New Evidence on the Effects of Expanding Contraceptive Choice

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Abstract

We estimate these effects in the context of Colorado's Family Planning Initiative, the largest program to have focused on long-acting-reversible contraceptives in the United States, which provided low-income women with free or low-cost contraceptives at Title X clinics beginning in 2009. We find that the effects on birth rates are largely concentrated among women in zip codes within 7 miles of clinics: the initiative reduced births by approximately 20 percent for 15–17 year olds and 18–19 year olds living in such zip codes. We also examine how extensive media coverage of the initiative in 2014 and 2015 altered its reach. After information spread about the availability and benefits of LARCs, we find a substantial increase in LARC insertions, extended effects on births among 15–17 year olds living greater than 7 miles from clinics, and significant reductions in births among 20–24 and 25–29 year olds.

JEL Classification: I18, J13, J18

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1 Introduction

A large body of research has demonstrated the remarkable ways in which improving women's ability to control childbearing can affect their outcomes. In particular, it's broadly accepted that expanding access to birth control pills and abortion during the 1960s and 1970s reduced childbearing and increased women's educational attainment, wages, and labor force participation, while reducing dependence on public assistance and improving resources in households with children.[1] While this evidence is critical in understanding historical trends in outcomes for women and their families, it is not clear how relevant they are to today's context. Despite the fact that more US women are using contraceptives than at any other point in history, nearly half of all pregnancies, or 3 million per year, are unintended (Finer and Zolna, 2016; Bailey and Lindo, 2018).

Given that one-third of today's unintended pregnancies are to women using some form of contraception xxx insert cite xxx, improving access to more effective forms of contraception could help reduce unintended pregnancy and improve outcomes for today's generation of women. Towards this end, there is a great deal of enthusiasm for expanding access to long-acting reversible contraceptives (LARCs), a category comprised of intrauterine devices and subdermal implants. These devices are inserted by a doctor and do not require anything of the user and thus eliminate user-compliance errors. As a result, they have failure rates less than 1% whereas birth control pills, injectables, patches, rings, and condoms, which have failure rates of 6–18%.

Though several medical organizations have called on LARCs to be more widely promoted—including the American College of Obstetricians, Gynecologists' Committee on Adolescent Health Care, the American Academy of Pediatrics, and the Center for Disease Control and Prevention—only 12% of women, and only 5% of teenagers, chose a LARC in 2012 (Bailey and Lindo, 2018). Such low take-up is attributed to the fact that women often lack awareness of LARC availability or effectiveness, have misconceptions about safety, or cannot afford the high up-front fixed costs. Notably, 49% of residents

[1] See Goldin and Katz (2002), Bailey (2006), Guldi (2008), Bailey (2009), Bailey (2012), Bailey, Guldi, and Hershbein (2013), Myers (2017), Bailey, Malkova, and McLaren (2018), and Beauchamp and Pakaluk (Forthcoming). Also see Bailey and Lindo (2018) for a review.

in obstetrics/gynecology training programs use LARCs (Zigler, Peipert, Zhao, Maddipati, and McNicholas, 2017), and 65 percent of participants in a contraception counseling program chose a LARC when it was offered at no cost (Secura, Allsworth, Madden, Mullersman, and Peipert, 2010), implying that information and financial barriers impede higher usage rates.

In this paper we examine the impact of expanding access to LARCs on childbearing and other related outcomes. To do so we analyze the effects of the Colorado Family Planning Initiative (CFPI), a program that allowed Title X clinics in Colorado to substantially expand the provision of LARCs to their low-income clients beginning in 2009. Whereas earlier work has shown that the initiative reduced birth rates for 15–19 year olds residing in counties with Title X clinics (Lindo and Packham, 2017), in this study we leverage more granular data and more recent years of data to answer several new questions, including: What kind of "reach" can we expect from a clinic-based initiative like this one? Do the effects extend to women who live a moderate distance away from a clinic? Are there effects on high-school-aged teenagers? On older teenagers and women in their twenties? Do the effects vary across race and ethnicity? Did the extensive media coverage that began in 2014 alter the reach of the program? Is there any evidence of impacts on other outcomes associated with women's or newborns' health?

We answer most of these questions using two separate administrative datasets on contraception use and births. After providing evidence that the initiative led to increases in LARC use, we estimate the effects on births using a difference-in-differences design that compares changes in births for women in zip codes closest to Title X clinics to changes in births for women in zip codes farther away. We use a non-parametric approach to identify which zip codes were most affected by the initiative and find that the effects are largely concentrated among women in zip codes within 7 miles of Title X clinics. We find that the initiative reduced births by approximately 20 percent for 15–17 year olds and 18–19 year olds living in such zip codes. Averaging across all years, we find no evidence of significant effects on births among older women, or women living in more distant zip codes, on average. However, when we focus on the period of time after the initiative received extensive media attention, we observe a trend break in the number of LARC insertions; that the effects on births among 15–17 year olds extend out those living 11–13 miles from clinics; and that there are significant effects on births among 20–24 and 25–29 year olds.

In our other analyses, we find xxxxxxxx discuss other results in Tables 3 - 6 xxx these differential effects across age groups imply changes in the composition of the type of births, particularly for those that tend to involve relatively high hospital costs, we find no evidence that the CFPI reduced the fraction of infants born under 2500 grams. xxx Finally, since changes in contraception access could impact the number of pregnancies ending in termination, we estimate effects of the CFPI on abortion rates; however, these estimates are too imprecise to provide anything more than suggestive evidence.

These results have several implications for policy. First, the magnitude of the effects indicates that expanding free and low-cost access to LARCs through Title X clinics can reduce unintended pregnancy for a large share of young women who live close to such clinics.[2] Second, expanding free and low-cost access to LARCs can help women from a broad range of ages—from 15–29—to avoid unintended pregnancy. Quite notably, the effects are especially prominent for 15–17 year olds and also 18–19 year olds, which suggests that the initiative may have improved women's ability to invest in their high school and post-high-school education and thus have important implications for their economic circumstances. Third, our results indicate that estimates of the effect for all women living in a county with a clinic (e.g., in Lindo and Packham (2017)) obscure much larger effects for women who live closest to a clinic. Finally, our results also highlight an important *limitation* of expanding free and low-cost access to LARCs through Title X clinics. Specifically, a large share of Colorado's population (58.9 percent) live in zip codes for which we did not find any statistically significantly impact of the initiative. Moreover, we find that reducing information barriers increases the geographic reach of the program over time. These findings underscore the importance of devising alternative methods to improve information and access to LARCs for women living in these more rural areas.

[2] Reductions in unintended pregnancy are implied by any reduction in births that results from women voluntarily opting for more effective methods of contraception.

2 Background

This section reviews the effectiveness and uptake of long-acting reversible contraceptives before providing background information on the Colorado Family Planning Initiative. To do so, we borrow heavily from the discussion in Lindo and Packham (2017).

