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ABSTRACT

Contraceptive Access Creates Positive Selection in Infant Health*

This paper documents an important unintended consequence of expanding contraceptive access; namely that it creates positive selection in the health of the children being born. I use a family planning intervention which gave thousands of long-acting reversible contraceptives to reproductive-age women in the St. Louis metropolitan area as a source of plausibly exogenous variation in contraceptive access to demonstrate that it reduced the rates of both extremely preterm births and infant mortality. I use both a synthetic control and synthetic difference-in-differences design, with my most conservative estimates suggesting that this program led to reductions of 2.5 extremely preterm births and 1.3 infant deaths per 1,000 live births across St. Louis County, reductions of approximately 23% and 15% respectively. I find large reductions for both Black and White mothers, with Black mothers experiencing a greater reduction in magnitude, but smaller reductions as a percentage of the baseline rate.

JEL Classification: J13, I18, I12

Keywords: contraceptive access, infant mortality, preterm birth, family planning

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1. Introduction

In a concurring opinion to the landmark 2022 Supreme Court Decision in *Dobbs vs. Jackson Women's Health Organization*, Justice Clarence Thomas suggested the need to revisit the 1965 decision in *Griswold vs. Connecticut*, which affirmed the right of married couples to use contraception (Salganicoff and Ranji (2023)). In the wake of the Dobbs decision, conservative lawmakers have discussed and proposed legislation aimed at restricting access to intrauterine uterine devices (IUDs) in Idaho, Arkansas, Louisiana, Missouri, and Michigan (Sullivan (2024)). On June 5, 2024, Senate Republicans blocked a bill which would have enshrined a federal right to access contraception, despite the bill having bipartisan support.[1] Given the uncertainty in the current regulatory environment around contraceptive access, it is vital that researchers and policymakers understand the full scope of ramifications which may occur if contraceptive access is limited.

This paper sheds light on one important unintended consequence of *expanding* contraceptive access; namely that it creates positive selection in the health of the children being born and that the effects are larger for Black mothers, who are more susceptible to adverse infant health outcomes at baseline. Put differently, when women are given autonomy over their reproductive lives, the women who choose to opt out of becoming pregnant and having a baby are precisely the ones who were most likely to suffer an adverse outcome if they were to give birth. I demonstrate this by using a program led by medical researchers at Washington University in St. Louis as a source of plausibly exogenous variation in contraceptive access. This program distributed thousands of long-acting reversible contraceptives (LARCs) to women in the St. Louis area between 2007 and 2011. Using the synthetic difference-in-differences method of Arkhangelsky et al. (2021), I find that this program led to large reductions in extremely preterm births and infant mortality for both Black and White mothers in St. Louis County, with significantly larger reductions for Black mothers.

My estimates suggest that this program led to reductions of 2.5 extremely

[1]The bill received support from the majority of the Senate at 51-39, but needed to receive at least 60 votes to overcome the filibuster.

preterm births (EPBs), or births which occur before 28 weeks of gestation, and 2.0 infant deaths per 1,000 live births, reductions of approximately 23% off of the base rates for both outcomes. In each case, Black mothers experience much larger declines in raw magnitude, with estimates indicating a reduction of 3.8 extremely preterm births and 3.3 infant deaths per 1,000 live births, compared with reductions of 2.2 extremely preterm births and 1.4 infant deaths for White mothers. However, due to the large disparities which exist at baseline across racial groups, these reductions are actually larger for White mothers as a percentage of baseline levels. Regardless, these results indicate that expanding contraceptive access creates positive selection in the health of the children being born for both Black and White mothers.

A number of important papers have demonstrated the broad-ranging ways in which giving women autonomy over their reproductive lives can have positive impacts on the next generation. There is a substantial literature which tracks infants exposed to legal abortion access in utero into adulthood, finding that exposed cohorts exhibit lower levels of criminal behavior,[2] are less likely to experience a teen pregnancy (Donohue, Grogger, et al. (2009)), are less likely to engage in drug use (Charles and Stephens (2006)), and are more likely to graduate college (Ananat, Gruber, et al. (2009)). Others have looked specifically at the ways in which access to family planning services impacts the overall health of the children who are ultimately born, with a series of studies finding that abortion access reduces the infant mortality rate.[3]

Ananat and Hungerman (2012) look instead at the effect of expanding access to the birth control pill, leveraging variation in when the pill became accessible to single women in different states to look at how it shifted the compositional health of the children being born. In contrast to abortion access, they find that the introduction of the pill increased the share of children born with low birthweight and the share of children whose families were receiving welfare in the short run. This occurred because the pill was not cheap and was rarely covered by insurance,

[2] Donohue and Levitt (2001), Donohue and Levitt (2008), Donohue, Grogger, et al. (2009), Donohue and Levitt (2020), and François et al. (2014)

[3] Grossman and Jacobowitz (1981), Corman and Grossman (1985), Joyce (1987), Gruber et al. (1999), and Pabayo et al. (2020)

which means it was mainly available to more upwardly mobile women who were less likely to suffer adverse infant health outcomes if they had gotten pregnant. These effects balanced out in the long run, because women used the pill mainly to delay rather than avoid pregnancy, enabling them to pursue more stable relationships and better educational and economic outcomes before choosing to have children.

Flynn (2024) looked at how the Colorado Family Planning Initiative (CFPI), a privately-funded family planning program which gave free LARCs to mostly low-income women in Colorado created positive selection in the health of the children being born. That program led to reductions of 0.9 EPBs and 1.1 infant deaths per 1,000 live births. Interestingly, this paper did not find impacts on average birth weight or weeks of gestation, suggesting that LARC access does not shift the overall distribution of births, but rather has potential to reduce the rare but tragic events in the tail of the distribution by allowing the women who are most vulnerable to these outcomes to avoid pregnancy altogether.

A major shortcoming of this paper was the inability to examine heterogeneous treatment effects by race, as approximately 91% of births in Colorado are to White mothers. Tragically, Black mothers suffer infant deaths at roughly 2.4 times the rate of White mothers (Jang and Lee (2022)), which suggests that an intervention which expands contraceptive access to a more diverse community could have a much larger positive impact on infant health outcomes than the CFPI. This paper builds on this literature by examining the effect of the St. Louis Contraceptive CHOICE Project on infant health. As over 30% of births in St. Louis County are to Black mothers and over half of the participants in CHOICE were Black, this program offers an important opportunity to investigate the heterogeneous treatment effects of expanding contraceptive access. I find that not only did this program lead to large reductions in adverse infant health outcomes for all mothers, but that the results were consistently larger in magnitude for Black mothers.

This is also an important contribution because it suggests that the reductions reduction documented in Flynn (2024) are in fact due to the increase in contraceptive access and not some other idiosyncrasy of the CFPI, as these two interventions were very different from one another. The CFPI was funded by an anonymous donor and operated through the Colorado Department of Public Health and Environment by expanding access at Title X family planning clinics throughout the state. CHOICE, on the other hand, was funded as part of a research project by academics at Washington University in St. Louis and implemented entirely within the St. Louis region. The fact that they occurred in different years, were implemented in different ways, and served different populations, but both led to reductions in adverse infant health outcomes approximately 1-2 years after implementation suggests that it is in fact the LARC access, and not some other piece of either of the two programs or some confounding population-level change that is important for creating positive selection in infant health outcomes.

The rest of this paper will proceed as follows. Section two will give background information on LARCs generally as well as the CHOICE Project. Section three outlines my identification strategy for estimating the effect of CHOICE on infant health outcomes in St. Louis County. Section four displays my results, while section five performs a back-of-the-envelope calculation on how many LARCs were needed to prevent each EPB and infant death and then concludes.

2. Background

2.1. Long-Acting Reversible Contraceptives

Long-Acting Reversible Contraceptives (LARCs), which include subdermal hormonal implants and intrauterine devices, are the most effective forms of reversible contraception available. They are as effective as sterilization (Kumari (2016)), with failure rates up to 20 times lower than pills, patches, and rings (Curtis and Peipert (2017)). They are greater than 99% effective and reliably prevent pregnancy for anywhere from three to 10 years (CDPHE (2017)). Once a LARC is inserted, it is virtually immune to user error, meaning that its effectiveness does not depend on the patient remembering to take a daily pill or install a barrier method. Other methods have much higher failure rates, even when used perfectly, and they are also much more susceptible to the risk of user error (Trussell (2004)). This suggests that an intervention which increases LARC usage has the potential to greatly increase the overall effectiveness of the contraception being used, even if the patients who receive LARCs were contracepting using another method prior to the intervention.

