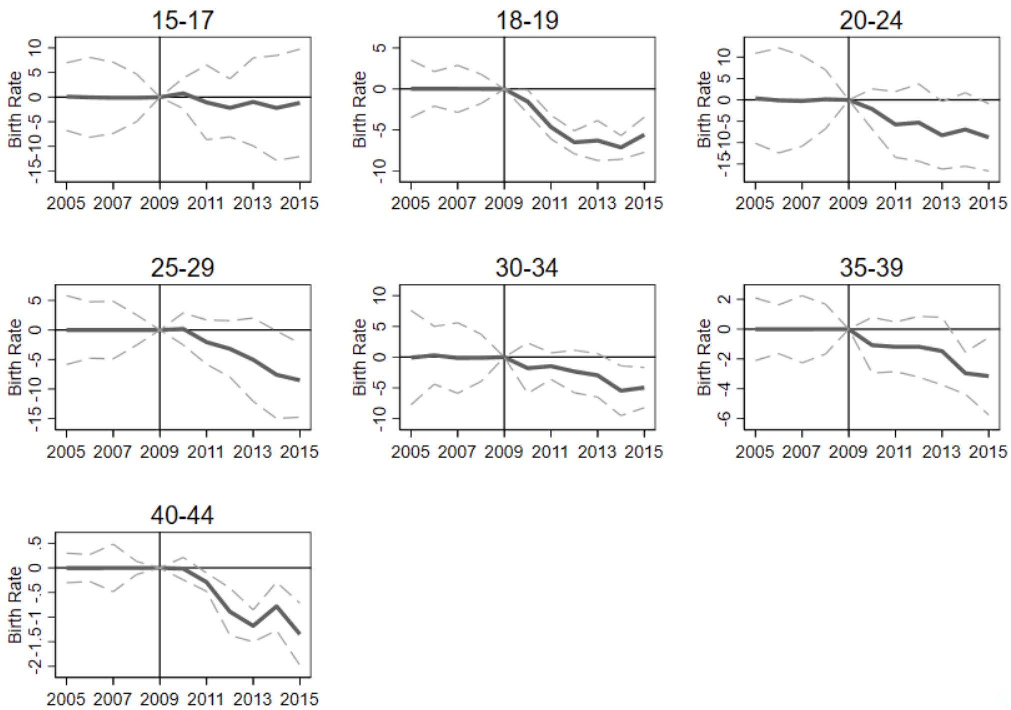
Rossen, L. et al. (2023). *Updated Methodology to Estimate Overall and Unintended Pregnancy Rates in the United States*. Tech. rep. National Center for Health Statistics (U.S.)

Stevenson, Amanda J. et al. (2021). “The impact of contraceptive access on high school graduation”. In: *Science Advances* 7.19.

Yeatman, Sara et al. (2022). “Expanded Contraceptive Access Linked To Increase In College Completion Among Women In Colorado”. In: *Health Affairs* 41.12. PMID: 36469823, pp. 1754–1762.

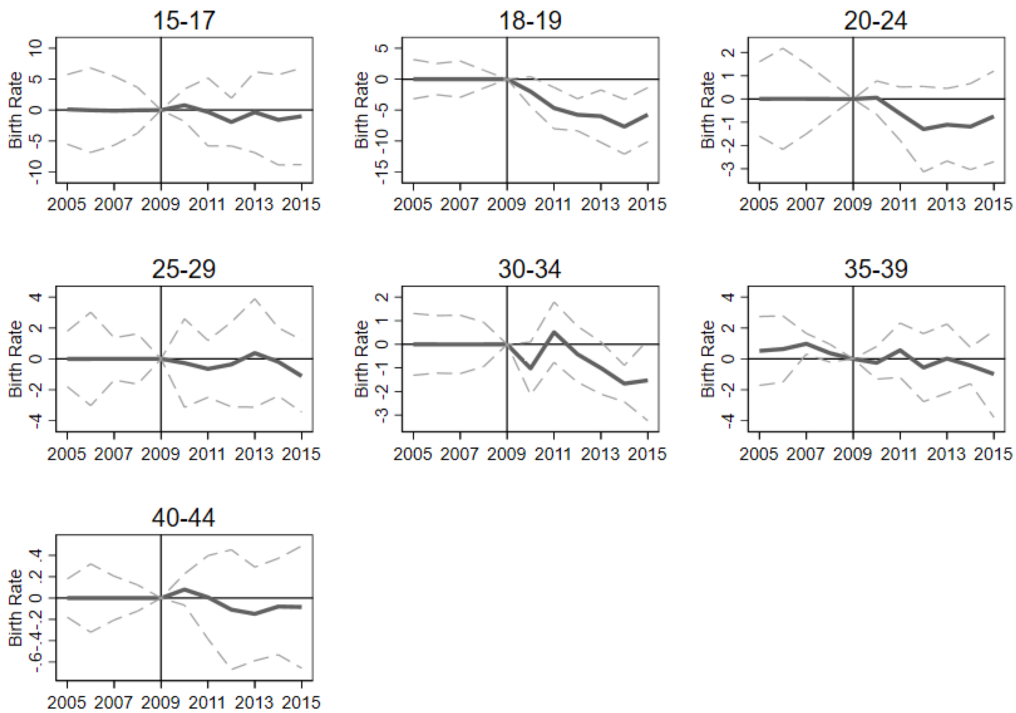
A. Appendix Figures and Tables (Not for Publication)

Figure A.1 — Event-Study Estimates of the Effect of the Colorado Family Planning Initiative on Age-Specific Fertility Using the Weight from the Synthetic Control Method



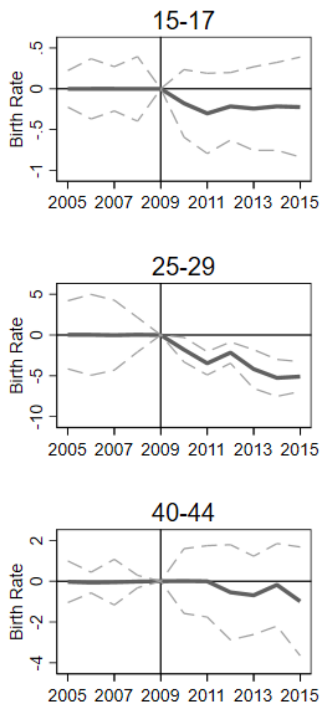
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative on the birthrate for women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each specification, the weight from the synthetic control method on that age group are used to create the control group. Because these control groups use a limited subsample of states, we use Huber-White standard errors instead of clustering at the state level.

Figure A.2 — Event-Study Estimates of the Effect of the Colorado Family Planning Initiative on First Births Using the Weight from the Synthetic Control Method



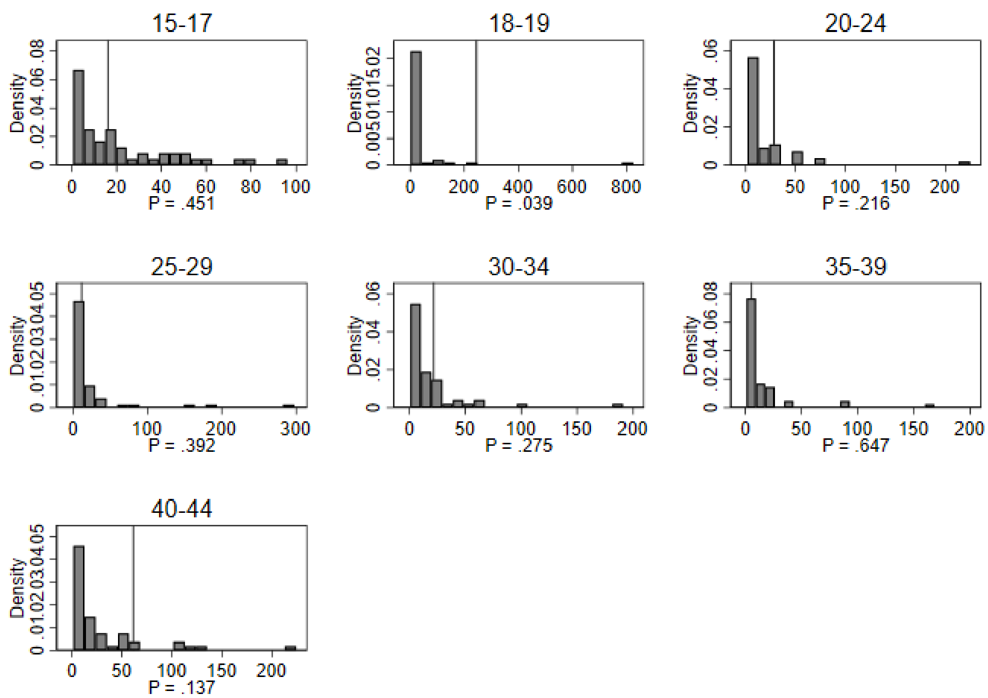
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative on the first birthrate for women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each specification, the weight from the synthetic control method on that age group are used to create the control group. Because these control groups use a limited subsample of states, we use Huber-White standard errors instead of clustering at the state level.