2.1 Long-Acting Reversible Contraceptives (LARCs)

LARC methods include intrauterine devices (IUDs) and subdermal implants. IUDs are small, T-shaped devices inserted into the uterus to prevent pregnancy, while implants are a thin, matchstick-sized plastic rod inserted under the skin of the non-dominant upper arm. The two most common IUDs are Mirena and ParaGard. Mirena is a hormonal IUD that releases progestin to prevent sperm motility and lasts for up to 5 years. ParaGard, a copper IUD, contains no hormones and can last up to 12 years. Nexplanon, the most popular implant, contains etonogestrel and can last up to 4 years.

Most importantly, during the first year of typical use, fewer than 1 in 1,000 women using an IUD or implant become pregnant, due to the fact that LARCs eliminate the potential for user-compliance error as they require nothing of the user after insertion.[3] Accordingly, professional health organizations such as the American Congress of Obstetricians and Gynecologists and the American Academy of Pediatrics have endorsed LARCs as preferred methods for young, sexually active women.

Despite the relative ease and effectiveness of LARCs, take-up is lower than nearly every other type of contraceptive device. Only 5.8 percent of adolescents and women aged 15–19 have ever used an implant or IUD, and only 14 percent of US women chose a LARC in 2014 (Guttmacher Institute, 2018). Substantial barriers to use include patients lack of familiarity, lack of access, and/or misconceptions about safety.[4] For young women

[3] For comparison, oral contraceptives and condoms and have typical-use effectiveness rates of only 91 percent and 82 percent, respectively, and 80 percent and 82 percent among teenagers under the age of 18 (Dinerman, Wilson, Duggan, and Joffe, 2012; Grady, Hayward, and Yagi, 1986).

[4] Such safety concerns may be a result of the reputation of the Dalkon Shield. The Dalkon Shield, an IUD introduced in the 1970s, increased women's risk for pelvic inflammatory disease and caused an array of severe injuries, leading the US Food and Drug Administration to ban the device in the 1974. Although Congress has since passed laws requiring new oversight for IUD approval, and current alternatives do not suffer from these design flaws, the decades-old controversy is still relevant in shaping attitudes towards IUDs today (Bailey and Lindo, 2018).

especially, who may face social stigma or large transportation costs, scheduling and attending the procedure itself may also serve as a deterrent. Insertion is uncomfortable and sometimes painful, and women can experience side effects, such as menstrual pain and bleeding, spotting, headaches, nausea, and mood changes (Grimes, 2007).[5,6] Moreover, for women wishing to become pregnant in the near future, alternative methods of contraception that do not require a visit to the doctor (for removal) to restore their ability to become pregnant may be more attractive.

Importantly, the high upfront costs of the devices may also create large barriers to uptake. LARCs can cost upwards of $500 out-of-pocket, and even insured patients may pay up to a $160 copayment (Trussell, Lalla, Doan, Reyes, Pinto, and Gricar, 2009; Planned Parenthood, 2017). And while the Affordable Care Act, which requires insurers to cover all FDA-approved contraceptives, has reduced or eliminated concerns about costs for some women since 2011, there is an exemption for employers with a religious or moral objection that was recently expanded in 2017. Moreover, these contraceptives mandates may not be as impactful for women that rely on their parents' health insurance if they are worried about confidentiality.[7] As a result, the costs of LARCs continue to be highly salient for many women.[8]

In addition to these demand-side concerns, from the provider's perspective there also exist barriers to that contribute to the low rate of LARC use among U.S. women. First, doctors and nurses may themselves be unaware or misinformed about LARC technology, and they must be trained on proper LARC insertion/removal to provide them to patients.

[5]Based on their clinical trials, the five IUDs available on the U.S. market (Mirena, Paragard, Sklya, Liletta, and Kyleena) have discontinuation rates due to adverse reactions between 12 percent and 22 percent. As a point of comparison, clinical trials for the commonly prescribed birth control pill, Ortho Tri Cyclen, have had discontinuation rates due to adverse reactions between 11 and 21 percent.

[6]The Food and Drug Administration requires that this information be included in the patient package inserts for contraceptives. More serious and rare side effects can occur for patients with IUDs and include pelvic inflammatory disease, uterus perforation, and ectopic pregnancies. Risk of pelvic inflammatory disease occurs in 1 in 100 cases, and is no greater with an IUD than the risk to the general population. Uterus perforation occurs in less than 1 in 1000 cases. Ectopic pregnancy is the most serious and rare possible side effect of an IUD. In rare events in which a women becomes pregnant while using an IUD, the risk of having an ectopic pregnancy ranges from 6–50 percent (Grimes, 2007).

[7]According to a recent survey, 68 percent of teens stated that their primary reason for not using birth control is because they are afraid that their parents might find out (The National Campaign to Prevent Teen and Unplanned Pregnancy, 2015).

[8]Notably, Mestad, Secura, Allsworth, Madden, Zhao, and Peipert (2011) find that 70 percent of women aged 14–20 choose a LARC when it is offered at no cost.

Second, health clinics that provide free and low-cost contraceptives often cannot afford to offer LARCs to every client. As a result, a large proportion of Title X clinics do not offer LARCs at all, and those that do usually have to offer them to clients selectively. For example, just 61 percent of Title X clinics offered implants, 65 percent offered the copper IUD and 67 percent offered a hormonal IUD in 2015 (Zolna and Frost, 2016).

By allocating funds and technical assistance for LARCs, the CFPI allowed Colorado Title X clinics to offer these devices to thousands of women for the first time. Below, we discuss in greater detail the extent of the LARC-focused program and provide details on its implementation.

2.2 The Colorado Family Planning Initiative (CFPI)

In 2009 the Colorado Department of Public Health and Environment (DPHE) established the CFPI in an effort to lower the state's unintended pregnancy rate through family planning.[9] Over the course of the initiative, the Colorado DPHE received $23 million in provisional funding from the Susan Thompson Buffett Foundation to expand family planning services, and, in particular, provide free LARC methods to low-income women in Title X clinics. All of Colorado's 28 agencies applied for and received funding, which was distributed to 68 Title X clinics across the state from 2009–2015.[10,11]

While the specifics of each agency's implementation strategy varied by clinic capacity and client population, Title X clinics generally agreed to spend their funds on the following objectives: supplying free IUDs and contraceptive implants to low-income women; equipping staff and providers with more knowledge about LARC insertion, promotion, and counseling; and providing technical assistance for billing, coding, and clinic management. Additionally, the CFPI offered general assistance to Title X agencies to increase the LARC usage and supported the provision of vaginal rings, tubal ligations, and va-

[9] Our description of the implementation of the Colorado Family Planning Initiative draws heavily from conversations with the Colorado Department of Public Health and Environment and the detailed discussion provided in Ricketts, Klingler, and Schwalberg (2014).

[10] Due to the declared success of the program, additional public funding for LARCs was appropriated in 2016 after the depletion of private funds.