Despite the many benefits of LARC use, only 3.8% of reproductive-age women in the United States were using LARCs between 2006-2010 (Branum and Jones (2015)). LARCs had been significantly more popular in the 1970s before a number of safety concerns led to a large decline in use (Cleland et al. (2012)). Improved devices were approved during the 1990s and interest had rebounded somewhat, but the public remained somewhat skeptical of their safety. In addition to the valid safety concerns from earlier devices, a series of misconceptions about LARCs were prevalent. These included the beliefs that LARCs caused infertility (Hubacher et al. (2001)), osteoporosis (Bahamondes et al. (2010)), and even cancer (Castellsague and Diaz (2011)), among others. There are also real side effects and risks with the procedure, including menstrual irregularities, acne, and weight gain (Russo et al. (2013)). An often under-appreciated cost of LARC uptake is that the procedure itself is painful (Callahan et al. (2019)). According to Narayan et al. (2018), adolescents who received IUDs reported higher pain than they anticipated from the insertion, though even after the procedure 78% of users still claimed they would recommend the IUD to others.

In addition to these concerns, cost is likely the most important barrier to LARC use. This is unfortunate as LARCs are often the most cost effective form of contraception in the long run, but they come with a high upfront cost of up to $800 (CDPHE (2017)) which many women cannot afford, leading them to choose less effective, more expensive methods.[4] Numerous studies have documented an unmet demand for LARCs, with cost consistently being the most frequently cited barrier to adoption (Henke et al. (2020), Burke et al. (2020), Potter et al. (2014)). A recent randomized-controlled trial by Bailey et al. (2023) found that offering vouchers which cover 100% of the cost of LARC methods increased their utilization by 324%. A number of other studies have looked at interventions which remove the cost bar-

[4]For example, oral contraceptives can cost around $50 a month, which would mean that an $800 LARC would be cheaper as long as it remained in place for 16 months. If it was used for the full 10 years, it would cost less than 14% of the total cost of the oral contraceptive over the same period.

rier to LARC use, generally finding that they dramatically increase use (Ricketts et al. (2014), M. Biggs et al. (2015), Birgisson et al. (2015)). In addition to increasing takeup, programs which expand LARC access have also been shown to reduce the teen birth rate (Lindo and Packham (2017), Kelly et al. (2020)) and increase female high school and college completion (Stevenson et al. (2021), Yeatman et al. (2022)).

2.2. *St. Louis Contraceptive CHOICE Project*

In 2007, researchers based at Washington University in St. Louis launched the St. Louis Contraceptive CHOICE Project (henceforth CHOICE) in order to study the contraceptive choices women make when cost and access barriers are removed and they are educated about the benefits of different contraceptive methods.[5] The privately-funded study enrolled 9,256 women aged 14-45 in the St. Louis metropolitan area who had been sexually active in the past six months or planned to be sexually active in the next six months, wanted to avoid pregnancy for at least a year and were interested in trying a new form of contraception.[6] The program was designed to remove the high upfront cost barrier which prevented many women from choosing LARCs, to educate patients on the various misconceptions which often made them less likely to want LARCs, and to provide access to the devices through medically trained professionals. The women were all read a script describing LARC methods, were counseled on the full range of contraceptive methods available and were screened for STIs.

Once the participant chose a contraceptive method and it was approved by a physician, she received it at no cost for up to three years, and was allowed to change methods at any point. 75% of the participants chose a LARC method, which means that approximately 7,000 LARCs were inserted between 2007-2011. This translates to one LARC for every 28.9 women aged 15-44 in St. Louis County in 2006. For comparison, the Colorado Family Planning Initiative inserted 36,762

[5]My discussion of CHOICE draws heavily from McNicholas et al. (2014), Secura et al. (2014), and Birgisson et al. (2015)

[6]The full list of conditions on participation was that the women needed to (1) be between 14-45 years of age (2) reside in the St. Louis region; (3) speak English or Spanish; (4) be interested in contraception; (5) have been sexually active with a male partner in the past six months or expect sexual activity in the next six months; (6) desire to avoid pregancy; (7) not be currently using contraception or be interested in starting a new reversible method.

LARCs across Colorado from 2009-2015 (CDPHE (2017)), which translates to roughly one LARC for every 27.6 women aged 15-44 in the state in 2009. Participants who chose LARCs reported higher continuation rates than those who chose other methods at 12 (87% vs. 57%) and 24 (77% vs. 41%) months, and LARC uptake did not result in greater sexual risk taking behavior, as measured by the number of sexual partners. Birgisson et al. (2015) found that CHOICE led to a population-level reduction in the number of repeat abortions in St. Louis compared with Kansas City, and Secura et al. (2014) found the program led to reductions in teen pregnancies, births, and abortions, with the largest reductions occurring for young Black women.

3. Methodology and Data

3.1. Data

In order to estimate the effect of the St. Louis Contraceptive CHOICE Project on infant health outcomes, I use restricted-access data from the National Vital Statistics System (NVSS) which include the universe of birth records occurring in the United States from 2004-2013. The records include the number of weeks of gestation, which I use to calculate whether the birth was deemed 'extremely preterm'. They also include the county of residence, which I mark as treated if the mother lived in St. Louis County, where the CHOICE project was based, when she gave birth. These data also include the race and ethnicity of the mother, which I will use to explore heterogeneous treatment effects. Finally, in the tragic case of an infant death, the birth records are linked to the infant death record, which allows me to observe not only whether or not a death resulted from a specific birth, but also the cause of death. I use this data to calculate county-wide rates of both EPBs and infant mortality for each year in the data.

Table 1 displays summary statistics for births in St. Louis versus the rest of the United States for 2006, the year before the CHOICE Project began. The table motivates my use of synthetic control methods, as births in St. Louis County are very different, on average, from births in the rest of the country. Births in St. Louis

County are much more likely to result in an extremely preterm birth or an infant death, and they have gestational lengths which are .22 weeks shorter. Mothers in St. Louis County are about a year older on average, and are less likely to be a teen mother. They are also less likely to be White or Hispanic, more likely to be Black, and more likely to be married than other mothers in the U.S. All of these differences are significant at the 1% level.

3.2. Empirical Strategy

I estimate the effect of CHOICE on infant health outcomes using both the Synthetic Difference-in-Differences (SDID) method of Arkhangelsky et al. (2021) and the Synthetic Control Method (SCM) of Abadie and Gardeazabal (2003) and Abadie, Diamond, et al. (2010). These methods offer different strengths and weaknesses for estimating the treatment effect in this setting which are largely complementary. In general, synthetic methods are ideal for settings with a comparative case study such as this one, where a single unit is treated at a specific time, but where the correct choice of a control unit is non-obvious. These methods select a control group from the possible set of controls (the donor pool) by solving an optimization problem which seeks to minimize the squared distance between the treated and control group on a set of parameters of the researcher's choosing. This distance is minimized by selecting a set of non-negative weights for each unit in the donor pool, such that the weighted average of all the units in the donor pool is as close as possible to the treated group. The SDID further builds on this strategy by also choosing weights which minimize the squared difference in trends between the treatment and control group. In this case, I match on the pre-treated outcomes themselves, finding a control group that mirrors St. Louis County as closely as possible for EPBs and infant mortality from 2004-2007. I then compare the evolution of St. Louis County with its synthetic version in the years following the CHOICE Project in order to estimate the effect of the program. The key underlying assumption is the standard difference-in-difference assumption that absent the intervention, St. Louis County would have continued to evolve similarly to its synthetic version in the post-treatment years.

The biggest shortcomings of the SCM method in this setting are that when the pretreatment match is weak, the estimator can be biased, and that the matching algorithm only matches on the levels of the chosen variables and not the trends. As mentioned above, the SDID method of Arkhangelsky et al. (2021) improves on both of these shortcomings by choosing weights which minimize the squared difference in trends between the treatment and control group, subject to a regularization parameter which prevents overfitting. In addition, SDID also introduces a set of time-period weights which underweight unusual values of the control group in the pre-period. The main shortcoming of the SDID approach in my setting with only one treated unit is that the preferred methods of conducting inference, the bootstrap and jackknife-based approaches are either unreliable or undefined. Arkhangelsky et al. (2021) therefore offer a 'placebo' method for conducting inference, where standard errors are calculated by iteratively replacing the treated group with a group from the donor and using the noise in the placebo predictions to build confidence intervals. This approach relies on an assumption that the error distribution in the treated and control groups has equal variance, which is untestable with realized data.