Figure A.3 — Event-Study Estimates of the Effect of the Colorado Family Planning Initiative on Non-first Births Using the Weight from the Synthetic Control Method



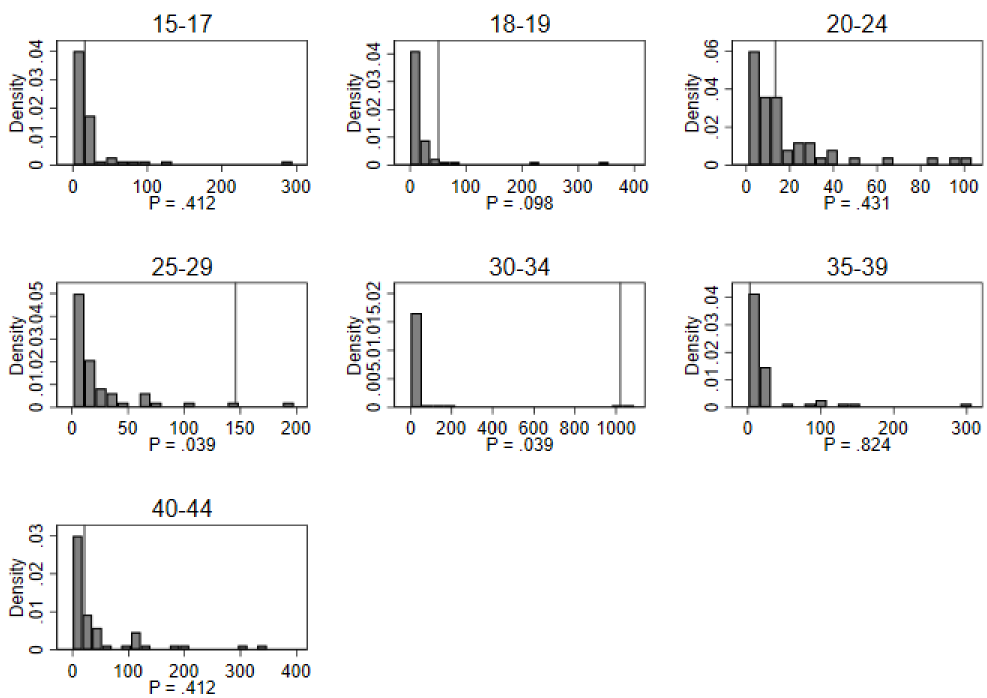
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative on the non-first birthrate for women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each specification, the weight from the synthetic control method on that age group are used to create the control group. Because these control groups use a limited subsample of states, we use Huber-White standard errors instead of clustering at the state level.

Figure A.4 — Distributions of Placebo Estimates of the Effect of the Colorado Family Planning Initiative on Birth Rates by Age Group



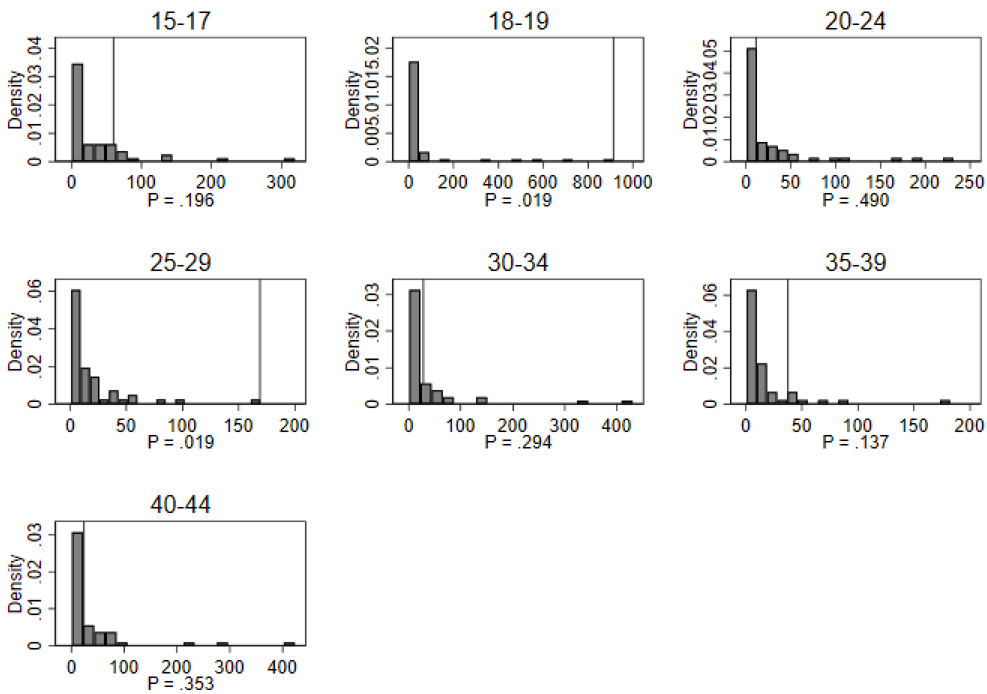
Note: This figure displays the distribution of placebo estimates of the effect of the Colorado Family Planning Initiative on birth rates in Colorado and the other 49 states and the District of Columbia. Within each histogram, the vertical line represents the true estimate on Colorado. The age group being analyzed is displayed at the top of each graph, while the the p-value, which compares the rank of the Colorado estimate to the total number of estimates, is displayed at the bottom of each histogram.

Figure A.5 — Distributions of Placebo Estimates of the Effect of the Colorado Family Planning Initiative on First Birth Rates by Age Group



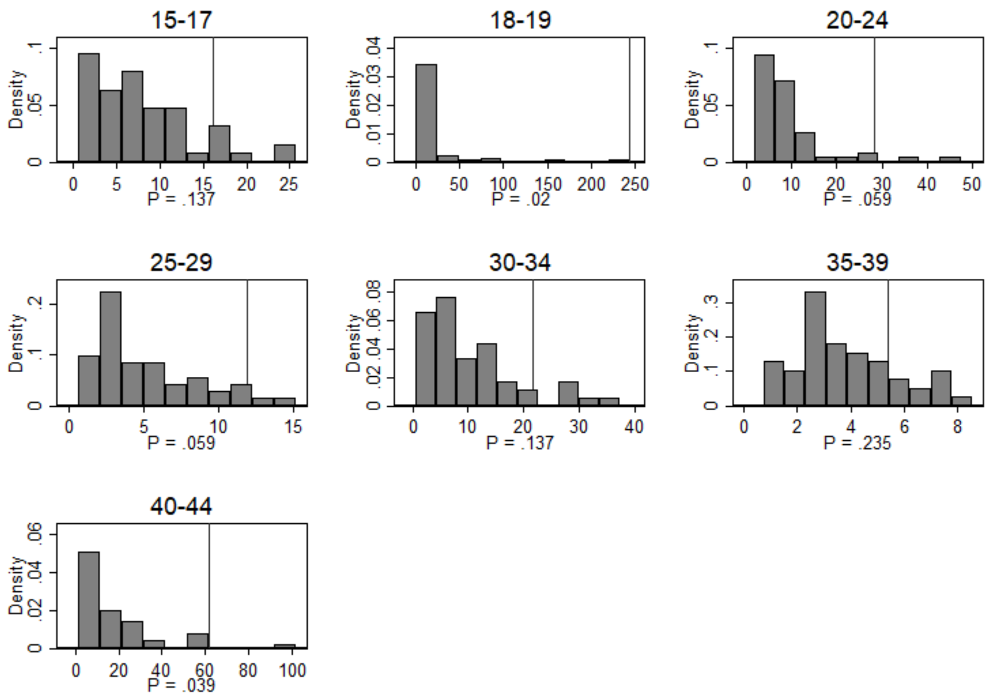
Note: This figure displays the distribution of placebo estimates of the effect of the Colorado Family Planning Initiative on first birth rates in Colorado and the other 49 states and the District of Columbia. Within each histogram, the vertical line represents the true estimate on Colorado. The age group being analyzed is displayed at the top of each graph, while the the p-value, which compares the rank of the Colorado estimate to the total number of estimates, is displayed at the bottom of each histogram.