[11] Money was allocated proportionally to agencies based on their number of clients and the predicted number of LARC insertions in the following year.

sectomies. However, the use of the ring remained fairly constant among clients after the CFPI was implemented, and tubal ligations and vasectomies are extremely rare among young women.[12]

The foundation allocated funding directly to Title X agencies, which receive federal and state funds to provide free or low-cost family planning counseling, sexually transmitted disease screening, and contraceptives. The expansion within the existing network of Title X family planning clinics offered a number of advantages. Due to existing contracts with agencies within the network, the Colorado DPHE was able to expedite the funding process and make use of clinic networks and infrastructure in place to better facilitate collaboration, while current Title X regulations and protocols support high-quality health care and the ongoing collection of data. Since many Title X clinics already had waiting lists of women seeking these expensive devices, the goal of the CFPI was to focus efforts on the unmet demand for highly effective contraceptives and expand access more broadly.

Moreover, Title X clinics are specifically aimed at providing services to low-income women, who may face the largest hurdles to obtain LARCs. Colorado Title X guidelines require all contraceptive methods and exam fees be incorporated into a schedule of discounts, or sliding fee schedule. Anyone reporting that their income is at or below 100 percent of the poverty level pays nothing for any service, and no client is denied services because of an inability to pay. In Colorado, 90 percent of Title X clients report incomes below this level, meaning that nearly all clients pay nothing for contraceptives and doctor visits.[13] Prior to the CFPI, the high upfront costs of LARCs paired with the fact that clinics provided their services for free meant that widespread provision of LARCs was prohibited. In the first year of the program, 20 out of 28 Colorado Title X agencies offered IUDs for the first time, and 16 agencies offered the implant for the first time. In the following year, all Colorado agencies offered IUDs and all but one agency offered subdermal implants, suggesting that the CFPI funding was crucial in allowing clinics to offer LARCs as a contraception option to all women.

[12]Take-up of rings among Colorado Title X clients aged 15–29 is about 7 percent, while take-up of ligations and vasectomies is less than 0.5 percent.

[13]Agencies must accept verbal communication of income and no verification is required.

3 Empirical Approach

We use data on contraceptive use and childbearing from two separate administrative datasets. These data allow us to observe the number of women visiting Colorado Title X clinics and their contraception choices before and after the CFPI, and to analyze trends in births by age, race, and ethnicity. Below, we provide a detailed description of the data used in our analysis as well as our strategies for estimating the causal effects of the CFPI.

3.1 Data

To understand how Title X clients' contraception choices changed in response to the CFPI, we use family planning agency-level data from the Colorado Department of Public Health and Environment (DPHE). These data include information on contraceptive methods at the time clients left the clinic (for various age groups), as well as the total number of LARC insertions per year. The data span from 2008 to 2015, which allow us to see client's choices from one year prior to the CFPI through the seventh year of the program.

To estimate the effect of the initiative on births for various groups defined by age, race, and ethnicity, we use restricted-access birth data from the Colorado DPHE. These data include a record of every birth to Colorado residents from 2003 to 2016. Critically, these data provide mother's zip code of residence, which allows us to conduct a richer and more granular analysis than (Lindo and Packham, 2017). These data also include information on mother's race, ethnicity, and age in addition to measures of infant health. For our analysis we assign births to the year of conception based on the mother's last menstrual period to construct a measure of births conceived in a particular year.

While nearly all of our analyses focus outcomes measured from birth records, we also consider effects on abortions using county-level data on abortions by age group collected by the Colorado Department of Public Health and Environment for 2004–2016.[14,15]

Because all Colorado Title X agencies accepted CFPI funding, our primary identifi-

[14]These data do not separate counts by 15–17 year olds and 18–19 year olds; therefore any analysis of abortions by age group will consider 15–19, 20–24, and 25–29 year olds.

[15]In the event that an observation is censored, we assume that the number of abortions is zero.

cation strategy uses distance from a zip code's population centroid to the nearest Title X clinic to establish treatment status. This approach is motivated by several recent studies documenting the significant effects of distance to women's health clinics on preventative health care utilization, abortion, contraception use and births (Lu and Slusky, 2016; Lindo, Myers, Schlosser, and Cunningham, 2017; Packham, 2017; Quast, Gonzalez, and Ziemba, 2017; Fischer, Royer, and White, 2018). Namely, as distance to a clinic increases, the likelihood that a woman will seek family planning and health services decreases.[16] To measure the distance from a zip code centroid to the nearest Title X clinic, we geocoded the addresses of each Title X clinic in the state from an archived directory of Colorado clinics. Using GPS coordinates, we calculate total travel distance from a centroid to a clinic using the *geonear* package for Stata, which draws on Google Maps API data (Picard, 2010).

To control for time-varying zip-code-level economic conditions, we use data from the American Community Survey (ACS), which contains yearly estimates of poverty rates and unemployment. Because population data by race and age is unavailable by zip code, we additionally include population counts from the National Cancer Institute's Surveillance, Epidemiology, and End Results Program (SEER) to construct county-level measures of demographics, including the fraction of 15–17, 18–19, 20–24, and 25–29 year olds, the fraction of each age group that are black, the fraction Hispanic and demographic fractions by single age.

[16] Specifically, Lu and Slusky (2016) uses a zip-code-level analysis to estimate how much Title X clinic closures affect women's takeup of breast exams, mammograms, and pap tests. They find that an increase of 100 miles to the nearest clinic leads to a decrease in these preventative care tests by 11–18 percent. Lindo, Myers, Schlosser, and Cunningham (2017) analyzes the effect of abortion clinic closures on clinic access and finds that closures affect women living within 200 miles of a clinic, although effects are largest for women living nearest to a clinic. In particular, increasing the travel distance by 25 miles reduces abortion by 10 percent. Packham (2017) studies the 2011 Texas Title X funding cuts resulting in 82 clinic closures and finds that contraception use by Title X clients decreased by 32 percent and teen birth rates increased by 3.4 percent as a result of reduced access to family planning services. Quast, Gonzalez, and Ziemba (2017) and Lindo, Myers, Schlosser, and Cunningham (2017) use variation in abortion facility closings in Texas and finds that increases in distance to the nearest abortion facility reduces abortion rates. Fischer, Royer, and White (2018) similarly finds that increasing distance to an abortion provider reduces abortions, while increasing distance to a family planning clinic increases births.

3.2 Identification Strategies

Our primary approach for estimating the effects of the Colorado Family Planning Initiative is a difference-in-differences design that uses zip codes that are farther from Title X clinics as the comparison group for zip codes closest to clinics receiving funding. In our preferred specifications, we define our treated zip codes as those within 7 miles of a Title X clinic, although we perform additional tests to provide evidence that our results are not sensitive to this choice.[17] The identifying assumption underlying this approach is that the proportional changes in births in the comparison zip codes provide a good counterfactual for the proportional changes that would have been observed in the treated zip codes in the absence of the CFPI.