In order to conduct inference for the SCM , I implement a randomization inference similar to the one performed in Cunningham and Shah (2018), which has the same basic strategy as the placebo method of conducting inference for SDID. First, I estimate a placebo synthetic control for each unit in the donor pool, assuming that it was treated in 2007 instead of St. Louis. I then use the weights from each iteration and estimate the standard difference-in-differences specification below on that county:

$$y_{ct} = \beta_0 + \beta_1 * Post_t * Treat_c + \delta_t + \gamma_c \tag{1}$$

Where y_{ct} is the infant health outcome measure in time t for county c. $Post_t$ takes a value of one in all years greater than 2007, while $Treat_c$ is an indicator for whether county c is designated as the treated county in that particular specification. I also include county (γ_c)and year (δ_t) fixed effects. This procedure results in a distribution of placebo estimates. In the results section, I will refer to the resulting estimate from this procedure as the 'DID' estimate. I then compare the value of the estimate for St. Louis to the distribution of placebos. If the intervention did in fact lead to a large change in the outcome of interest, the true treatment effect should be much larger than the average 'placebo' treatment effect. I then order the coefficients in decreasing order of magnitude and estimate the p-value for St. Louis as $\frac{Rank}{N}$.

Because of the complementary strengths and weaknesses of the two approaches, I present estimates using both strategies. In cases where the SCM pretreatment match is close, the results from the two strategies are largely consistent, though they tend differ where the SCM pretreatment match is weak, and therefore susceptible to bias.

A major benefit of both of these approaches is that they minimize the number of subjective choices made by the researcher. The one exception to this is in the choice of the donor pool. Since St. Louis County is one of the largest metropolitan areas in the country, it does not make sense to include small rural counties in the donor pool, as they have small numbers of annual births causing rates of rare adverse infant health outcomes to vary wildly. I therefore exclude from the donor pool all counties which have less than 10,000 births in any year of the sample. This leaves me with 66 potential control counties, which are all large population centers like St. Louis. When I estimate the effect of CHOICE on infant health outcomes for Black mothers, I further exclude any counties with less than 1,000 annual births to Black mothers, which leads me to drop an additional 14 counties. There are therefore 66 donor counties for the full sample, and 52 donor counties for Black mothers. A map of the counties which are included in the full donor pool is displayed in Appendix Figure A.1, and a list of the 14 counties which are included in the full donor pool but excluded from the donor pool for Black mothers is displayed in Appendix Table A.1.

4. Results

Figure 1 displays a time series for both the number of extremely preterm births and infant deaths for every 1,000 live births in St. Louis County compared with the rest of the United States.[7] There is a clear break in trend which occurs in 2008, with a reduction of between 2.5 and 3 instances per 1,000 live births. No similar reductions occur across the rest of the United States, where EPBs are stable throughout the period between 7.3 and 7.7 instances per 1,000 live births. Infant deaths are steadily declining in the U.S. throughout the sample period, but at a much slower rate than what we see in St. Louis in 2008. Infant deaths across the U.S. decline from 6.35 per 1,000 live births in 2004 to 5.53 in 2013, with the largest single year reduction occuring between 2010 and 2011, where they decline by 0.23 infant deaths per 1,000 live births, from 5.94 to 5.71. This decline is less than one tenth of the reduction which occurs in St. Louis County from 2007 to 2008. This figure also serves to motivate my use of the synthetic approaches, as there are clear differences in both the pre-treatment level and trend for both outcomes. SDID and SCM will help provide evidence for whether the large reductions which occur in 2008 in St. Louis also show up in counties which have similar infant health outcome levels and trends prior to 2007.

4.1. Synthetic Difference-in-Differences

Table 2 displays results for both infant health outcomes, first for all mothers in St. Louis County, and then separately for Black and White mothers. Each column of the table includes the point estimate along with it's standard error, as well as an indicator for which group of mother's is being examined, along with the base rate of the outcome of interest for that group of mothers from 2004-2007, and a calculation of the percentage change off of the base rate that is implied by the point estimate. Figure 2 displays the corresponding SDID graph to go with each specification in Table 2. In each graph in the figure, the vertical line represents the year that CHOICE began, the solid time-series represents the outcome of interest for mothers in St. Louis County, while the dashed time series represents the synthetic comparison group. The gray area in the bottom left corner of each graph represents the time weights for the pre-treatment years, which generally show that the SDID method weighted years closer to the intervention the highest.

[7] Iowa and Colorado are both excluded from the comparison, as they both received interventions which increased LARC access in this period

In all six cases, the CHOICE Project is associated with large reductions in the outcome of interest, with each estimate being statistically significant at the 5% level, though there is substantial heterogeneity. Column one indicates that for all mothers in St. Louis County, there is an estimated reduction of 2.534 EPBs per 1,000 live births, which represents an approximate 23% reduction off of the base rate of 11.02. The top left graph of 2 demonstrates that trends between the treated and control group closely mirrored one another prior to CHOICE, but that trends in the control group remained flat or even weakly increased after 2007 while EPBs in the treated group plummeted.

Column two displays the SDID estimate for only Black mothers, and the point estimate of -3.756 is nearly 50% larger than the estimate for all mothers. This estimate actually represent a smaller percentage change off of the baseline rate (16.9% compared with 23.0%), due to the fact that Black mothers experienced EPBs at over double the rate of all mothers prior to CHOICE. The standard error on this estimate is larger due to the fact that there is more variation in EPBs across births to Black mothers overall, but the estimate is still significant at the 5% level. The middle-left graph in Figure 2 shows that, as with all mothers, trends for Black mothers in St. Louis County closely mirrored the synthetic version up to the intervention, after which trends in the control group stayed level while EPBs in St. Louis declined. Column three displays the estimate for White mothers, and the result is smaller in magnitude but more precisely estimated due to the smaller standard error. CHOICE was associated with a reduction of 2.155 EPBs per 1,000 births to White mothers in St. Louis County, which represents a 35.4% reduction off of the base rate of 6.08.

Columns 4-6 repeat columns 1-3 with the rate of infant deaths per 1,000 live births replacing EPBs on the left-hand side, with the same overall pattern emerging. There are large, economically meaningful, statistically significant declines for all three groups, with all three estimates significant at the 5% leevel. The point estimate of -3.272 for Black mothers is the largest, 60% larger than the estimate of -2.044 for all mothers and 140% larger than estimate of -1.357 for White mothers. Still, the reductions for White mothers are the largest as a percentage of the baseline rates, due to the fact that infant deaths are much rarer for White mothers to begin with.[8]

Appendix A displays the same results, instead the SCM instead of SDID. The results are broadly similar, with significant reductions for all groups, which are larger in magnitude for Black mothers and larger as a percentage of the base rates for White mothers. Where there is discordance between the two sets of estimates, it is generally where the pretreatment fit is poor in the SCM, which has been shown to lead to biased estimates.

5. Discussion and Conclusion

5.1. Back of the Envelope Calculations

It is worth considering whether the number of LARCs distributed via CHOICE could plausibly have caused the large reductions in EPBs which I find in the previous section. The SDID estimate on all of St. Louis County suggests a reduction of 2.53 EPBs per 1,000 live births. With approximately 12,000 births per year from 2004-2007, this suggests a reduction of about 30 EPBs per year. Considering that there were approximately 7,000 LARCs inserted via CHOICE, this translates to roughly one EPB avoided for every 233 LARCs distributed. For infant deaths, the SDID estimate of 2.04 fewer deaths per 1,000 live births suggests a total reduction of 24.5 infant deaths per year, or one fewer death for every 286 LARCs distributed. This figure is actually identical to the estimate of one infant death avoided for every 286 LARCs distributed via the Colorado Family Planning Initiative by 2012 in Flynn (2024), which was the year with the largest degree of implied selection. This suggests that the overall degree of selection implied by CHOICE is larger than than for CFPI on average, but that they are both within the same ballpark. This makes sense as the participants in CHOICE were more vulnerable to these outcomes at baseline.

Looking specifically at the impact on EPBs to Black mothers, since 50.5% of CHOICE participants were Black, if they opted into LARC methods at a similar rate as other women, this would mean approximately 3,530 LARCs went to Black

[8] Black mothers in St. Louis County experienced 16.56 infant deaths per 1,000 live births from 2004-2007, compared with only 5.25 deaths per 1,000 live births for White mothers.

women. The SDID estimate from the previous section suggests a reduction of 3.76 EPBs and 3.27 infant deaths per 1,000 live births. Between 2004-2007, there were approximately 3,700 births to Black mothers in St. Louis County per year. This means that CHOICE was associated with a reduction of approximately 14 EPBs and 12 infant deaths to Black mothers each year, which translates to roughly one EPB avoided for every 252 LARCs distributed and one infant death avoided for every 294 LARCs distributed.