Figure A.6 — Distributions of Placebo Estimates of the Effect of the Colorado Family Planning Initiative on Non-First Birth Rates by Age Group



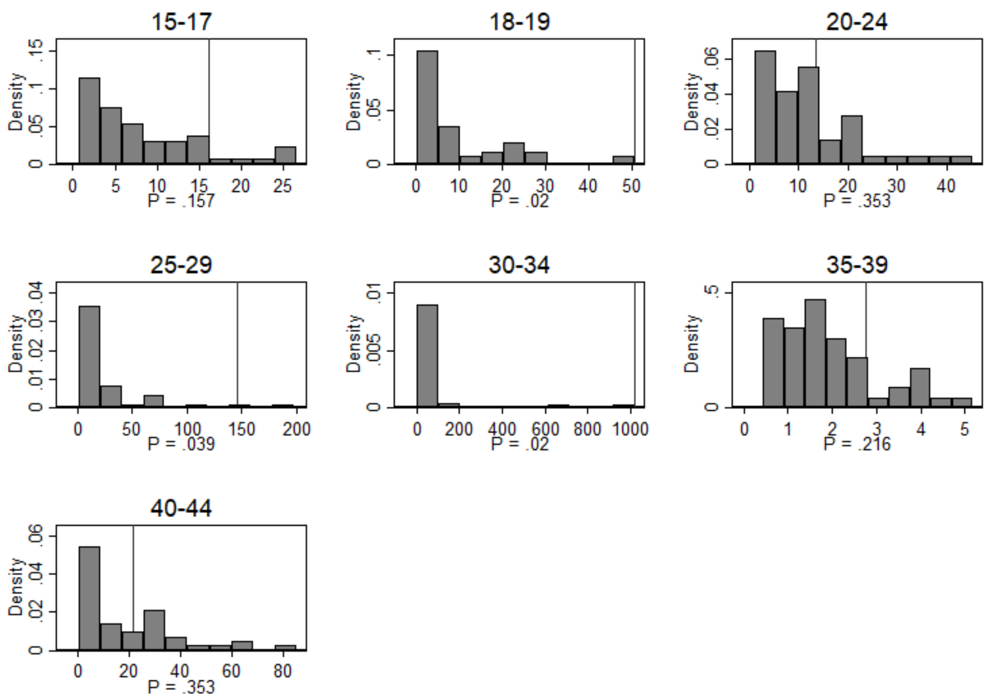
Note: This figure displays the distribution of placebo estimates of the effect of the Colorado Family Planning Initiative on non-first birth rates in Colorado and the other 49 states and the District of Columbia. Within each histogram, the vertical line represents the true estimate on Colorado. The age group being analyzed is displayed at the top of each graph, while the the p-value, which compares the rank of the Colorado estimate to the total number of estimates, is displayed at the bottom of each histogram.

Figure A.7 — Distributions of Placebo Estimates of the Effect of the Colorado Family Planning Initiative on Birth Rates by Age Group - Adjusted to Prevent Vanishingly Small Pre-Treatment RMSPE Fits



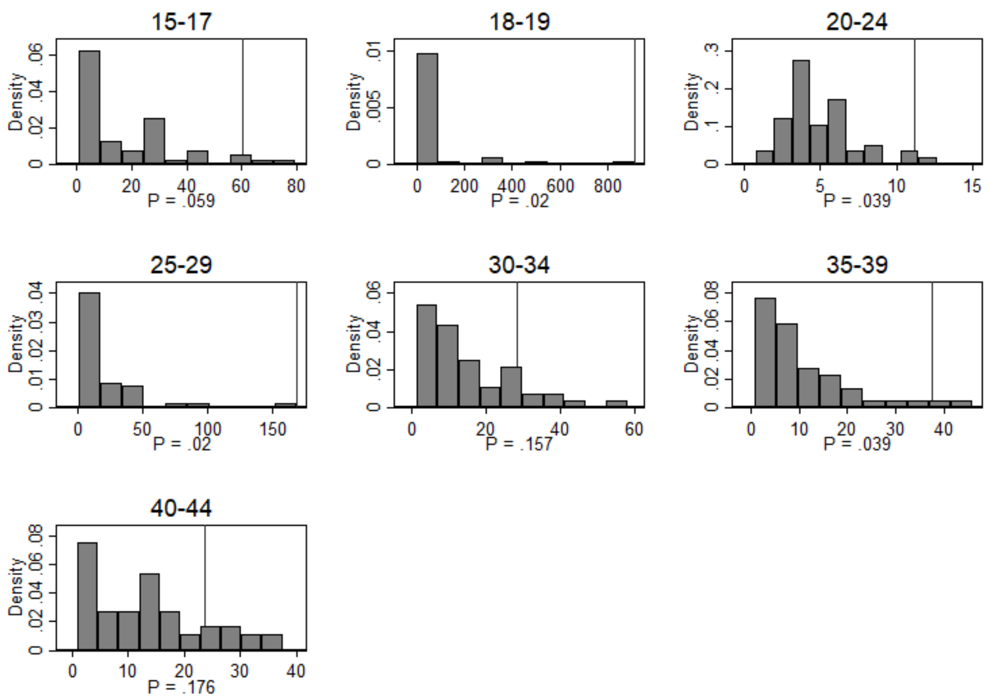
Note: This figure displays the distribution of placebo estimates of the effect of the Colorado Family Planning Initiative on birth rates in Colorado and the other 49 states and the District of Columbia. Within each histogram, the vertical line represents the true estimate on Colorado. The age group being analyzed is displayed at the top of each graph, while the the p-value, which compares the rank of the Colorado estimate to the total number of estimates, is displayed at the bottom of each histogram. The placebo estimates are adjusted so that the Colorado pre-treatment RMSPE is the lowest, preventing vanishingly small pre-treatment RMSPE fits from causing pre-post RMSPE ratios from tending towards infinity.

Figure A.8 — Distributions of Placebo Estimates of the Effect of the Colorado Family Planning Initiative on First Birth Rates by Age Group - Adjusted to Prevent Vanishingly Small Pre-Treatment RMSPE Fits



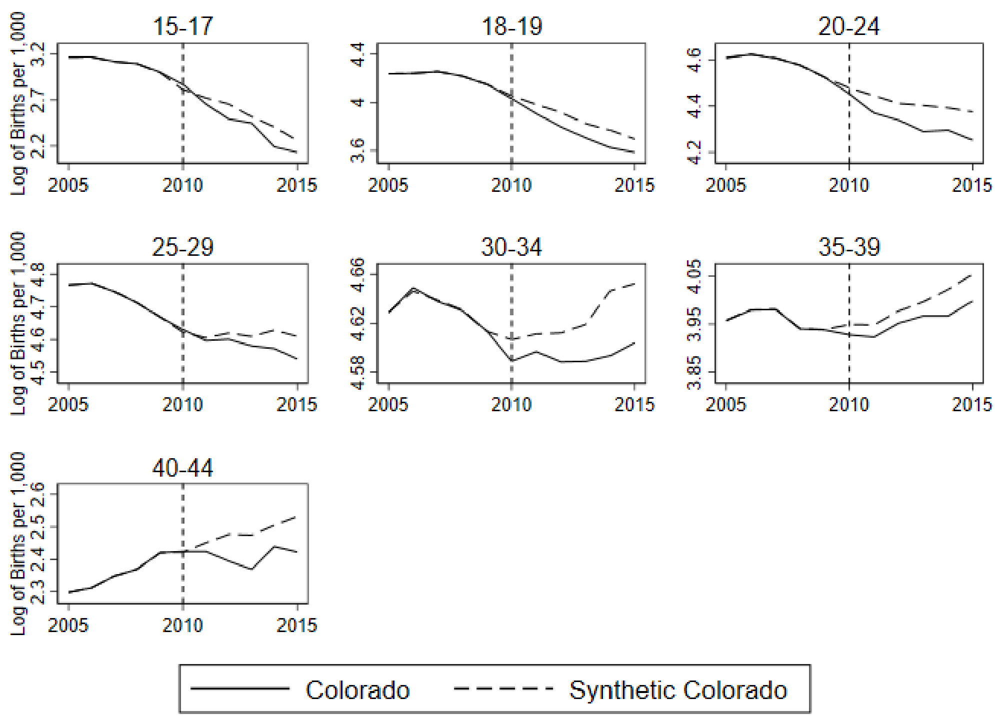
Note: This figure displays the distribution of placebo estimates of the effect of the Colorado Family Planning Initiative on first birth rates in Colorado and the other 49 states and the District of Columbia. Within each histogram, the vertical line represents the true estimate on Colorado. The age group being analyzed is displayed at the top of each graph, while the the p-value, which compares the rank of the Colorado estimate to the total number of estimates, is displayed at the bottom of each histogram. The placebo estimates are adjusted so that the Colorado pre-treatment RMSPE is the lowest, preventing vanishingly small pre-treatment RMSPE fits from causing pre-post RMSPE ratios from tending towards infinity.