We begin our analysis by estimating Ordinary Least Squares (OLS) models of the following form:

$$Births_{zt} = \alpha_z + \alpha_t + \beta X_{zt} + \theta CFPI_{zt} + \epsilon_{zt} \tag{1}$$

where $Births_{zt}$ measures births in zip code z in year t using the inverse hyperbolic sine (IHS) of the count[18], $CFPI_{zt}$ is an indicator variable that takes a value of one in all years after the CFPI began for zip codes defined to be "near" a Title X clinic and zero otherwise, α_z are zip code fixed effects to control for systematic differences across zip codes, and α_t are year fixed effects to control for shocks to birth counts that are common to all zip codes in each year. Given that the outcome variable is the IHS of birth counts, θ can be interpreted as an elasticity and, unlike a standard log transformation, the analysis utilizes observations that have zero counts.[19] All analyses allow errors to be correlated within zip codes over time when constructing standard-error estimates.

We also report estimates that consider how the effects evolve over time with OLS

[17]Results from a range of distances are discussed below in Section 4.2.

[18]This transformation takes on the form $sinh_z^{-1} = ln(z + \sqrt{1 + z^2})$.

[19]We have similarly considered an approach that uses birth rates based on annual population counts for each of our age subgroups based on zip code-level population counts taken decennially. While this leads to estimates that are qualitatively similar to those we present, it leads to estimates that are larger in magnitude but much less precise.

models of the following form:

$$Births_{zt} = \alpha_z + \alpha_t + \beta X_{zt} + \sum_{k=0}^{7} \theta_k CFPI_{z,t-k} + \epsilon_{zt} \qquad (2)$$

where $CFPI_{z,t-k}$ is an indicator variable that takes a value of one k years after the CFPI began for zip codes defined to be "near" a Title X clinic and zero otherwise. All other terms are unchanged from Equation 1.

We consider how the effects to vary over time for several reasons. First, the nature of contraceptive choice, sexual activity, and childbearing all would suggest that effect may grow over time after the program's implementation, even when we assign births to their year of conception. In particular, the share of sexually active women using LARCs is expected to increase over time as they visit clinics and, more generally, become increasingly aware of this option. Second, the program was rolled out at the state level starting in fiscal year 2008 (i.e. July 2008), with money distributed to agencies each year.[20] Although the donated funds ceased after the summer of 2015, the state decided to continue funding the program on its own starting in 2016. Accordingly, we may expect that throughout the program's duration, effects accumulate as teens and older women continue to use LARCs and/or as information about the program spreads. At the same time, the effects on specific age groups may vary over time as women naturally age into other age groups. Finally, while the CFPI was not promoted publicly by the state during its rollout, in 2014 the Colorado DPHE released an internal report on the achievements of the initiative, which generated national news attention from 2014–2015 and which may have altered its effects.

As with any difference-in-differences design, the validity of our approach requires common trends in the outcome over time for the treatment and control groups (those near Title X clinics and those farther away, respectively). We provide support for this assumption with evidence that outcomes for these groups are not diverging from one another prior to the CFPI. We also examine data from the American Community Survey to ex-

[20]The Colorado DPHE disbursed funds to local agencies starting in July 2008; however, the first year of implementation of the CFPI did not begin until January 2009.

amine whether population flows constitute a threat to the the validity of the identifying assumption.

4 Results

4.1 Effects of the CFPI on LARC Use

Before presenting our estimated effects on birth rates, we first analyze how the CFPI affected LARC uptake and client caseload. The top panel of Figure 1 shows the per capita increase in LARC insertions by age group for women visiting Title X clinics in Colorado. While LARC insertions are increasing for women of all ages over time following the CFPI, the most striking increases are for women under age 25, with some increases to women aged 25–29.

In the bottom panel of Figure 1 we also address the notion that the impact of LARCs on childbearing is likely to depend on both LARC usage and on the rates of childbearing. Towards this end, the bottom panel of Figure 1 displays the number of Title X clients choosing a LARC per the number of births by age group in 2008. When accounting for differences in births across age groups, take-up rates are highest among the youngest women.

To compare this pattern of LARC use with the use of other contraceptives, Figure 2 shows how the primary method of contraception used by women visiting Colorado Title X clinics has evolved over time. In 2008, the year before the initiative began, LARCs had a usage rate for teenagers and 20–29 year olds of less than 3 percent and 7 percent, respectively, which was lower than usage rates for condoms, injections, rings, and birth control pills. By 2015, LARC take-up among women under age 30 had risen to nearly 26 percent, surpassing all methods except oral contraceptives.

This increase in LARC use is mirrored by a decline in the use of oral contraceptives, indicating that the initiative led to a substitution of LARCs for oral contraceptives. That the substitution appears to be along this margin has important implications for the effects on pregnancy. Most obviously, we would expect this sort of substitution to reduce unintended pregnancy, because LARCs are more effective than oral contraceptives. It also suggests that we would likely expect the effects to be smaller than if the program instead caused substitution away from condoms (as the primary form of contraception), because condoms are less effective than oral contraceptives.

We note that because these statistics reflect annual Title X clinic *visitors*, and the long-acting quality of LARCs is expected to reduce the likelihood of a return visit to a clinic. Therefore, findings will almost certainly understate the degree to which LARC use has increased among women served by Title X clinics. Indeed, when comparing LARC insertions versus reported LARC take-up of Title X clients, over 81,000 more women had a LARC inserted between 2009–2015 than those reporting using a LARC in 2015. While insertion data are not available by age group, assuming that the same ratio of visitors using LARCs to cumulative LARC insertions holds implies over 28,000 insertions to women aged 15–29 between 2009 and 2015.

To further demonstrate that the increases in LARC use in Colorado depart from trends in take-up across the rest of the United States, Figure 3 depicts the difference between LARC usage among Colorado's Title X clinic clients and LARC usage among Title X clinic clients across the United States as a whole. Despite starting at a similarly low rate in 2008, LARC usage among women aged 15–29 visiting Title X clinics across the United States only grew to approximately 13 percent by 2015 versus nearly 30 percent for women aged 15–29 visiting Title X clinics in Colorado. Overall, these findings indicate that the CFPI increased the number of women seeking highly effective contraceptives.[21]

4.2 Estimates of the Geographic Reach of the Initiative

xxxxxxxx As described in Section 3.2, to estimate the effects of the CFPI on births we rely on an estimation strategy that compares changes in births for women residing in zip codes near Title X clinics, who we expect to be affected by expanded access to LARCS, to changes in births for women residing in more distant zip codes who are less

[21] The CFPI appears to have had a much smaller impact on contraception use among older women. For female Title X clients in Colorado over the age of 29, LARC use increased to 24.4 percent in 2015 versus 12.3 percent for clients across the US. It is for this reason that we focus our remaining analyses on women aged 15–29.

likely to be affected. Because it is not clear a priori which zip codes should be considered "near" to Title X clinics in this context, we use a non-parametric data-driven approach to answer this question in a similar spirit to Muralidharan and Prakash (2017).