Looking instead at White mothers, approximately 40.8% of CHOICE participants were white, which suggests that around 2,850 LARCs went to White mothers. With around 7,800 annual births to White mothers from 2004-2007, the estimated SDID reductions of 2.15 EPBs and 1.36 infant deaths per 1,000 live births suggests that CHOICE was associated with an annual reduction of 16.8 EPBs and 10.6 infant deaths to White mothers. Comparing this to the total number of LARCs distributed to White women, this suggests that there was roughly one EPB avoided for every 170 LARCs distributed and one infant death avoided for every 269 LARCs distributed.

5.2. Conclusion

This paper investigates an important unintended consequence of expanding access to long-acting reversible contraception; namely that it creates positive selection in the health of the children being born. I use the St. Louis Contraceptive CHOICE Project, which was a privately funded program implemented by a group of researchers out of Washington University in St. Louis as a source of plausibly exogenous variation in LARC access to estimate its effect on infant health outcomes. Using both the synthetic control method of Abadie, Diamond, et al. (2010) and the synthetic difference-in-differences method of Arkhangelsky et al. (2021), I find large, sustained reductions in both extremely preterm births and infant deaths for both Black and White mothers in St. Louis County. These estimates are much larger on average than those from Flynn (2024), which looked at another intervention which provided free LARCs to low-income women in Colorado. One potential reason for why the estimates in this study are larger is that mothers in St. Louis County were more susceptible to these tragic outcomes to begin with. While mothers in Colorado suffered EPBs and infant deaths at around 6 instances per 1,000 live births prior to their LARC intervention, mothers in St. Louis suffered around 11 EPBs and 8-9 infant deaths per 1,000 live births, which suggests there may have been more room for improvement with St. Louis mothers.

Taken together, these studies demonstrate that when vulnerable women are given the autonomy to opt out of pregnancies they do not desire, the women who choose avoid getting pregnant are the ones who were most likely to suffer a tragic outcome in the first place. This suggests that given women full autonomy over their reproductive lives, whether in the guise of expanded contraceptive access or the ability to terminate unwanted pregnancies, has the potential to reduce these adverse infant health outcomes at a population level. At the very least, policymakers who are considering laws which would restrict women's access to reproductive health services should be aware of the potential unintended consequence that doing so could increase these adverse events.

There are a few potential mechanisms through which this selection effect could be operating. For one, the would-be mothers who take advantage of expanded LARC access to avoid an unwanted pregnancy could be doing so because they know their lives are not in a place where they could appropriately take care of a baby. They could be in a place where they are unable to adequately pay for the child's needs, they could be in a relationship with a potentially abusive partner whom they do not trust to co-parent with, or they could be making a number of other lifestyle choices that are not conducive to rearing a child. All of these could impact the pregnancy in a way that makes these tragic outcomes more likely. Another possibility is that the fact that a pregnancy is unwanted could be a catalyst for extremely preterm births. A key finding from the 'Turnaway Study', a decade-long longitudinal study which compared the outcomes of women who sought abortions but were either just above or just below the gestational cutoff to obtain them, found that women who desired an abortion but were turned away were at an increased risk for anxiety and other mental health problems during pregnancy (M. A. Biggs et al. (2017)). Multiple studies have shown that anxiety during pregnancy is a risk factor for early birth (Dunkel Schetter et al. (2022)), so it could well be that the fact that the pregnancy is unwanted is what ultimately leads to these adverse events.

Table 1 — Summary Statistics of Births in St. Louis County Versus the Rest of The United States - 2006

	St. Louis County	Rest of U.S.	p-value
Extremely Preterm Births	11.03	7.49	0.000
Infant Mortality	8.61	6.63	0.006
Weeks of Gestation	38.31	38.53	0.000
Mother Age	28.35	27.37	0.000
% Teenage Mothers	0.081	0.104	0.000
% White	0.635	0.777	0.000
% Black	0.312	0.155	0.000
% Hispanic	0.039	0.248	0.000
Mother Married	0.630	0.616	0.001
Observations	12,425	4,218,681	

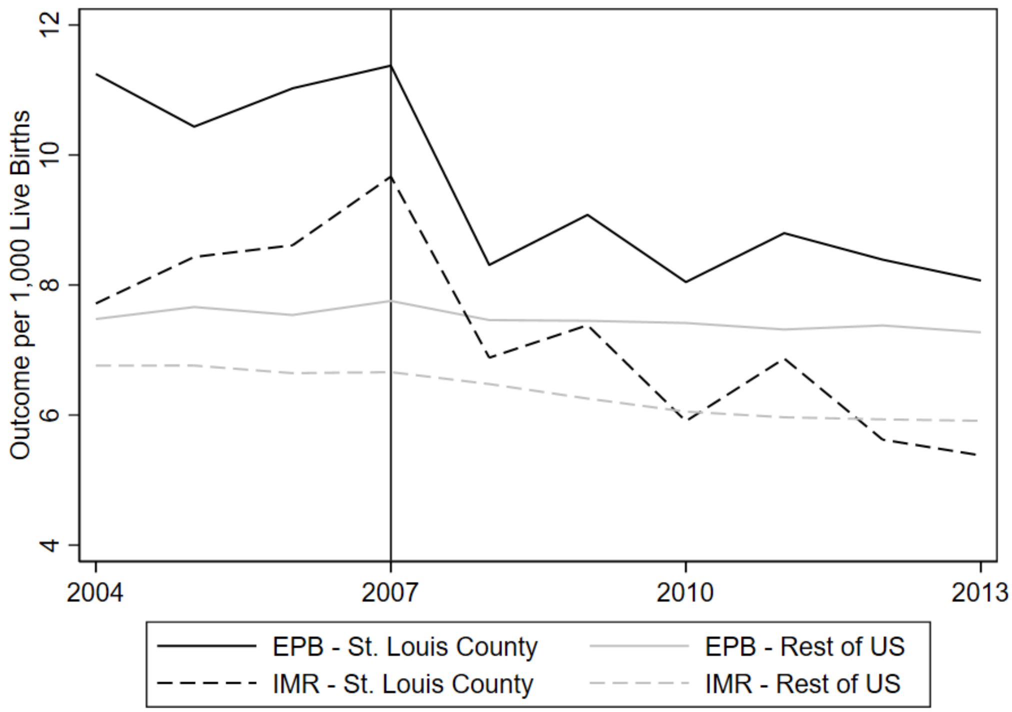
Note: This table displays summary statistics comparing St. Louis County to the rest of the United States in 2006 using data from the National Vital Statistics System (NVSS). The first column displays the mean for the 12,425 births where the mother was a resident of St. Louis County. The second column displays means for births from the rest of the United States, excluding Iowa and Colorado where there were similar LARC interventions in 2009. The third columns displays the p-value of a test of equality between the two means.

Table 2 — Synthetic Difference-in-Differences Estimates of the Effect of the CHOICE Project on Infant Health Outcomes - Broken Out by Maternal Race

	(1) EPB	(2) EPB	(3) EPB	(4) IMR	(5) IMR	(6) IMR
Treat x Post	-2.534***	-3.756*	-2.155**	-2.044***	-3.272**	-1.357*
	(0.677)	(1.724)	(0.670)	(0.551)	(1.227)	(0.577)
Mothers	All	Black	White	All	Black	White
Baseline Rate (2004-2007)	11.02	22.24	6.08	8.61	16.56	5.25
Percentage Change	-22.99%	-16.89%	-35.44%	-23.74%	-19.76%	-25.85%
Inference Method	Placebo	Placebo	Placebo	Placebo	Placebo	Placebo
Repetitions	500	500	500	500	500	500
Observations	670	530	670	670	530	670