Figure A.9 — Distributions of Placebo Estimates of the Effect of the Colorado Family Planning Initiative on Non-First Birth Rates by Age Group - Adjusted to Prevent Vanishingly Small Pre-Treatment RMSPE Fits



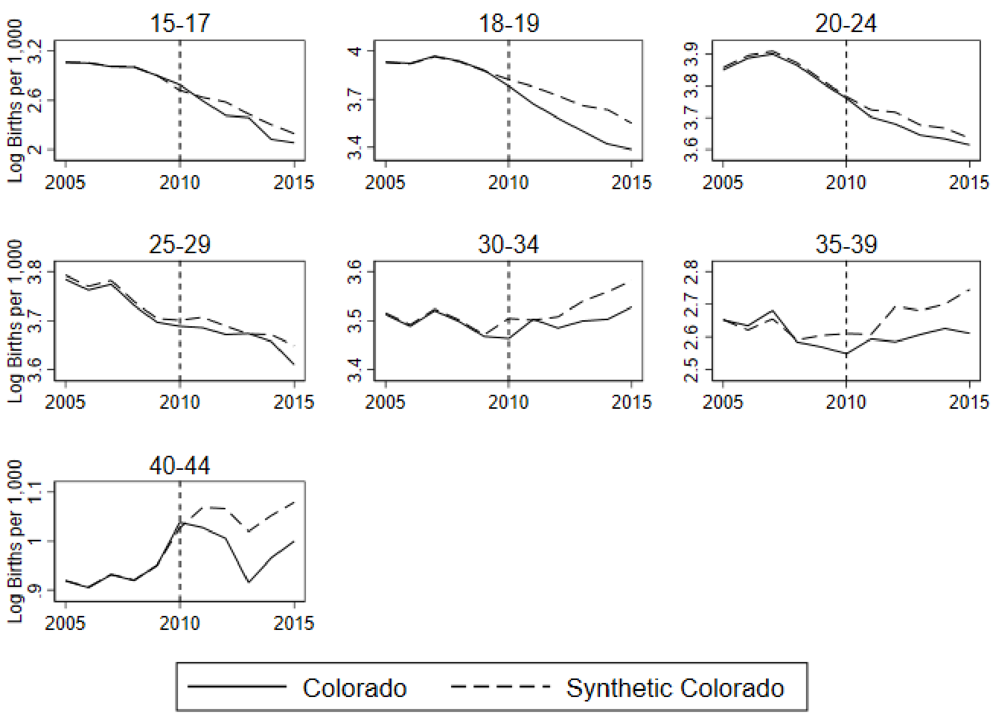
Note: This figure displays the distribution of placebo estimates of the effect of the Colorado Family Planning Initiative on non-first birth rates in Colorado and the other 49 states and the District of Columbia. Within each histogram, the vertical line represents the true estimate on Colorado. The age group being analyzed is displayed at the top of each graph, while the the p-value, which compares the rank of the Colorado estimate to the total number of estimates, is displayed at the bottom of each histogram. The placebo estimates are adjusted so that the Colorado pre-treatment RMSPE is the lowest, preventing vanishingly small pre-treatment RMSPE fits from causing pre-post RMSPE ratios from tending towards infinity.

Figure A.10 — Synthetic Control Estimates of the Effect of the Colorado Family Planning Initiative on Log of Age-Specific Fertility



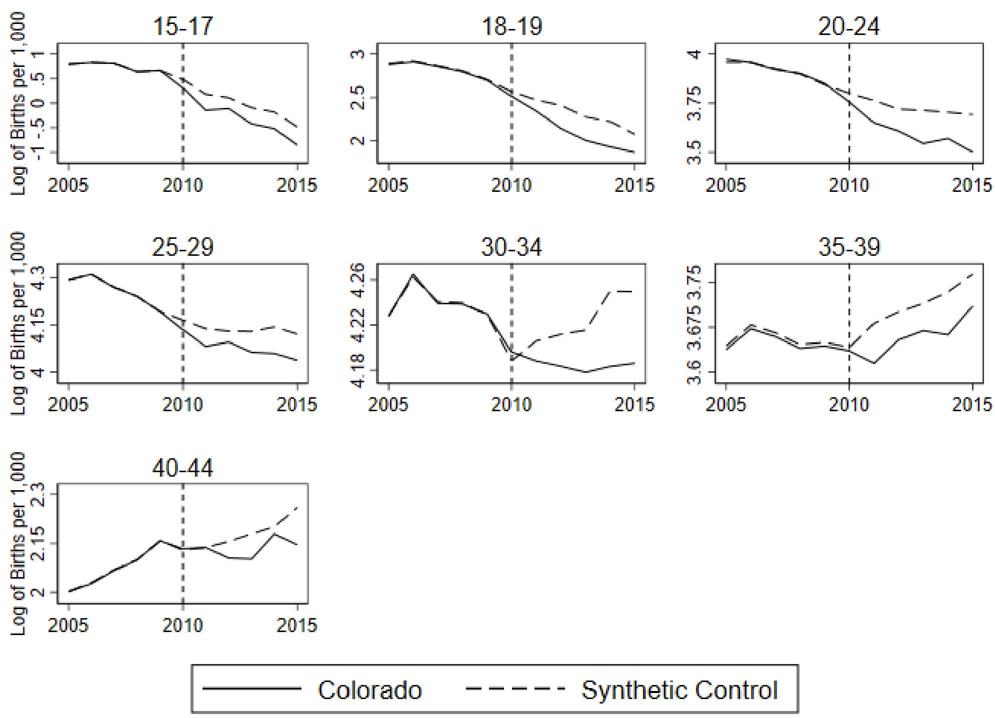
Note: This figure displays synthetic control estimates of the effect of the Colorado Family Planning Initiative on the log of the birthrate for women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each figure, the solid black line represents the trend in Colorado, while the dashed line displays trends in the synthetic version of Colorado, which is calculated as a weighted average of the other 49 states which is designed to minimize the difference in the pretreated outcome between Colorado and Synthetic Colorado.

Figure A.11 — Synthetic Control Estimates of the Effect of the Colorado Family Planning Initiative on Log of Age-Specific Fertility - First Births



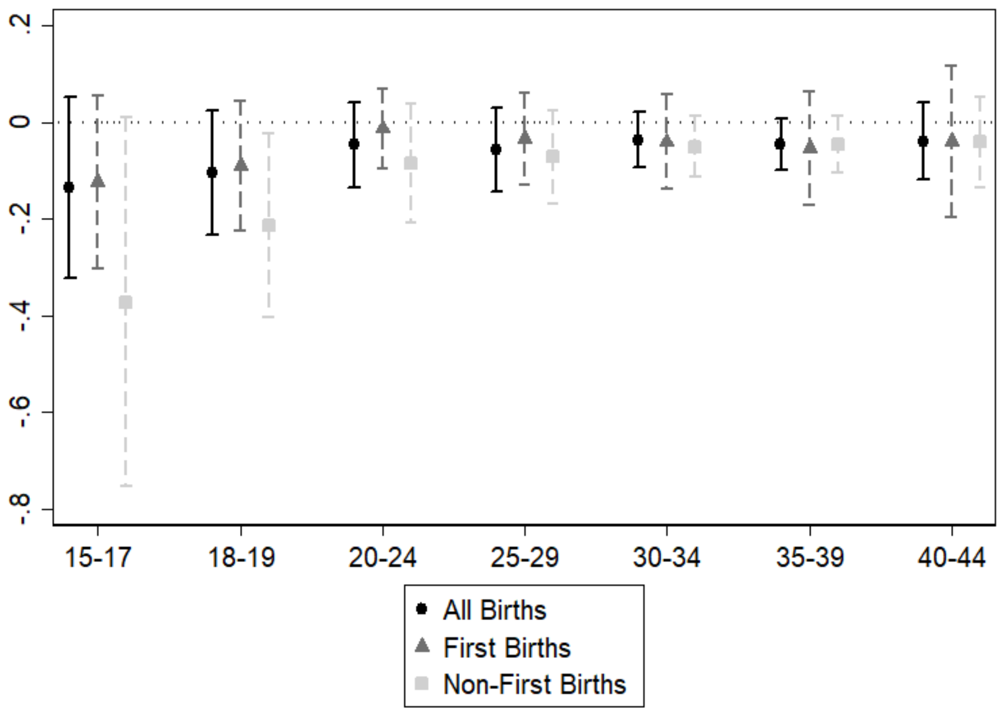
Note: This figure displays synthetic control estimates of the effect of the Colorado Family Planning Initiative on the log of the number of first births per 1,000 women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each figure, the solid black line represents the trend in Colorado, while the dashed line displays trends in the synthetic version of Colorado, which is calculated as a weighted average of the other 49 states which is designed to minimize the difference in the pretreated outcome between Colorado and Synthetic Colorado.