Specifically, we use the difference-in-differences model (Equation 1) to estimate the effects using a rolling distance-window to define the treated group while maintaining a constant comparison group. We consider "treated" zip codes h to $h + 5$ miles from a Title X clinic for $h = 0, 1, ...15$ and use a comparison group comprised of zip codes greater than 20 miles from a Title X clinic. In so doing, we generate 16 separate difference-in-differences estimates, each intended to measure the effect on birth rates for a different set of zip codes defined based on their distance from a Title X clinic. The results are shown in Figure 4, with separate panels for the estimated effects on births for different age groups.

As expected, we see significant estimated effects for the specifications in which the treatment group is comprised of zip codes that are especially near Title X clinics. For example, the very first estimate plotted in Panel A indicates that after the CFPI births to 15–17 year olds fell approximately 10 percent more for zip codes 0–5 miles from a clinic than they fell for zip codes greater than 20 miles from a clinic. The estimated effect becomes larger when we consider women in zip codes 1–6 miles but then shrinks towards zero as we evaluate the effects on women farther and farther away. The estimated effect on births to 15–17 year olds is no longer statistically significant at the five-percent level when we consider those 7–12 miles from a clinic. The pattern of estimates is similar when we instead consider births to 18–19 year olds (Panel B). There is relatively little evidence that births to 20–24 year olds or births to 25–29 year olds are affected (Panels C and D).

Overall, these estimates imply that the reach of the CFPI—in terms of having a measurable impact on birth rates for some groups of women—was 7 miles. These results determine our definition for treatment and control groups in all subsequent analyses. In particular, in our subsequent analyses we define our treatment group as those zip codes within 7 miles of a Colorado Title X clinic, and compare changes in births in these zip codes to changes in births in zip codes further than 7 miles from a clinic. Because clinics did serve some women living in more-distant zip codes, this approach can be viewed as estimating a lower bound for the true effects. We also note that any estimates based on this approach will represent intent-to-treat estimates, because only a small share of the population is treated; thus, our estimates will understate the effects of the program on the women it actually served.

To better understand how these groups of zip codes compare to one another with respect to observable characteristics, we present summary statistics for variables used in our zip code-level analysis in Table 1.[22] Table 1 compares average raw birth counts, demographic variables, poverty rates, and unemployment rates for zip codes within 7 miles of a Title X clinic and zip codes more than 7 miles from a Title X clinic separately. Notably, the treatment group—zip codes closest to a Title X clinic—has higher average birth counts in all years (for example, 12.97 versus 3.29 for 18–19 year olds), which in large part reflects the fact that these zip codes also are more highly populated. This table additionally reports time travel distance information and travel time information, although these variables do not change over the sample period.[23] While the zip codes in the treatment group may be up to 7 miles from a clinic, on average they are 3.6 miles to their nearest clinic which corresponds to a 9 minute drive. Zip codes further than 7 miles are an average of 22.2 miles from, corresponding to 53 minutes of driving time.

4.3 Graphical Evidence of Trends

Before discussing our preferred estimates of the effects of the CFPI on childbearing, we first present graphical evidence to support our main results and the validity of our research design. In Figure 5, we show births to women aged 15–29 for zip codes within and further than 7 miles over time. For all age groups, trends in births are tracking for all zip code groups prior to the implementation of the CFPI, providing some support for the common-trends identifying assumption. After 2009, births in zip codes 0–7 miles from a clinic decline sharply compared to other zip code groups, especially for women

[22]We also provide a geographical visualization of Title X clinic locations and zip code distance in Appendix Figure A1.

[23]Driving time is calculated using the *geonear* command in Stata 15, which is based on information from Google Maps API.

aged 15–17 and 18–19, suggesting a treatment effect for these groups.

As an additional way of assessing birth trends for women living within 7 miles of a participating clinic relative to other Colorado zip codes, in Figure 6 we present an event-study-styled graph showing difference-in-differences estimates of the effects on births over time, including periods of time prior to its implementation. In each panel, the black circles represent the estimated effects at different points in time (relative to the year prior to the implementation of the CFPI) from a baseline model controlling for zip-code and year fixed effects. The comparison group includes all Colorado zip codes farther than 7 miles from a clinic.[24] The figure also shows estimates based on a model that additionally controls for time-varying measures of demographics and economic conditions (gray squares).[25] Additionally, in an attempt to compare zip codes that are most alike, we also show estimates from a third specification that limits the analysis to zip codes within 15 miles of a clinic (blue diamonds). Effectively, this approach involves a comparison of zip codes within 7 miles of a clinic to zip codes 7–15 miles from a clinic. Finally, the figure also shows estimates from a specification that includes year, zip and county-by-year fixed effects to allow for zip codes in separate counties to experience differential shocks by county over time (green triangles). Essentially, this specification uses other zip codes *within the same county* as the comparison group for each zip code within 7 miles of a clinic.

Although the exact magnitude for each estimate may be difficult to discern, the results in Figure 6 do reveal some clear patterns. Specifically, the sets of estimates provide support for the idea that births in treated and control zip codes followed a similar trajectory prior to the adoption of the CFPI. This evidence is particularly strong for the 15–17 and 18–19 year old age groups, which is where we find strongest and clearest evidence of impacts on births. The estimated effects in the pre-period are more volatile and less precisely estimated for the older age groups.[26]

[24]In estimating the effects over time, the year prior to the implementation of the CFPI, 2008, serves as the omitted category.

[25]These controls include zip-code-level unemployment rates and poverty rates and county-level fractions of individuals aged 15–29 by age, ethnicity, and race.

[26]Confidence intervals are not shown in the figure so the estimates from different specifications can be seen more clearly.

4.4 Main Results

In Table 2 we present our main results. They are based on the difference-in-differences model specified by Equation 2 and, motivated by our analysis of the "geographic reach" of the CFPI, they use women in zip codes more than 7 miles from a clinic as the comparison group for women in zip codes within 7 miles of a clinic. Specifically, all estimates are based on a model that includes year and zip code fixed effects while the estimates shown in even columns are based on a model that additionally controls for time-varying demographic and economic characteristics. As before, we separately estimate the effects for women aged 15–17, 18–19, 20–24, and 25–29.