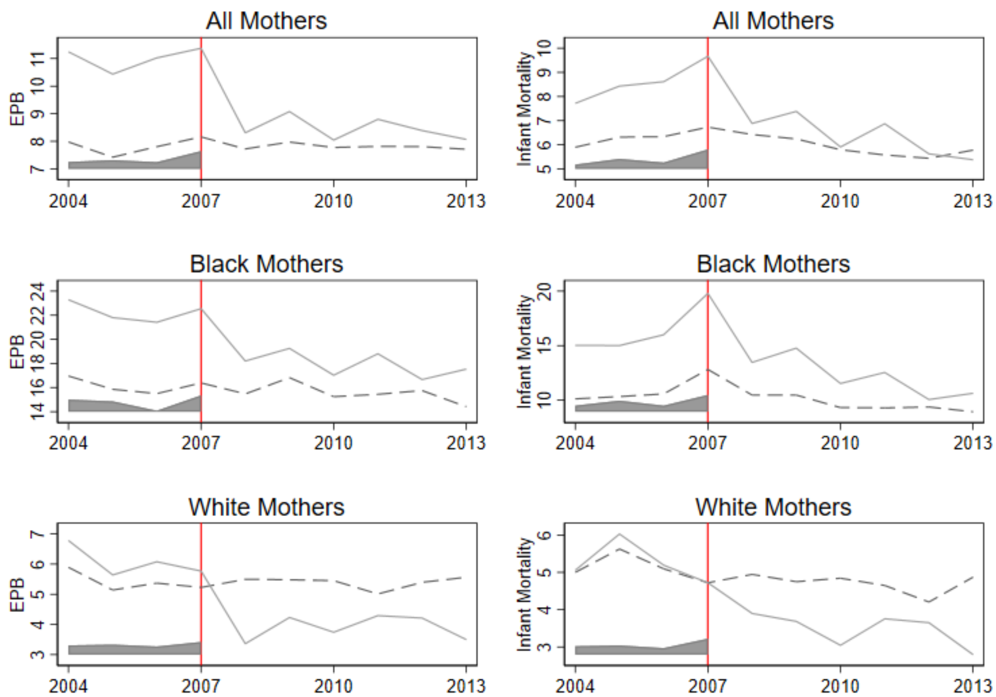
Note: This table displays synthetic difference-in-differences (SDID) estimates of the effect of the St. Louis Contraceptive CHOICE Project on infant health outcomes in St. Louis County using data from the National Vital Statistics System (NVSS). The first column displays the estimate with the number of extremely preterm births (EPBs) per 1,000 live births on the left-hand side. Columns two and three repeat this specification, only for births to Black mothers and then White mothers, respectively. Columns four through six repeat the specifications from columns one through three replacing EPBs on the left-hand side with the number of infant deaths per 1,000 live births. For each estimate, the lower half of the table includes the baseline line of the outcome of interest from 2004 to 2007, along with the estimated reduction as a percentage of the baseline rate. In all specifications, I conduct inference using the placebo method from Arkhangelsky et al. (2021), with 500 repetitions for each estimate. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1 — Time Series of Infant Health Outcomes in St. Louis County vs. the Rest of the US - 2004-2013



Note: This figure displays the time series of rates of extremely preterm births (EPBs) and infant deaths per 1,000 live births comparing St. Louis County to the rest of the United States in 2006 using data from the National Vital Statistics System (NVSS). The solid black line displays the annual rate of EPBs in St. Louis County, the dashed black line displays the annual rate of infant deaths in St. Louis county, while the solid and dashed gray lines display the same rates for the rest of the United States with the exception of Colorado and Iowa, who had similar LARC interventions in 2009. The vertical line at 2007 represents the year in which the St. Louis Contraceptive CHOICE Project began.

Figure 2 — Synthetic Difference-in-Differences Estimates of the Effect of the Contraceptive CHOICE Project on Infant Health Outcomes in St. Louis County



Note: This figure displays the synthetic difference-in-differences graphs for each of the six main specification from this paper. The left half displays the estimates on the rate of extremely preterm births, while the right half displays estimates on the rate of infant mortality. The top row displays estimates on all mothers in St. Louis County, the middle row displays estimates for Black mothers in St. Louis County, while the bottom row displays estimates for White mothers in St. Louis County.

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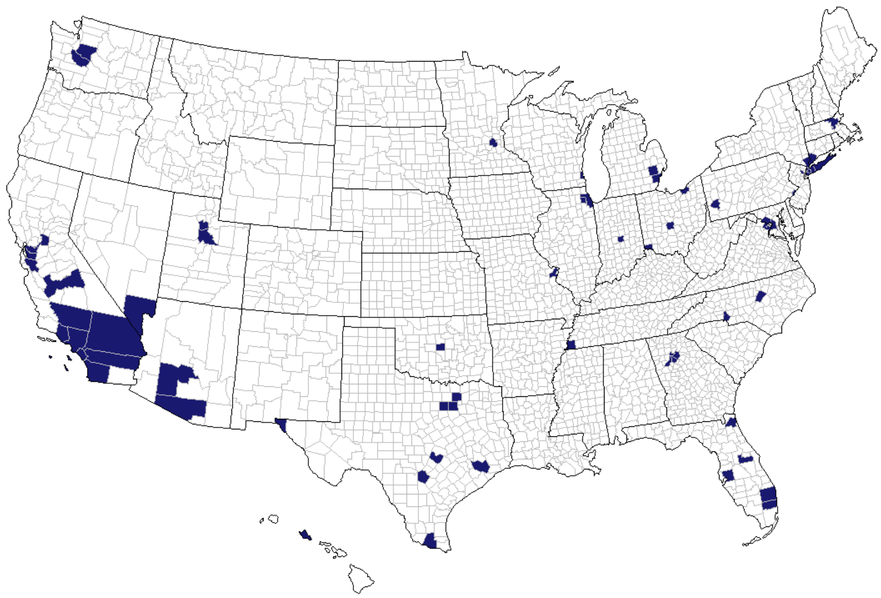
A. Online Appendix Tables/Figures (Not for Publication)

Table A.1 — List of Counties Excluded from Donor Pool Due to Having Fewer Than 1,000 Annual Births to Black Mothers

County Name	State	Min. Births	Min. White Births	Min. Black Births
Orange County	California	41,200	28,660	550
Santa Clara County	California	25,500	13,450	540
Salt Lake County	Utah	18,600	16,160	240
Hidalgo County	Texas	16,700	15,830	40
Fresno County	California	16,300	12,730	830
Kern County	California	14,500	12,110	740
El Paso County	Texas	14,100	12,830	270
Honolulu County	Hawaii	13,500	3,380	440
Pima County	Arizona	12,800	10,190	500
Utah County	Utah	11,900	10,620	40
Ventura County	California	11,500	9,450	150
DuPage County	Illinois	11,300	8,410	550
Pierce County	Washington	11,100	7,990	980
Collin County	Texas	10,600	7670	680

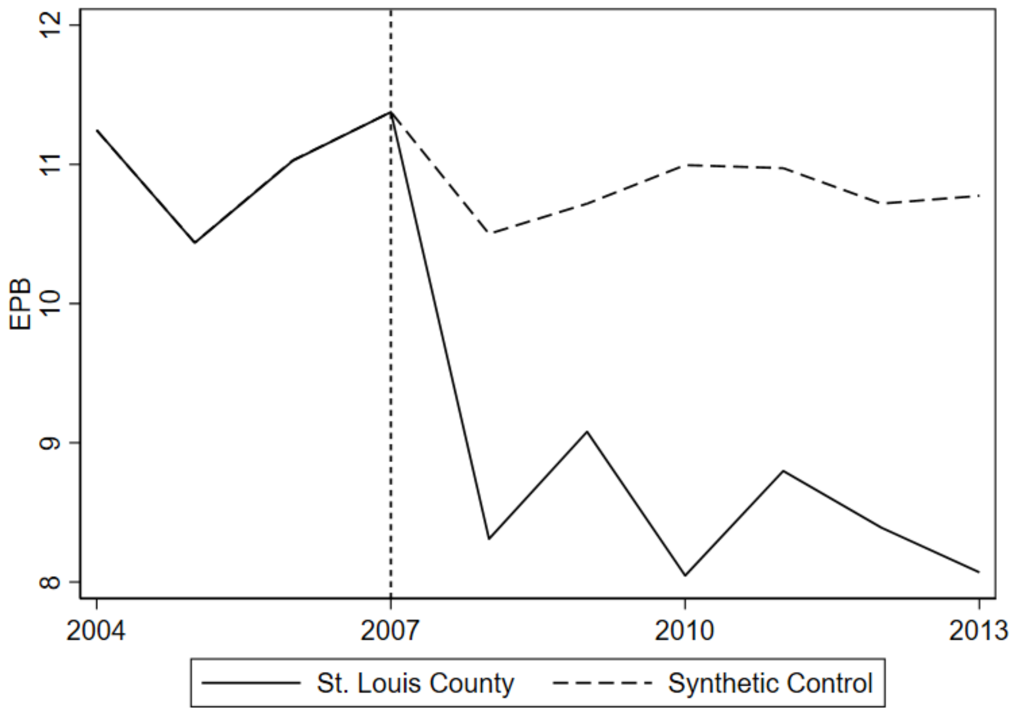
Note: This table displays data from the 14 counties with over 1,000 total births each year from 2004-2013, but which do not have a minimum of 1,000 births to Black mothers each year. These counties are therefore dropped from the specifications that estimate the effect of the St. Louis Contraceptive CHOICE Project on infant health outcomes for Black mothers. The first column displays the name of the county. The second column displays the state the county is in. The third column displays the minimum yearly number of total births to mothers who reside in that county, rounded to the nearest 100. The fourth column displays the minimum yearly number of births to White mothers in that county, rounded to the nearest 10. The fifth and final column displays the minimum yearly number of births to Black mothers, rounded to the nearest 10/