Figure A.12 — Synthetic Control Estimates of the Effect of the Colorado Family Planning Initiative on Log of Age-Specific Fertility - Non-First Births



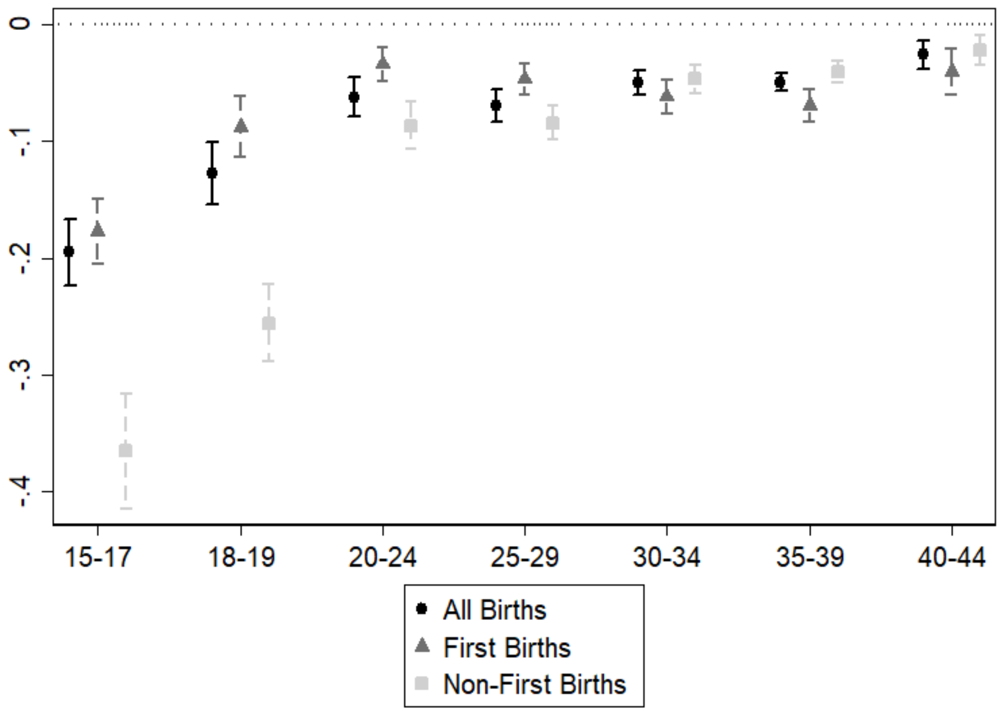
Note: This figure displays synthetic control estimates of the effect of the Colorado Family Planning Initiative on the log of the number of non-first births per 1,000 women aged 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, and 40-44 using restricted access natality data from the National Vital Statistics System. In each figure, the solid black line represents the trend in Colorado, while the dashed line displays trends in the synthetic version of Colorado, which is calculated as a weighted average of the other 49 states which is designed to minimize the difference in the pretreated outcome between Colorado and Synthetic Colorado.

Figure A.13 — Comparison of Synthetic Difference-in-Differences Estimates on the Effect of the Colorado Family Planning Initiative on the Log of Births per 1,000 Women



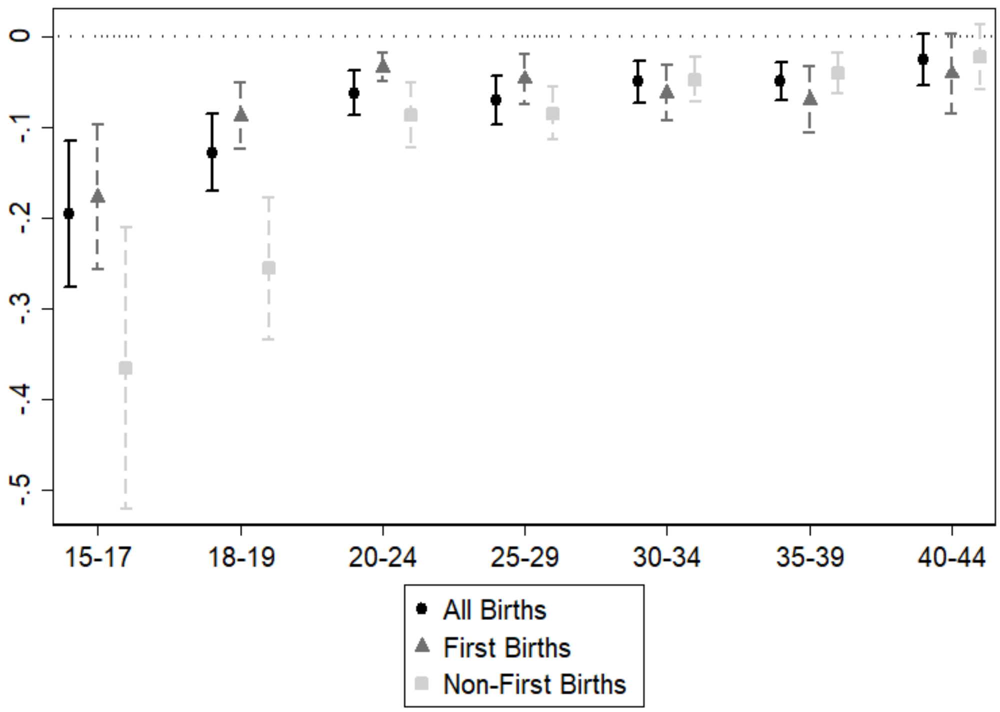
Note: This figure displays coefficient estimates from synthetic difference-in-differences (SDiD) specifications on the effect of the Colorado Family Planning Initiative on the log of the birthrate in each age group. Within each age group, the first coefficient represents the effect on all births, along with 95% confidence intervals. The second coefficient represents the effect on first births, while the third coefficients represents the effect on non-first births. Confidence intervals are calculated using the placebo method with 1,000 repetitions

Figure A.14 — Comparison of Difference-in-Differences Estimates on the Effect of the Colorado Family Planning Initiative on the Log of Births per 1,000 Women Using the Entire US as a Control Group - Standard Errors Clustered at the State Level



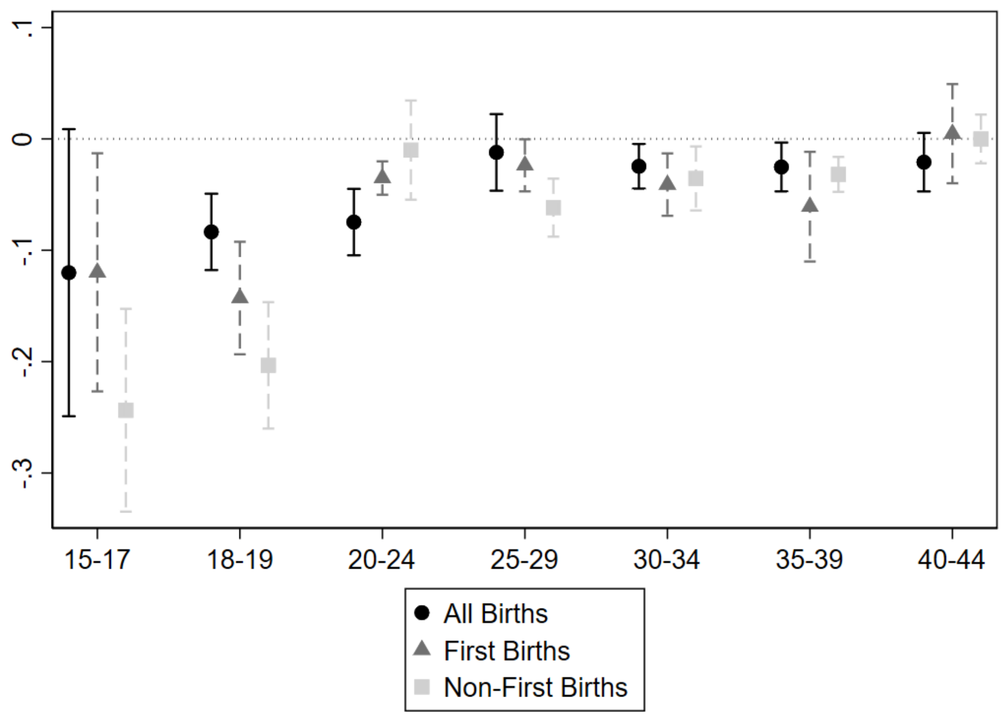
Note: This figure displays coefficient estimates from difference-in-differences specifications on the effect of the Colorado Family Planning Initiative on the log of the birthrate in each age group, using the entire United States as a control group. Within each age group, the first coefficient represents the effect on all births, along with 95% confidence intervals. The second coefficient represents the effect on first births, while the third coefficients represents the effect on non-first births. Standard errors are clustered at the state level.