Columns 1–2 and 3–4 present results for 15–17 year olds and 18–19 year olds, respectively. In Columns 1–2, estimates are negative and statistically significant for all years, and indicate that the CFPI reduced childbearing for women aged 15–17 living within 7 miles of a clinic by 20 percent over 7 years. Estimates shown in Columns 3–4 indicate a similar, albeit slightly smaller, effect for women aged 18–19. Specifically, they indicate that the CFPI decreased births for women aged 18–19 living within 7 miles of a clinic by 18 percent. Perhaps unsurprisingly, effects become larger throughout the duration of the program, suggesting that as more women receive LARCs, more unintended pregnancies are prevented over time. These effects correspond to over 300 fewer births to 15–17 year olds per year and 586 fewer births to 18–19 year olds per year across the state of Colorado as a result of the program, or 4,400 births over 7 years.[27]

In Columns 5–8, we present estimates for women in their twenties. Consistent with the graphical evidence from Figure 6, there is not any clear evidence of effects for women women aged 20–24 (Columns 5 and 6) or women aged 25–29 in the short run. However, we do see evidence of significant effects (ranging from 12–16 percent) on 20–24 year olds 6–7 years after the implementation of the CFPI. Similarly, there is also evidence of significant effects (ranging from 8–10 percent) on 25–29 year olds 6–7 years after the implementation of the CFPI. Overall, estimates in Table 2 demonstrate that the CFPI had large and immediate impacts on births to high-school aged teenagers and older teenagers. While

[27]This is based on the fact that the average annual number of births to 15–17 year olds and 18–19 year olds per zip code is 2.547 and 5.60, respectively, and there are 588 zip codes in our sample.

the CFPI also appears to have reduced births to women in their twenties, these effects are not evident until many years after the CFPI was implemented. We explore this finding in greater detail in the next section.

4.5 Exploring the Role of Advertising and Awareness

Though the CFPI was implemented in 2009 and eventually received international news coverage, it was not covered by any local, national, or international media outlets for many years.[28] The program's exposure changed after the Colorado DPHE released an internal report on the achievements of the initiative and published an academic paper in *Perspectives on Sexual and Reproductive Health* in 2014, one year before the initiative was set to run out of funding.[29] This sparked media attention to the program beginning in July 2014 and including a front-page story in the New York Times with the headline "Colorado Finds Startling Success in Effort to Curb Teenage Births" (Walker, 2015).[30] This coverage was sustained through 2015 and 2016 as policy-makers vigorously debated whether to provide funding to continue the program.[31,32]

Our main results, shown in Table 2, provide suggestive evidence that media attention heightened the effects of the initiative. Specifically, the widespread coverage of the program aligns with our finding that the CFPI had significant effects on the number of births to women in their twenties in its sixth and seventh years, but not before.

[28]The initiative was not marketed by the state and we have only been able to find a single media mention of the initiative prior to 2014, which was in the context of an article published 5/6/2013 in *Windsor Now!* headlined "Plan B still banned from county clinics." The Colorado Family Planning Initiative was simply mentioned in this article as having been approved by Weld county commissioners at the same hearing where the commissioners said they would stand by their prior decision to keep Plan B out of county health clinics.

[29]The Susan Thompson Buffett Foundation provided funding for the CFPI from 2009–2015, with all funds expiring in the summer of 2015.

[30]Other outlets covering the program included CNN, Denver Post, NPR, and Vox (Schmidt, 2014; Popovich, 2014; Frank, 2015; Horsley, 2015).

[31]In May 2015, the Colorado state senate voted to kill a bill allocating $5 million in funding for the initiative. After a push for continued funding by the DPHE, in August 2015, state officials announced that a group of organizations pledged $2 million to fund the program through the summer of 2016, with no promise of renewed funding in subsequent years (Paul, 2015). Following the end of these private funds, in 2016 the Colorado Senate voted 30-5 to pass a budget bill that included $2.5 million in Title X funding for LARC provision. The Colorado DPHE has since stated that this pledge of new funds was partially due to the reported benefits of LARC access and public awareness of the successes of the CFPI (Colorado Department of Public Health and Environment, 2017).

[32]Politicians and other advocates gained significant media attention by wearing IUD-shaped earrings at the proceedings.

As another approach to assessing the role of advertising, we explore the share of clients having a LARC inserted at Title X clinics in Colorado. Specifically, in Figure 7 we display LARC insertions per female Title X client for each year, 2009–2015.[33] Notably, "insertion" in this context is different from "usage" as reported in Figure 1 because usage statistics reflect both new and existing LARCs at time of exit. As shown in Figure 7, the number of LARC insertions per Title X client initially grew slowly (by 3.1 percent from 2009–2010), then grew steadily by 7.3–9.8 percent annually from 2010–2014 before it spiked by nearly 16 percent from 2014 to 2015. This jump is consistent with the idea that the significant media attention in 2015 caused a spike in women's interest in visiting Colorado's Title X clinics to obtain a LARC. It is also important to note, however, that the CFPI *was* covered by the media in the second half of 2014 and we do not see any evidence of a trend break between 2013 and 2014. As such, these results suggest that there was a delayed effect of the 2014 media coverage and/or that the 2015 news coverage was more impactful. Indeed, the 2015 spike may have been in part (or entirely) due to increased awareness of the possibility that clinics would have to stop providing LARCs without additional funding.

As a third and final approach to assessing whether the effect of the CFPI was different after extensive media coverage, we re-examine the geographic reach of the initiative with a focus on that period of time. This analysis is similar to that discussed in Section 4.2, where we showed that the initiative reduced births for women up to 7 miles from clinics when evaluating all years after the CFPI was implemented; here we instead focus on how the estimated effects vary with distance for 2014 and 2015, separately. In particular, we estimate Equation 1 using a sample containing all pre-CFPI years and only the relevant post-initiative year (i.e. 2014 or 2015) in an effort to parse out the year-by-year reach.

These results, shown in Figure 8, offer several additional insights. First, they indicate that the geographic reach, in terms of reducing births for 15–17 year olds, was larger in 2015 than in 2014. In 2014, the estimates are statistically significant for each 5-mile treatment group that we consider until we evaluate women in zip codes 5–10 miles

[33]Unfortunately, these data are not available after 2015. They also do not include separate counts by age group; thus, we focus on the numbers overall.

from a clinic. In 2015, the estimated effects are larger in magnitude and continue to be statistically significant until we evaluate women in zip codes 12–17 miles from a clinic. The results shown in Figure 8 also provide stronger evidence of effects on births of 20–29 year olds in 2015 than in 2014, which mirrors our results shown in Table 2.

As a whole, these analyses provide several new pieces of evidence to suggest that media coverage of the initiative increased women's interest in obtaining LARCs through Title X clinics and expanded the impact of the program to women in their 20s and also to high-school-aged teenagers living relatively far away from clinics. Taken together with our main results, these findings can inform policy questions on how the spread of information can encourage highly effective contraception use and how far women are willing to travel for low-cost contraceptives.

4.6 Additional Subgroup Analyses

Across all of our analyses, we find consistent evidence that the CFPI reduced births for women under the age of 29. We have also shown that the effects are greatest for teenagers (both high-school and post-high-school aged) and that they become significant for women in their 20s after the initiative received widespread media attention. In this section and the following section we further explore the degree to which there are heterogeneous treatment effects across different subgroups of women and zip codes and whether the change in composition of mothers affected infant health.