Figure A.1 — Map of Donor Pool Counties for Estimating the Effect of St. Louis CHOICE Project on Infant Health Outcomes



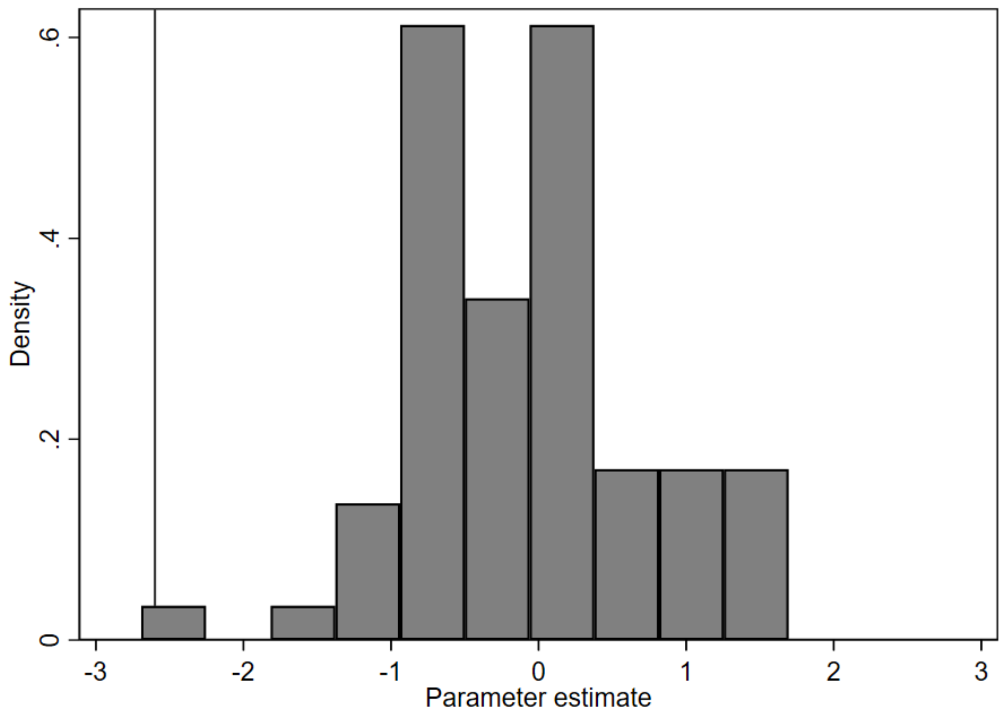
Note: This map displays the 67 counties in the United States which each have at least 10,000 births in each year from 2004-2013, calculated using natality data from the National Vital Statistics System. Counties with at least 10,000 births each year are in blue, while counties with fewer than 10,000 births in any of the ten years in the sample are white.

Figure A.2 — Synthetic Control Estimate of the Effect of the Contraceptive CHOICE Project on Extremely Preterm Births in St. Louis County



Note: This figure displays the synthetic control estimate for the effect of the St. Louis Contraceptive CHOICE Project on the rate of extremely preterm births per 1,000 live births in St. Louis County using data from the National Vital Statistics System. The black line displays the rate for St. Louis County, while the dashed line displays the weighted average of the rates of the synthetic control counties, where the weights are chosen in order to minimize the sum of the squared difference in the pretreatment rates of extremely preterm births.

Figure A.3 — Histogram of Placebo Treatment Effects from Randomization Inference of the Effect of St. Louis CHOICE Project on Extremely Preterm Births

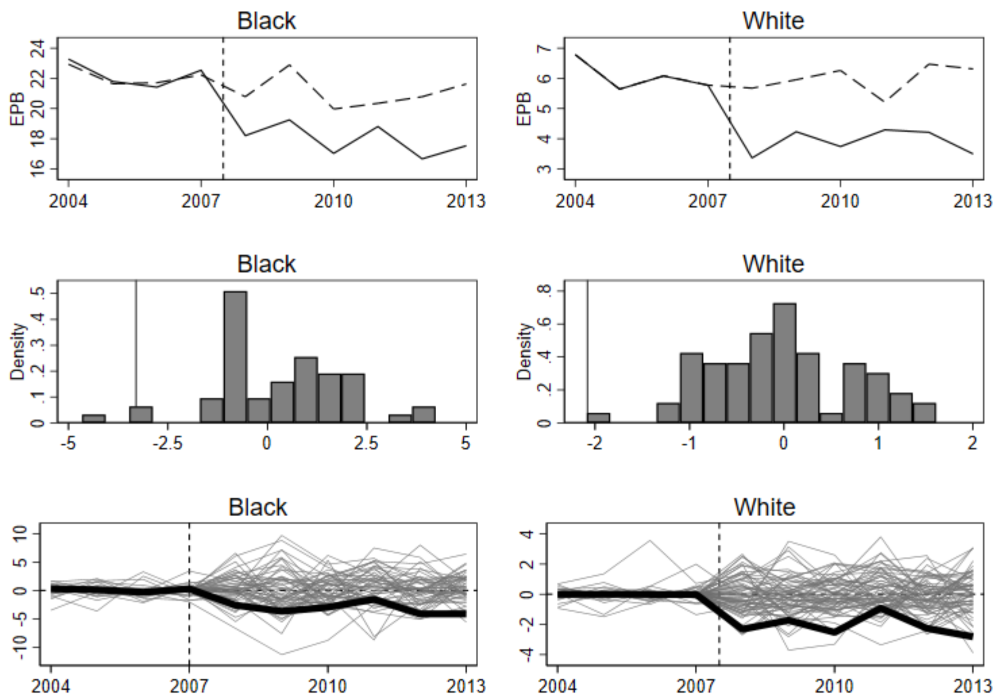


Note: This figure displays the distribution of placebo synthetic control estimates for the effect of the St. Louis Contraceptive CHOICE Project on the rate of extremely preterm births per 1,000 live births in St. Louis County using data from the National Vital Statistics System. The vertical line displays the true St Louis County treatment effect.

Figure A.4 — Synthetic Control Estimate of the Effect of the Contraceptive CHOICE Project on Extremely Preterm Births in St. Louis County - Placebo Treatment Graph

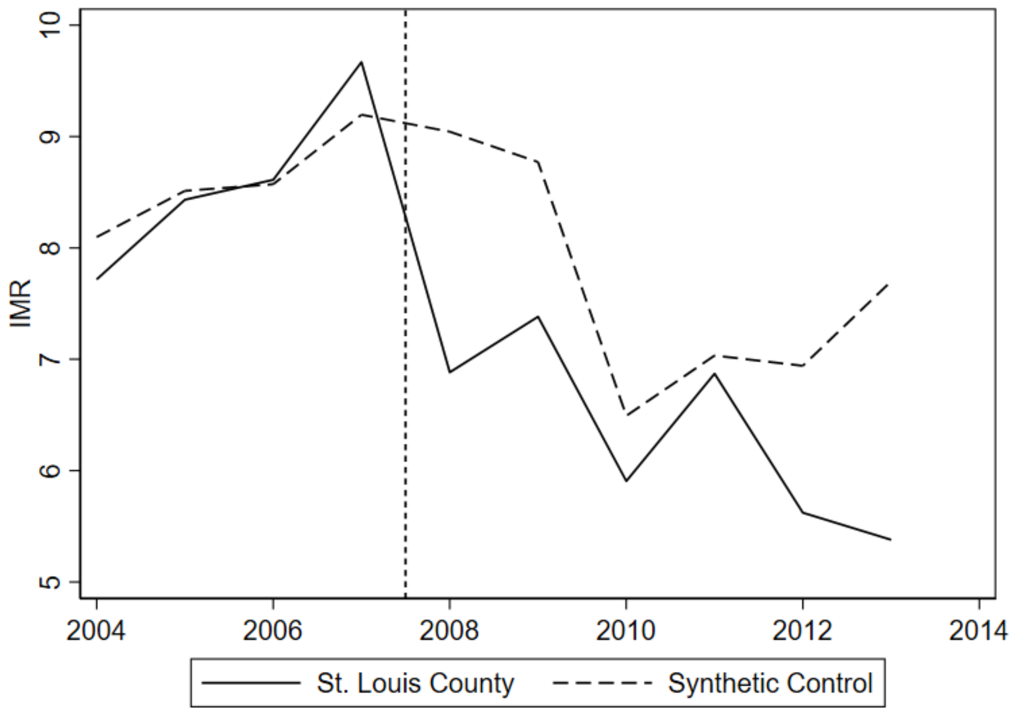
Note: This figure displays the evolution of each of the placebo synthetic control estimates for the effect of the St. Louis Contraceptive CHOICE Project on the rate of extremely preterm births per 1,000 live births in St. Louis County using data from the National Vital Statistics System. The true treatment effect is displayed in black and bolded, while the placebo treatment effects are gray.