Figure A.15 — Comparison of Difference-in-Differences Estimates on the Effect of the Colorado Family Planning Initiative on the Log of Births per 1,000 Women Using the Entire US as a Control Group - Huber-White Standard Errors



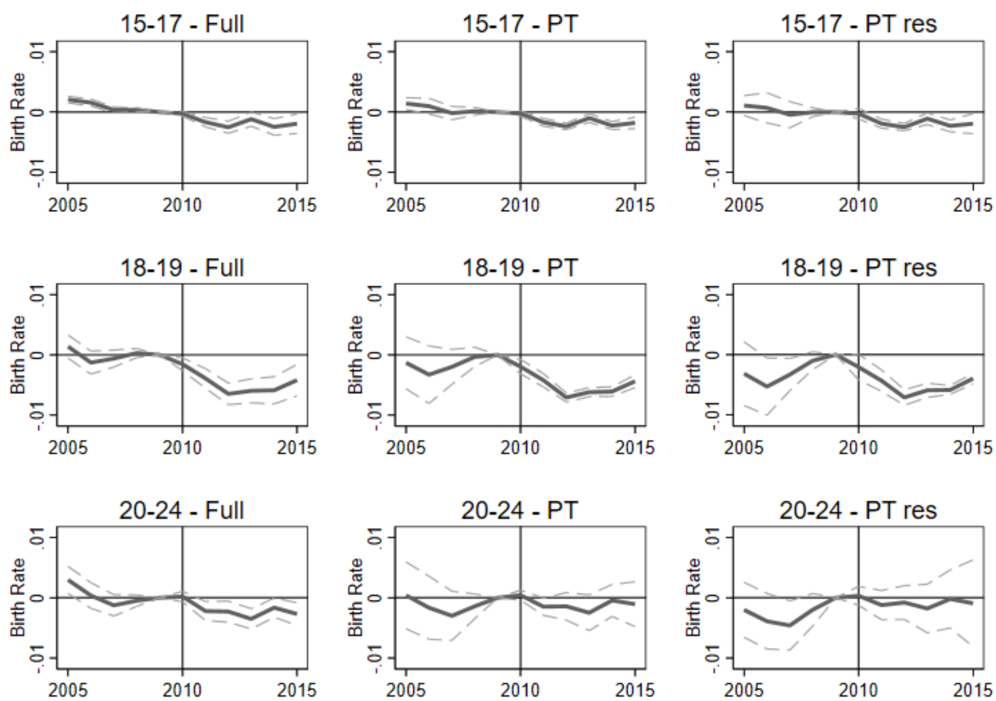
Note: This figure displays coefficient estimates from difference-in-differences specifications on the effect of the Colorado Family Planning Initiative on the log of the birthrate in each age group, using the entire United States as a control group. Within each age group, the first coefficient represents the effect on all births, along with 95% confidence intervals. The second coefficient represents the effect on first births, while the third coefficients represents the effect on non-first births. Estimates displayed using Huber-White standard errors

Figure A.16 — Comparison of Difference-in-Differences Estimates on the Effect of the Colorado Family Planning Initiative on the Log of Births per 1,000 Women - Including 2009 as Treated



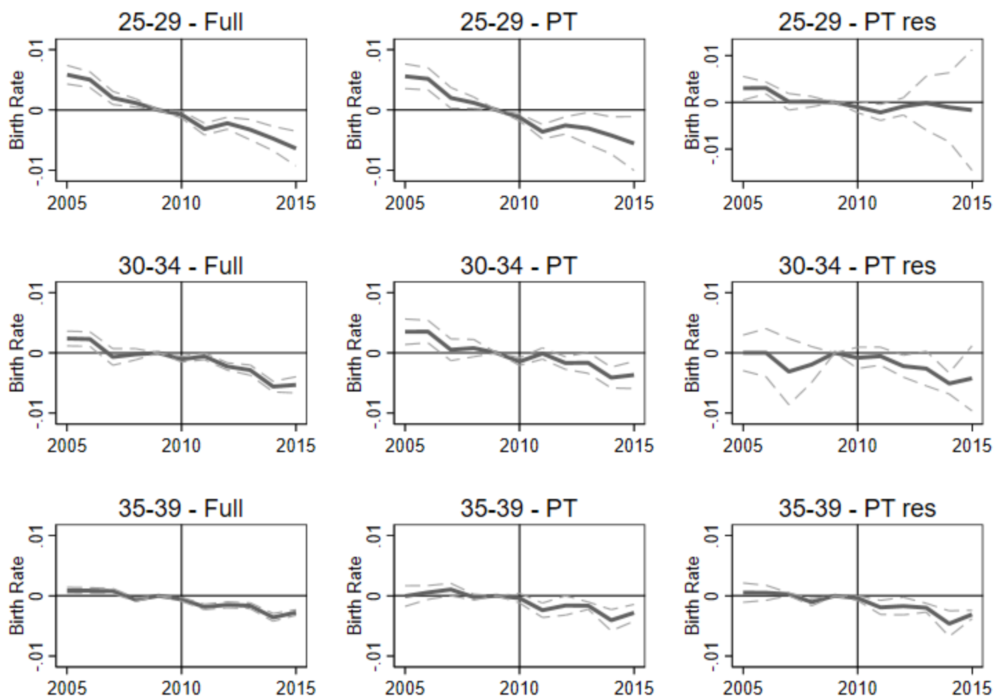
Note: This figure displays coefficient estimates from difference-in-differences specifications on the effect of the Colorado Family Planning Initiative on the log of the birthrate in each age group, where 2009 is included as a 'treated' year. Within each age group, the first coefficient represents the effect on all births, along with 95% confidence intervals. The second coefficient represents the effect on first births, while the third coefficients represents the effect on non-first births. Estimates displayed using Huber-White standard errors

Figure A.17 — Event-Studies for 15-17, 18-19, and 20-24-Year-Old Age Groups



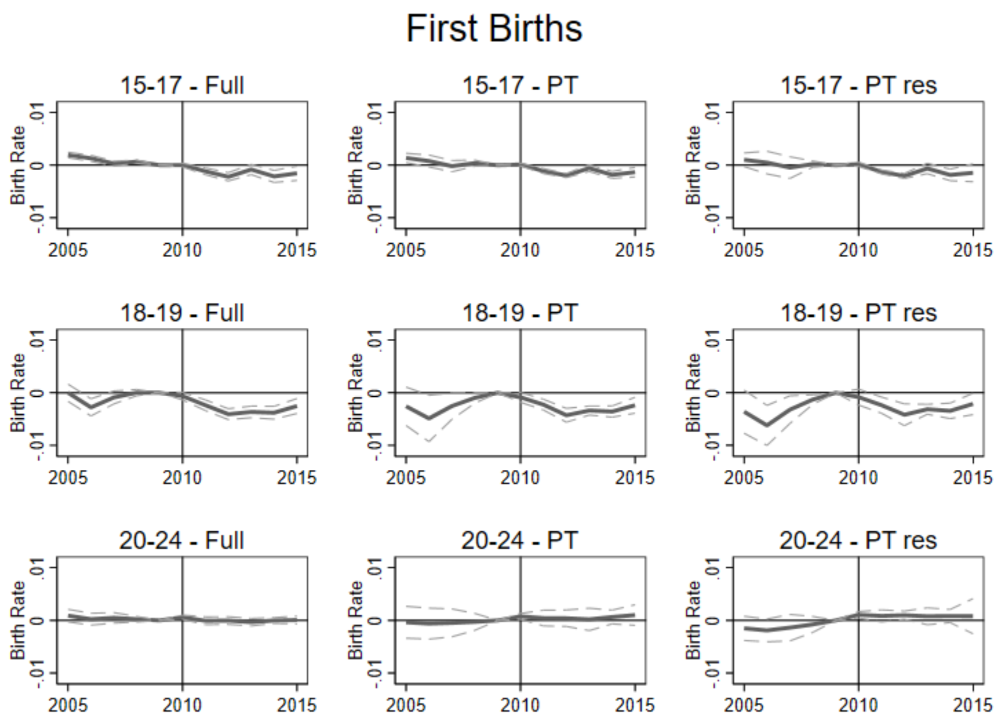
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative (CFPI) on overall fertility for the 15-17, 18-19, and 20-24-year-old groups. The left column displays the estimate when compared to all US states, the middle column displays the estimate when compared to a group of states which did not differ significantly from Colorado in level or trend in the years leading up to the CFPI for that particular age group, and the right column displays estimates when compared to a group of states (California, Delaware, Florida, and Illinois) which did not differ significantly from Colorado in level or trend across all age groups. Standard errors are clustered at the state level