Given that the CFPI provided funding for Title X clinics, we might expect birth rates to be more responsive in areas with a relatively large share of individuals living in poverty. That said, given that these clinics provide services based on self-reported income and because young women typically have low incomes, the effects might be similar across areas with different levels of poverty. We explore this issue in Table 3 by separately evaluating subgroups of high- and low-poverty zip codes. We define high-poverty zip codes as those having more than the median 2010 poverty rate and define low-poverty zip codes as having rates below this median. The estimated effects 3-7 years after implementation are nearly all statistically significant across Columns 1–4, implying that the CFPI reduced births to teens living in both high and low-poverty areas. Average effects for 15–17 year olds and 18–19 year olds are statistically similar across low- and high-poverty zip codes, and indicate a reduction in births of 15.3–20.6 percent. For women in their 20s, however, the effects on births appear to be driven by low-poverty zip codes, with estimates indicating reductions caused by the CFPI from 11.9–17.6 percent. Effects for high-poverty zip codes for these age groups are statistically insignificant for all years, and are much smaller in magnitude (1.3–1.9 percent). However, we note that these findings may be explained by the composition of individuals living in these lower income zip codes. Although high-poverty and low-poverty groups have similar average distance and travel time to clinics, high-poverty zip codes have twice as many births to 15–17 and 18–19 year olds as low-poverty zip codes and have higher concentrations of Black and Hispanic women. Below, we test to what extent effects vary across these groups of women.

In Table 4 we additionally analyze how much the effects of the CFPI vary across race and ethnicity. In Columns 1, 4, 7, and 10 we present estimates of the effects of the CFPI on births to White mothers, in Columns 2, 5, 8, and 11, we present estimates for Black mothers, and in the remaining columns, we show estimates for Hispanic mothers. Across all age groups, the estimated effects for Hispanics are larger than average. Estimates for white mothers are similar to our main results. Estimated effects for black mothers are similar to Hispanics for those 15–17 years old but we find no evidence of effects for the 18–19 year-old age group. And while we do find evidence of effects for the 20–24 year-old group of black women, it is smaller than the estimated effects for white and Hispanic women. Likewise, we find no evidence of effects for black women in the 25–29 year-old age group. Given this unexpected pattern of estimated effects across age groups for black women, further investigation of race and age based heterogeneity is important for future work.

Finally, since Title X clinics are most likely to locate in urban areas, we investigate whether effects are driven by women in urban or rural zip codes. We use the United States Department of Agriculture's Rural-Urban Commuting Area (RUCA) codes to classify each zip code as either urban or rural and estimate the effects separately for rural and urban zip codes.[34] The results of these analyses are presented in Table A1. Columns 1 and 2 show estimates from our preferred specification for 15–17 year olds at rural and urban zip codes, respectively. Columns 3–8 repeat this process for 18–19 year olds, 20–24 year olds, and 25–29 year olds. While the estimates are typically imprecise for women living in rural zip codes, as a whole these results indicate that the effects are largely similar for teenagers in rural and urban areas. That said, there we see weaker evidence of post-media-attention (post-2013) effects on 20–24 year-old women in rural areas than we do for 25–29 year-old women in urban areas.

4.7 Estimated Effects on Abortion

Thus far we have shown that the CFPI decreased childbearing for women aged 15–29. This evidence indicates that access to highly effective contraceptives decreased reduced unintended pregnancies that otherwise would have resulted in births. It is important to note that these estimated effects may understate the effects on unintended pregnancy overall, particularly if the program also reduced unintended pregnancies that otherwise would have resulted in abortions. This is not a trivial issue given that 29 percent of pregnancies to teenagers—and 26 percent of pregnancies to women aged 20–24—end in abortion (Kost, Maddow-Zimet, and Arpaia, 2017).

To investigate whether the CFPI also reduced unintended pregnancies that would have been terminated, in this section we present difference-in-differences-type estimates for abortion rates by age group (15–19, 20–24, 25–29).[35] For this analysis we use annual county-level abortion counts to construct an inverse hyperbolic sine measure of abortion rates.[36] Moreover, we measure a county's exposure to the CFPI based on the percent of its population living within 7 miles of a Title X clinic.[37] Our empirical model includes both county fixed effects and year fixed effects and clusters standard error estimates at

[34]Zip code-level classifications can be found at https://ruralhealth.und.edu/ruca and were created from USDA census tract data, by the University of North Dakota's Center for Rural Health. We classify a zip code as 'rural' if its RUCA code is 4.0 or higher.

[35]Separate breakdowns for younger (15–17) and older (18–19) are not available for this analysis.

[36]Specifically, this measure is constructed as $IHS(count) - IHS(population)$ as we could typically do if evaluating the natural log of a rate variable.

[37]Specifically, this county level measure of exposure is constructed as the fraction of people in a county that live in a zip code whose population centroid is within 7 miles of a clinic.

the county level.

Estimated effects for all years leading up to—and following—the implementation of the CFPI are presented in Figure 9, while estimates from our preferred model (excluding lead terms) are presented in Table 6. In general, the estimates are too imprecise to draw any strong conclusions. As we would expect, the estimates are more precise in Table 6 where they indicate a statistically significant effect on teenagers, but the event-study-type estimates in Figure 9 suggest that this may be in part due to somewhat differential trends prior to the CFPI. As a whole, we interpret the results of this analysis as providing suggestive evidence of effects on teenage abortion rates. A more cautious interpretation is that we cannot rule out very large or very small effects on abortion rates.[38]

4.8 Estimated Effects on Infant Health

To provide an even more comprehensive picture of the health effects of the CFPI, we extend our analysis to study whether the CFPI affected births that tend to involve relatively high hospital costs. Specifically, we use the same empirical strategy as our main results, but focus births involving low birth weight (less than 2500 grams), very low birth weight (i.e. less than 1500 grams), or low Apgar scores (less than 9).[39] The results of this analysis are shown in Table 5. Column 1 replicates our births analysis for women aged 15–29, Columns 2 and 3 show effects of the CFPI on the number of low birthweight and very low birthweight babies, respectively, and Column 4 displays estimates for the number of infants scoring less than a 9 out of 10 on the 5-minute Apgar test.

Estimates in Column 1 largely reinforce our main findings—that the CFPI reduced births to women aged 15–19 by 7.9 percent, with larger effects in later years. Estimates in Columns 2–4 indicate that the CFPI also had effects on births that typically involve more-than-average hospital care. In particular, the CFPI reduced the number of low birthweight infants by 11.9 percent, and very low birthweight infants by 9.0 percent.

[38] We have similarly estimated analogous to the procedure described above to analyze effects on county-level chlamydia and gonorrhea rates to evaluate whether lowering the cost of obtaining contraceptives increases more risky sexual behavior. Estimates are too imprecise to be meaningful.

[39] The Apgar is a test score scaled from 1-10 and serves as a measure of the status of the newborn immediately after birth. Nearly 82 percent of infants in our sample score either a nine or ten. Scores between four and seven indicate that some assistance for breathing and/or resusitation might be required.