Figure A.5 — Synthetic Control Estimates of the Effect of the Contraceptive CHOICE Project on Extremely Preterm Births in St. Louis County, Broken out by Race



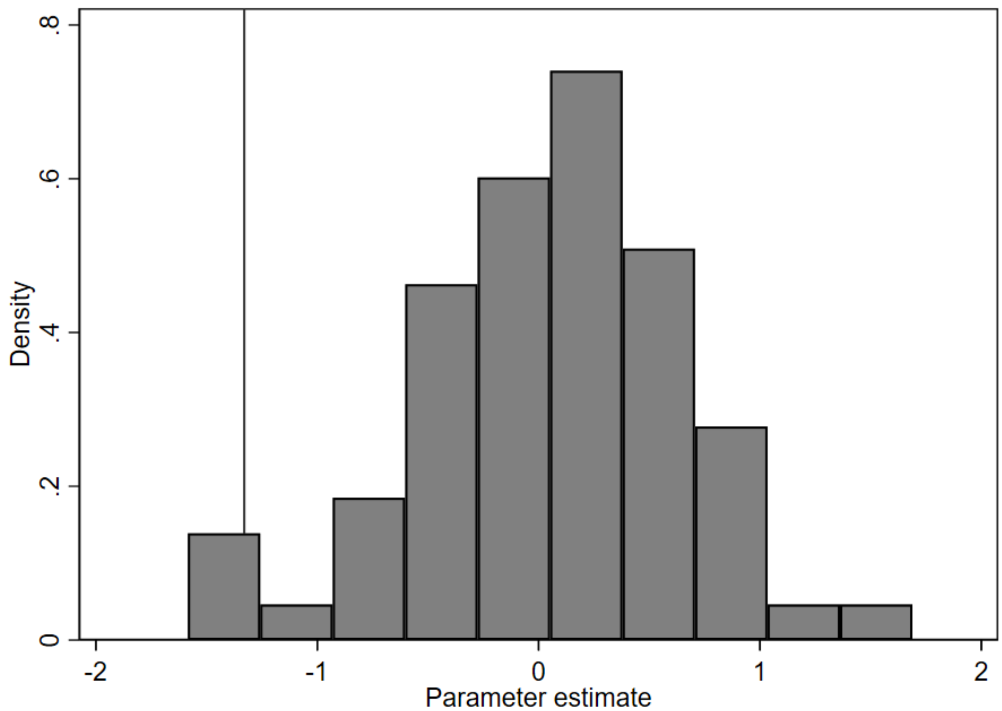
Note: This figure displays the synthetic control estimates for the effect of the St. Louis Contraceptive CHOICE Project on the rate of extremely preterm births per 1,000 live births in St. Louis County using data from the National Vital Statistics System, with the results broken down by the race of the mother. The left panel displays the three synthetic control graphs for Black mothers, while the right panel displays the same graphs for White mothers. The top graph shows the time series of the rate of extremely preterm births in St. Louis County compared with its synthetic control The middle graph displays a histogram of the placebo difference-in-differences estimates, with a vertical line where the true St Louis County treatment effect lies. The bottom graph shows the evolution of St. Louis County and each of the placebos compared with their synthetic control, where the true treatment effect is displayed in black and bolded, while the placebo treatment effects are gray.

Figure A.6 — Synthetic Control Estimate of the Effect of the Contraceptive CHOICE Project on Infant Mortality in St. Louis County



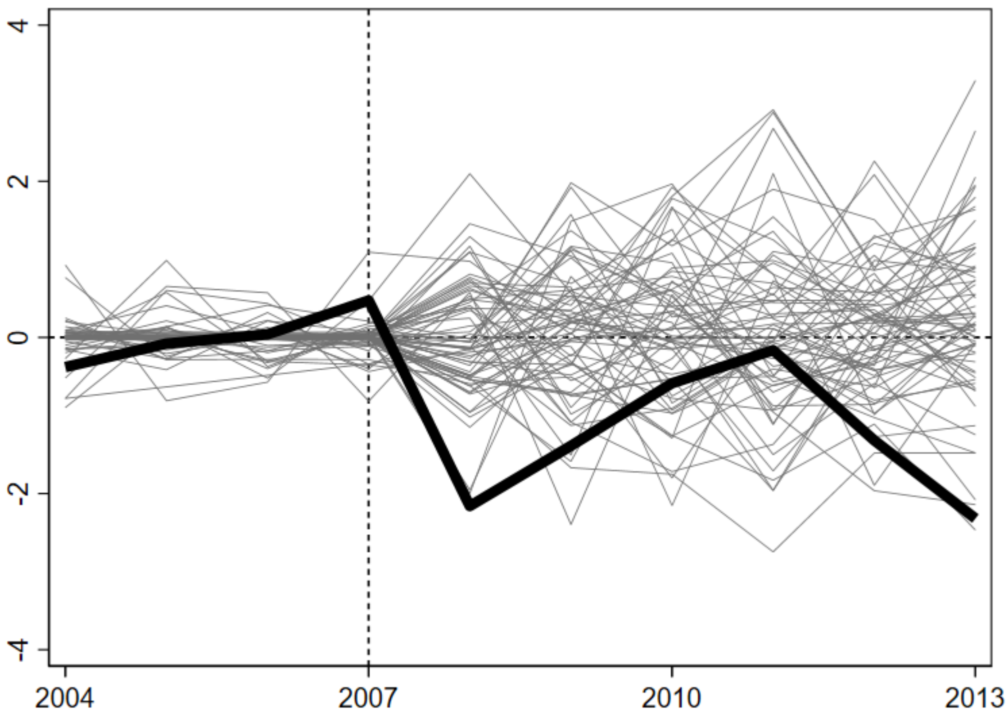
Note: This figure displays the synthetic control estimate for the effect of the St. Louis Contraceptive CHOICE Project on the number of infant deaths per 1,000 live births in St. Louis County using data from the National Vital Statistics System. The black line displays the rate for St. Louis County, while the dashed line displays the weighted average of the rates of the synthetic control counties, where the weights are chosen in order to minimize the sum of the squared difference in the pretreatment infant mortality rate.

Figure A.7 — Histogram of Placebo Treatment Effects from Randomization Inference of the Effect of St. Louis CHOICE Project on St. Louis County