Figure A.18 — Event-Studies for 25-29, 30-34, and 35-39-Year-Old Age Groups



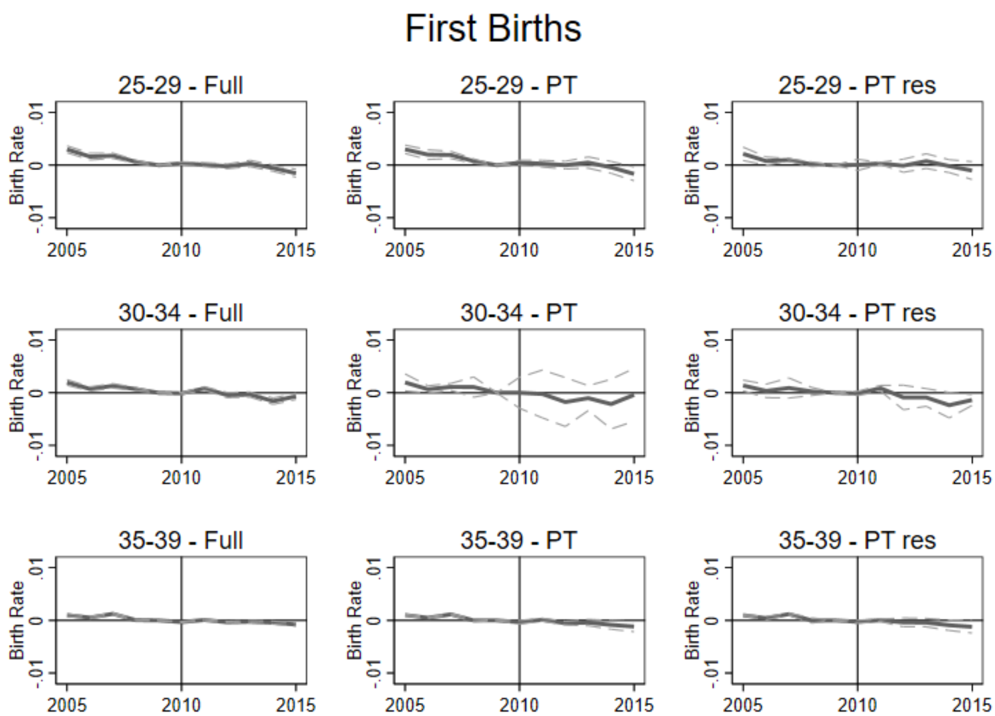
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative (CFPI) on overall fertility for the 25-29, 30-34, and 35-39-year-old groups. The left column displays the estimate when compared to all US states, the middle column displays the estimate when compared to a group of states which did not differ significantly from Colorado in level or trend in the years leading up to the CFPI for that particular age group, and the right column displays estimates when compared to a group of states (California, Delaware, Florida, and Illinois) which did not differ significantly from Colorado in level or trend across all age groups. Standard errors are clustered at the state level

Figure A.19 — First-Birth Event-Studies for 15-17, 18-19, and 20-24-Year-Olds



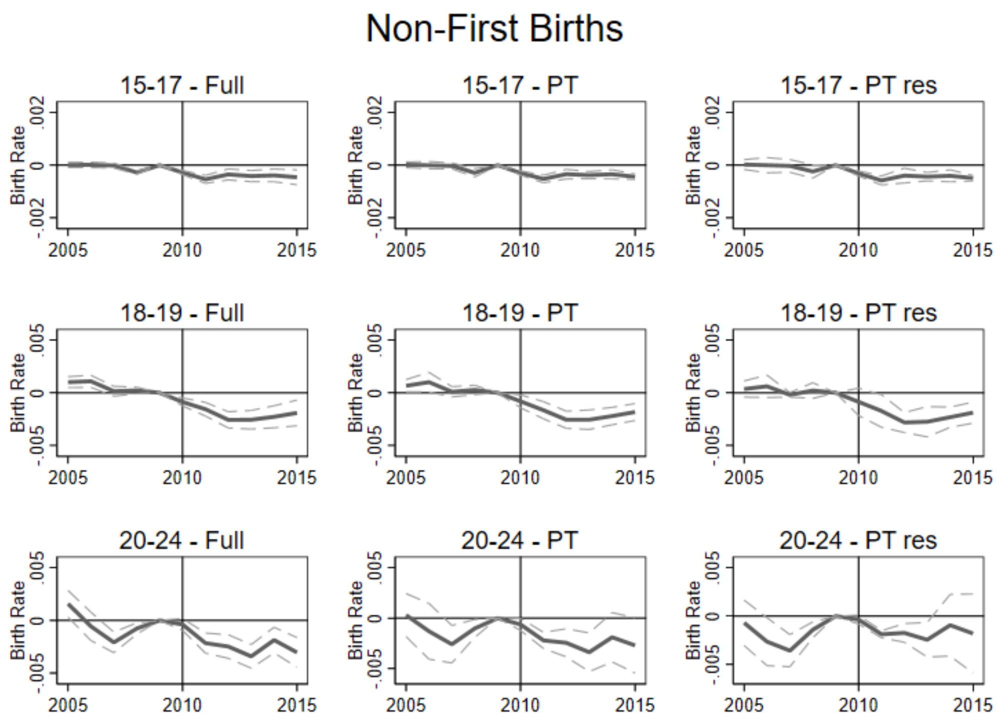
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative (CFPI) on the rate of first births for the 15-17, 18-19, and 20-24-year-old groups. The left column displays the estimate when compared to all US states, the middle column displays the estimate when compared to a group of states which did not differ significantly from Colorado in level or trend in the years leading up to the CFPI for that particular age group, and the right column displays estimates when compared to a group of states (California, Delaware, Florida, and Illinois) which did not differ significantly from Colorado in level or trend across all age groups. Standard errors are clustered at the state level

Figure A.20 — First Birth Event Studies for 25-29, 30-34, and 35-39-Year-Olds



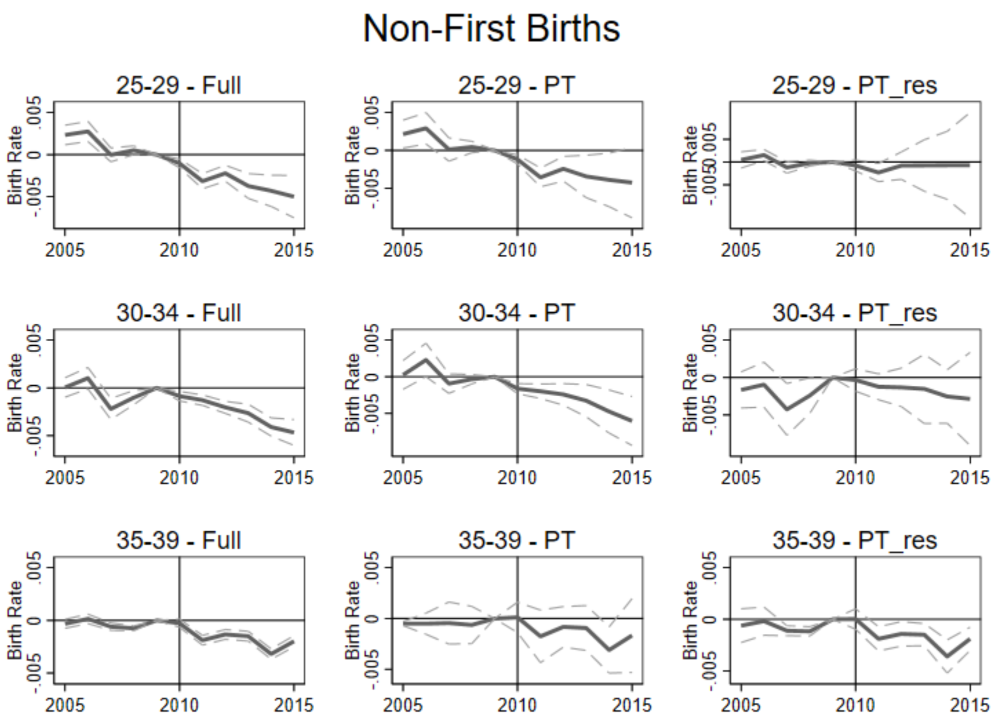
Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative (CFPI) on the rate of first births for the 25-29, 30-34, and 35-39-year-old groups. The left column displays the estimate when compared to all US states, the middle column displays the estimate when compared to a group of states which did not differ significantly from Colorado in level or trend in the years leading up to the CFPI for that particular age group, and the right column displays estimates when compared to a group of states (California, Delaware, Florida, and Illinois) which did not differ significantly from Colorado in level or trend across all age groups.

Figure A.21 — Non-First Birth Event Studies for 15-17, 18-19, and 20-24-Year-Olds



Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative (CFPI) on the rate of non-first births for the 15-17, 18-19, and 20-24-year-old groups. The left column displays the estimate when compared to all US states, the middle column displays the estimate when compared to a group of states which did not differ significantly from Colorado in level or trend in the years leading up to the CFPI for that particular age group, and the right column displays estimates when compared to a group of states (California, Delaware, Florida, and Illinois) which did not differ significantly from Colorado in level or trend across all age groups.

Figure A.22 — Non-First Birth Event Studies for 25-29, 30-34, and 35-39-Year-Olds



Note: This figure displays event-study estimates of the effect of the Colorado Family Planning Initiative (CFPI) on non-first births for the 25-29, 30-34, and 35-39-year-old groups. The left column displays the estimate when compared to all US states, the middle column displays the estimate when compared to a group of states which did not differ significantly from Colorado in level or trend in the years leading up to the CFPI for that particular age group, and the right column displays estimates when compared to a group of states (California, Delaware, Florida, and Illinois) which did not differ significantly from Colorado in level or trend across all age groups.

Table A.1 — Weights for Synthetic Control Method for Specifications Estimating the Effect of the Colorado Family Planning Initiative on Birthrates by Age.

15-17		*18-19*		*20-24*		*25-29*		*30-34*		*35-39*		*40-44*	
St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.
AZ	.362	TN	.331	MI	.553	WY	.276	CT	.468	CT	.285	NY	.354
ME	.344	CT	.166	NV	.180	DC	.213	ME	.200	NJ	.244	DE	.232
HI	.170	DE	.114	WY	.155	VT	.195	OR	.182	NE	.228	SD	.080
NM	.124	IN	.047	DC	.113	ND	.138	NE	.119	VT	.116	WA	.043
		KS	.033			NH	.098	VT	.031	MT	.111	DC	.036
		RI	.021			MI	.008			AK	.025	IA	.029
		NY	.019			IL	.007			DC	.003	ND	.016
		ND	.019			OR	.003			NH	.001	TX	.014
		WI	.017			FL	.003					OR	.011
		MA	.013			RI	.003					ID	.001

Note: This table displays the top ten states which received the most weight in each of the the synthetic control method (SCM) specifications estimating the effect of the Colorado Family Planning Initiative (CFPI) on birthrates by age group. For each set of columns, the first column displays the states which received weight, ordered by how much weight they received. When more than ten states received positive weight, we only display the ten states which received the most weight.

Table A.2 — Weights for Synthetic Control Method for Specifications Estimating the Effect of the Colorado Family Planning Initiative on First Birthrates by Age.

15-17		*18-19*		*20-24*		*25-29*		*30-34*		*35-39*		*40-44*	
St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.
AZ	.481	TN	.33	RI	.145	GA	.314	DE	.286	CT	.369	CT	.347
ME	.249	ND	.2	CA	.113	CT	.282	MD	.156	RI	.302	WV	.119
NE	.145	RI	.144	ND	.105	RI	.275	NH	.153	NH	.251	DC	.091
AK	.122	MT	.079	AZ	.088	NH	.093	RI	.14	DC	.078	RI	.029
NM	.003	HI	.072	UT	.052	ND	.036	MA	.11			NV	.018
		DE	.054	NV	.042			WY	.024			MD	.018
		KS	.008	GA	.039			NJ	.01			CA	.015
		NE	.007	DC	.023			MN	.006			HI	.014
		OH	.007	IL	.022			NY	.006			DE	.013
		NH	.007	PA	.017			DC	.005			GA	.013

Note: This table displays the top ten states which received the most weight in each of the the synthetic control method (SCM) specifications estimating the effect of the Colorado Family Planning Initiative (CFPI) on birthrates by age group. For each set of columns, the first column displays the states which received weight, ordered by how much weight they received. When more than ten states received positive weight, we only display the ten states which received the most weight.

Table A.3 — Weights for Synthetic Control Method for Specifications Estimating the Effect of the Colorado Family Planning Initiative on Nonfirst Birthrates by Age.

15-17		*18-19*		*20-24*		*25-29*		*30-34*		*35-39*		*40-44*	
St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.	St.	Wgt.
RI	.283	AK	.253	MI	.745	OR	.669	OR	.469	AK	.202	NY	.487
NM	.217	GA	.246	WY	.179	HI	.139	NE	.239	UT	.125	WY	.442
AZ	.079	AZ	.046	GA	.062	MT	.082	ME	.130	DC	.095	DC	.039
MT	.041	NY	.029	DC	.013	DC	.077	RI	.118	NJ	.088	HI	.029
ME	.022	VT	.025			WY	.033	GA	.044	SD	.038	SD	.003
IN	.021	MA	.022							ND	.031		
WV	.020	RI	.021							NE	.302		
OR	.015	CT	.018							CA	.018		
VA	.011	NH	.016							NY	.016		
DE	.011	NJ	.015							MA	.016		

Note: This table displays the top ten states which received the most weight in each of the the synthetic control method (SCM) specifications estimating the effect of the Colorado Family Planning Initiative (CFPI) on nonfirst birthrates by age group. For each set of columns, the first column displays the states which received weight, ordered by how much weight they received. When more than ten states received positive weight, we only display the ten states which received the most weight.

B. Alternative Control Group Specifications

For each age group, we estimate equation (1) using three separate control groups. First, we compare trends in Colorado to those in the rest of the United States. Second, we restrict the sample to a group of 'parallel trends' states which are not significantly different from Colorado on either level or trends from 2005-2009 for that particular age group. Third, we further restrict the sample to those states which are included in the parallel trends group for all age groups. This restricted parallel trends group consists of California, Delaware, Florida, and Illinois.

Figure A.17 displays estimates using each of our three alternative control groups for the 15-17, 18-19, and 20-24-year-old age groups. For 15-17-year-olds, there is a slight downward trajectory in pre-trends for the full sample, but no similar concerns for the other two control groups. Following CFPI, there are small but statistically significant declines of about 1.5-2.5 births per 1,000 women. This is compared with a base rate of 20.2 births per 1,000 women prior to 2010, representing an overall decline of 7.4-12.4%. Results are consistent across the control groups. For 18-19-year-olds, each specification displays a decline of about 4 births per 1,000 women in 2011, which increases to between 5.0 and 6.0 between 2012-2014. This is off a base rate of 63.4 births per 1,000 women prior to 2010, and thus represents a decline of 7.8-9.4%. It is somewhat comforting that the declines for the 15-17 and 18-19 age groups fall within the 6-9% decline estimated for the teen birth rate in Lindo and Packham (2017). Parallel trends for this age group actually look most reasonable when compared to the full US, though pre-trends are also insignificant for the age-specific parallel trends group. Pre-trends actually show a slight increase from 2006 to 2009 for the restricted parallel trends states, although the point estimates are similar following the CFPI.

Overall, there appears to be less happening in the 20-24-year-old group. When compared to the full US, there does appear to be a small decline of 2-3.5 births per 1,000 women, which increases towards the end of the sample. This is now against a base rate of 92.3 birth, and so only represents a 2.2-3.8% reduction. For both the parallel trends and restricted parallel trends specifications, there appears to be a slight increase in the pre-period, and then no statistically significant changes following the introduction of the CFPI.

Figure A.18 repeats this exercise for the 25-29, 30-34, and 35-39-year-old groups. Looking at the 25-29-year-old group, for both the full US and parallel trends groups there is a large decline following treatment, but it mostly looks like a continuation of the downward trend that existed prior to the CFPI. For the restricted parallel trends group, pre-trends are relatively flat, and although the confidence intervals are large, there appears to be little to no treatment effect. For the 30-34-year-old group, there is little movement prior to 2009, then a decrease which grows over time, though this effect is dampened in the PT and restricted PT specifications. In all three specifications, there is a reduction by 2012 of 1.6-2.2, or 1.6%-2.2% of the base rate of 100.8. By 2015, this reduction has increased in magnitude to 4.4-5.6. The 35-39-year-old group is similarly quiet pre-CFPI but then trends downward after 2009. In all three specifications, the decline is roughly 1.5 births per 1,000 women by 2012, and 3.5 in 2015. With a base rate of 51.3 births per 1,000 women, these represent declines of about 2.9% and 6.8%, respectively.

In order to understand how fertility was impacted across parity levels, Figures A.19 through A.22 repeat the exercise above, focusing first on live births for any particular mother and then all subsequent births. Figure A.19 displays the estimates on first births for 15-17, 18-19, and 20-24-year-old mothers while Figure A.20 displays the same estimates for 25-29, 30-34, and 35-39 year-old mothers. The decline in first births to 15-17-year-old mothers is roughly 1.5 births per 1,000 women for the years 2011-2015, which is slightly smaller than the average treatment effect for the sample as a whole. Compared with a base rate of 18.2 first births per 1,000 women, this represents a decline of 8.4%.

Figure A.21 displays the same estimates for non-first births. While the point estimates for 15-17-year-olds are somewhat smaller, averaging a 0.4-0.6 birth decline in non-first births across the 15-17-year-old age group, the base rate for this group is much smaller still. In 2009, there were only 1.9 non-first births per 1,000 women, compared with 21 first births. The 0.4-0.6 birth per 1,000 women decline represents a 20-29% decrease.

Looking at the 18-19-year-old group, all three specifications show a decline in first births of 3.0-3.5 births per 1,000 women from 2012-2014, though this effect decreases in later years. Compared to a base rate of 48.5 births per 1,000 women, this represents a decline of about 6.2-7.2%. Once again, the decline for non-first births is smaller in magnitude, though starting from a much smaller base rate. The decline in non-first births ranged between 2-2.7 across the three specifications. The base rate for non-first births was only 14.9, however, so this represents a decline of 14-18%.

Similar to when the model was estimated on all births, the estimates on first births show virtually no treatment effect on 20-24-year-olds, there is relatively little change in first births, but a significant decline in non-first births. Finally, the 35-39-year-old group displays significant reductions in both first and non-first births. Interestingly, among all age groups and across all three specifications, the decline in fertility in response to the CFPI appears larger among non-first births than among first births.