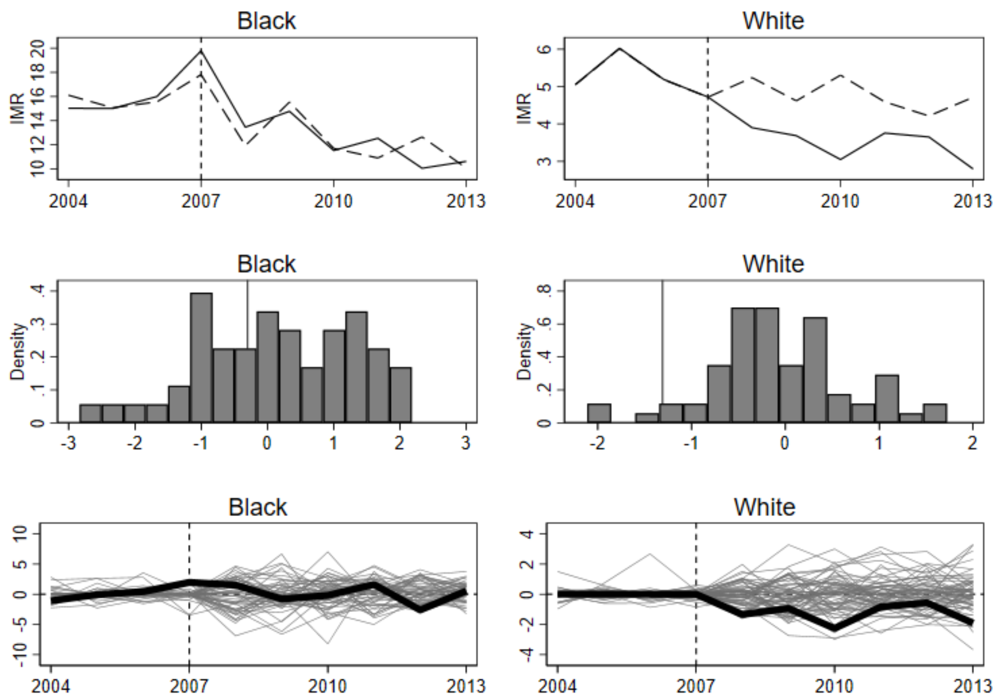
Note: This figure displays the distribution of placebo synthetic control estimates for the effect of the St. Louis Contraceptive CHOICE Project on the number of infant deaths per 1,000 live births in St. Louis County using data from the National Vital Statistics System. The vertical line displays the true St Louis County treatment effect.

Figure A.8 — Synthetic Control Estimate of the Effect of the Contraceptive CHOICE Project on Infant Mortality in St. Louis County - Placebo Treatment Graph



Note: This figure displays the evolution of each of the placebo synthetic control estimates for the effect of the St. Louis Contraceptive CHOICE Project on the number of infant deaths per 1,000 live births in St. Louis County using data from the National Vital Statistics System. The true treatment effect is displayed in black and bolded, while the placebo treatment effects are gray.

Figure A.9 — Synthetic Control Estimates of the Effect of the Contraceptive CHOICE Project on Infant Mortality in St. Louis County, Broken out by Race



Note: This figure displays the synthetic control estimates for the effect of the St. Louis Contraceptive CHOICE Project on the number of infant deaths per 1,000 live births in St. Louis County using data from the National Vital Statistics System, with the results broken down by the race of the mother. The left panel displays the three synthetic control graphs for Black mothers, while the right panel displays the same graphs for White mothers. The top graph shows the time series of the infant mortality rate in St. Louis County compared with its synthetic control The middle graph displays a histogram of the placebo difference-in-differences estimates, with a vertical line where the true St Louis County treatment effect lies. The bottom graph shows the evolution of St. Louis County and each of the placebos compared with their synthetic control, where the true treatment effect is displayed in black and bolded, while the placebo treatment effects are gray.

B. Synthetic Control Method

Figure A.2 displays results for the SCM estimating the effect of CHOICE on EPBs in St. Louis County. Prior to 2007, there is a close match between St. Louis County and its synthetic control, hovering at a rate of around 11 EPBs per 1,000 live births. In 2008, the year immediately following the implementation of the St. Louis Contraceptive CHOICE Project, there is a decline of about 0.5 EPBs in the synthetic control, but a much larger decline in St. Louis County, with a difference of around 2.2 EPBs per 1,000 live births between the two. This represents a difference of approximately 20% of the base rate of this outcome. After 2008, both groups rebound slightly and then level off, with St. Louis County continuing on a slight downward trajectory, though with some noise. The difference between the two grows from 2.2 in 2008 to 2.7 in 2013.

Appendix Figure A.3 displays a histogram of the placebo DiD treatment effects for St. Louis County, along with the 66 other counties in the donor pool. The difference-in-differences estimate for St. Louis represents a reduction of 2.69 EPBs per 1,000 live births. This is by far the largest estimate in the distribution, which translates to a p-value of $p = \frac{1}{67} = .015$. The next largest estimate in magnitude is an increase of 1.69 EPBs, which is roughly 37% smaller in magnitude than the reduction I find in St. Louis County. Finally, Appendix Figure A.4 displays the evolution of each 'treated' county compared with its synthetic control. The true treatment effect for St. Louis County is displayed in black and in bold, while the placebo treatment effects are gray. St. Louis County displays what is clearly the largest 'treatment effect', with a near perfect match prior to CHOICE, but a large reduction that is sustained for each year from 2008 through 2013. Occasionally, some of the placebo treatment effects will display estimates that are as large as St. Louis in magnitude for a single year, but these appear to be mostly noise, as they often revert to the mean immediately after.

Figure A.5 displays SCM estimates of the effect of CHOICE on EPBs in St. Louis, separately estimated for White and Black mothers. The first thing to notice with this figure is the stark disparity that existed at baseline for Black and White mothers in St. Louis County. Between 2004 and 2007, Black mothers experienced about 22-23 EPBs for every 1,000 live births, roughly three and a half times the rate of White mothers, who experienced only six to seven EPBs per 1,000 live births. In both cases, there is a close match between St. Louis County and its synthetic control throughout the pre-treatment period. Then, in 2008, EPBs show a dramatic decline relative to the synthetic control in both cases. The estimated decline of 2.1 EPBs per 1,000 live births for White mothers is the largest estimate in magnitude of the distribution, for a p-value of .015. For Black mothers, although the estimate 3.29 EPBs per 1,000 live births is clearly in the left tail of the distribution, it is only the third largest reduction, and there are also three positive estimates that have a larger magnitude. This translates to a p-value of $p = \frac{6}{53} = .113$.

Appendix Figure A.6 display the SCM estimate of the effect of CHOICE on infant mortality in St. Louis County. The pre-treatment match is less compelling than for EPBs, largely because St. Louis was trending up from 2004-2007. Still, the reduction in St. Louis is substantially larger than its synthetic control in the first two years following CHOICE, though it is not entirely clear whether this is a reversion to the mean or a true treatment effect. The control group nearly catches up by 2010 before diverging once more. The difference-in-differences estimate of this specification yields a reduction of 1.3 infant deaths per 1,000 live births. Appendix Figure A.7 displays the distribution of the estimates for St. Louis and the 66 placebo counties. The reduction of 1.3 is the second largest reduction in the distribution, though there is one estimate with a larger increase in magnitude. The randomization inference p-value for St. Louis is therefore $\frac{3}{67}$ = .045. Finally, Appendix Figure A.8 displays a graph of each of the placebo treatment effects compared with their synthetic controls. The reduction which occurs in St. Louis in 2008 is larger in magnitude than any of the other estimates, though the reversion which takes place in 2010 and 2011 as the control group catches up makes inference more challenging. Because of the imperfect pretreatment match, the SDID is preferrable to the SCM for this specification. The SDID estimates for infant mortality are displayed in columns 4-6 of Table 2. For the full sample of mothers, SDID estimates a reduction of 2.04 infant deaths per 1,000 live births, which is 23.74% of the baseline rate of 8.61 for 2004-2007, significant at the 1% level.

Appendix Figure A.9 displays SCM estimates of the effect of CHOICE on infant mortality in St. Louis County, broken out by the race of the mother. There is once again a large disparity in baseline levels of infant health, with Black experiencing infant deaths at roughly three times the rate of White mothers from 2004-2007. The pretreatment match for Black mothers is imperfect, with infant mortality rising throughout the pre-period for Black mothers relative to the control group. There is a sharp decline after 2007 for Black mothers, but this is mirrored closely in the control group and it is again unclear whether this decline is due to a treatment effect or simply a reversion to the mean after the large increase in 2007. The DID estimate for Black mothers represents a decline of only 0.3 infant deaths per 1,000 live births. This estimate is only larger than nine of the 53 placebos in magnitude, consistent with a p-value of $\frac{44}{53}$ = .830. On the other hand, the SDID estimate in column 5 of Table 2 returns a reduction of 3.27 infant deaths per 1,000 live births, significant at the 1% level. This represents a 19.76% reduction from the baseline 2004-2007 rate of 16.56.

Looking at White mothers, there does appear to be a treatment effect in the SCM specification on the right side of Appendix Figure A.9. There is a close match between St. Louis County and its synthetic control in the pre-treatment period, followed by a relative decline in the treated group in 2008 and the years following. The differences-in-differences estimate for White mothers represents a decline of 1.3 infant deaths per 1,000 live births. This is the seventh largest estimate in the distribution, consistent with a p-value of $\frac{7}{67}$ = .104. This is mirrored closely in the SDID estimate in column 6 of Table 2 of -1.36 infant deaths per 1,000 live births, which is significant at 5% and represents a reduction of 25.85% of the baseline 2004-2007 rate of 5.25.