This corresponds to approximately 482 fewer infants that may require extra care in the hospital per year.[40] Similarly, as shown in Column 4, we find that the CFPI reduced the number of infants with low 5-minute Apgar scores. Estimates in Column 4 indicate that the CFPI reduced the number of infants scoring 1-8 on the test by 23.5 percent 6-7 years after the program's initiation, suggesting that the CFPI led to an improvement in the overall health of infants born to women aged 15–29. As a whole, the estimates in Table 5 demonstrate that the CFPI reduced births that tend to involve relatively high hospital costs.[41]

5 Validity and Robustness

In this section we present a set of sensitivity checks to provide additional support for our main identifying assumption. We begin by addressing the possibility that differential trends in population flows and/or zip code demographics might be confounding our estimated effects. However, before doing so, we note that, based on findings discussed above, including those shown in Figure 6, it is unlikely that pre-existing trends in population flows and/or demographics are driving our results. To provide further evidence along these lines, we use data from the two most recent decennial censuses to show that treated and comparison zip codes did not change differently between 2000 and 2010, by evaluating the difference-in-differences in demographics across these years.[42] We additionally show a measure of predicted births based on these population estimates, as a way to gauge whether our estimates are large in comparison to what we would expect in the absence of the intervention. We present these estimates in Table A2.[43] We find no statistically significant effects on the number of women 15-29 years old or the share of 15-29 year old women who are white, black, or Hispanic. We also find no statistically

[40]This is based on the fact that approximately 6.3 births to women aged 15–29 are considered low birthweight, while 0.9 births to women aged 15–29 are considered very low birthweight, per zip code, per year, on average.

[41]Though the point estimates typically suggest the effect is larger for these types of births than births overall, the standard errors are too large to reject that the effects are the same at conventional levels of statistical significance.

[42]Ideally we would examine the same set of years that we examine in our main results; however, this analysis is constrained by the availability of Census data.

[43]The coefficients are transformed to represent the change expected over one year.

significant effects on the predicted number of births based these variables.[44] That said, we recognize that a lack of power means that we cannot rule out economically significant effects at conventional levels of statistical significance.

Second, we test how robust our analyses are to the definition of distance. In Table A3, we redefine treatment using additional distance measures: "as the crow flies" distance and driving time, in minutes, according to Google map data. To do so, we first consider our treatment group as those zip codes within 7 miles of a clinic, based on crow flies distance, and display these difference-in-differences coefficients in Panel A of Table A3. Across specifications for all age groups, estimates are consistent with our main results. In Panel B, we define our treatment group to be zip codes within 10 minutes driving time of a clinic, which most closely resembles a 7 mile travel distance range. Estimates are similar in magnitude and direction as our main results.

Next, we show how redefining our treatment group by the number of miles affects our estimates. In Table A4 we define two new treatment groups (zip codes within 0–5 miles and 0–10 miles of a Title X clinic), and their respective comparison groups, separately, and display these coefficients with our preferred treatment group (zip codes within 7 miles of a clinic) for each age group. Estimates for all treatment definitions are similar to our main results, and indicate reductions in births ranging from 16.0–20.1 percent for 15–17 year olds and 15.1–15.2 percent for 18–19 year olds. This provides some evidence that the CFPI, not our ad-hoc definition of treatment status, is responsible for the decline in births among young Colorado women.

Finally, we provide weighted least squares estimates in Table A5 in an effort to get a better sense of how the CFPI differentially affected zip codes with dissimilar population sizes. In Columns 2, 4, 6, and 8, each cell is weighted by the overall female zip code population according to the 2010 ACS. Notably, these alternative estimates are less precise than our main results. They are also smaller in magnitude than the OLS esti-

[44] Specifically, we estimate predicted births using a two-step procedure. First, we use 2010 data to evaluate the inverse-hyperbolic-sine of the number of births in each zip code as a function of the aforementioned variables. Second, we estimate the *predicted* inverse-hyperbolic-sine of the number of births for each zip code in 2000 and 2010 based on the coefficient estimates from step one combined with the observed demographics.

mates, which suggests that there are relatively large effects for zip codes with relatively small populations for the reasons described in (Solon, Haider, and Wooldridge, 2015). We explore this heterogeneity directly in Table A6, by presenting estimates for zip codes with less than 2,000 total females.[45] Notably, restricting attention to less-populated zip codes limits our number of treatment zip codes to only 26, as compared to 163 in the full sample. Therefore, it may be unsurprising that estimates in some columns of Table A6 are fairly imprecise. However, we note that these estimates do provide some suggestive evidence that estimates are comparatively large for less-populated zip codes for all age groups except 20–24 year olds, which sheds light on why the OLS estimates are relatively large in magnitude as compared to the WLS estimates.

6 Conclusion

In this paper, we document the effects of expanding access to highly effective contraceptives through the lens of The Colorado Family Planning Initiative, which provided free LARCs to low-income women at Title X clinics. Using zip-code-level Natality data, we compare Colorado zip codes within 7 miles of a Title X clinic to zip codes further away and estimate that the CFPI reduced births to 15–17 and 18–19 year olds by 20.1 percent and 17.8 percent, on average. We also find effects on older women, aged 20–24 and 25–29, with estimated reductions of 8.0 percent and 5.7 percent, respectively. Taken together, these effects correspond to nearly 6,800 fewer births to women aged 15–29 over 7 years. We find that these effects grow over time and persist even after the program's end.

Using a data-driven, non-parametric approach, we additionally analyze the geographic reach of the program, and find that teenagers are willing to travel further to obtain low-cost devices. These findings indicate that financial barriers to highly effective contraceptives may be of significant importance for this group. Finally, we study the impact of external advertising and notoriety of the CFPI, and find that the spread of information

[45] We choose this cutoff for two reasons. First, the median female population is about 1,900 and second, in Table A1 we find differential effects for rural areas, which have, on average, about 1,500 females. Effects for specifications that limit our sample to 1,500 individuals are qualitatively similar.

has a reach of approximately 12 miles for teens and 9 miles for women in their 20s. These results complement recent work finding statistically significant but imprecise evidence that LARC use can be increased through social media (Byker, Myers, and Graff, 2017). Despite the fact that any Title X client was eligible to participate in the program, we see little to no effects for women living further than 12 miles from a clinic, suggesting that low-income women living in areas with fewer health care resources may face larger hurdles in obtaining affordable contraceptives.

These results illustrate the importance of access to highly effective contraceptive devices in reducing unintended pregnancy. In light of recent proposed state and federal policy changes to cut family planning funding and with recent Supreme Court case rulings regarding employer-sponsored contraception and policies regarding abortion clinics, our findings have important and relevant policy implications. While a large existing literature shows that distance to family planning clinics impact preventative care, contraception use, and abortion, our paper provides clear evidence that information as well as financial barriers play a crucial role in women's fertility. Given the well-established link between family formation and women's long-run outcomes, it will become increasingly important for future research to determine the extent and scope of how expanding (or reducing) access to LARCs affects sexual activity and human capital formation more broadly.

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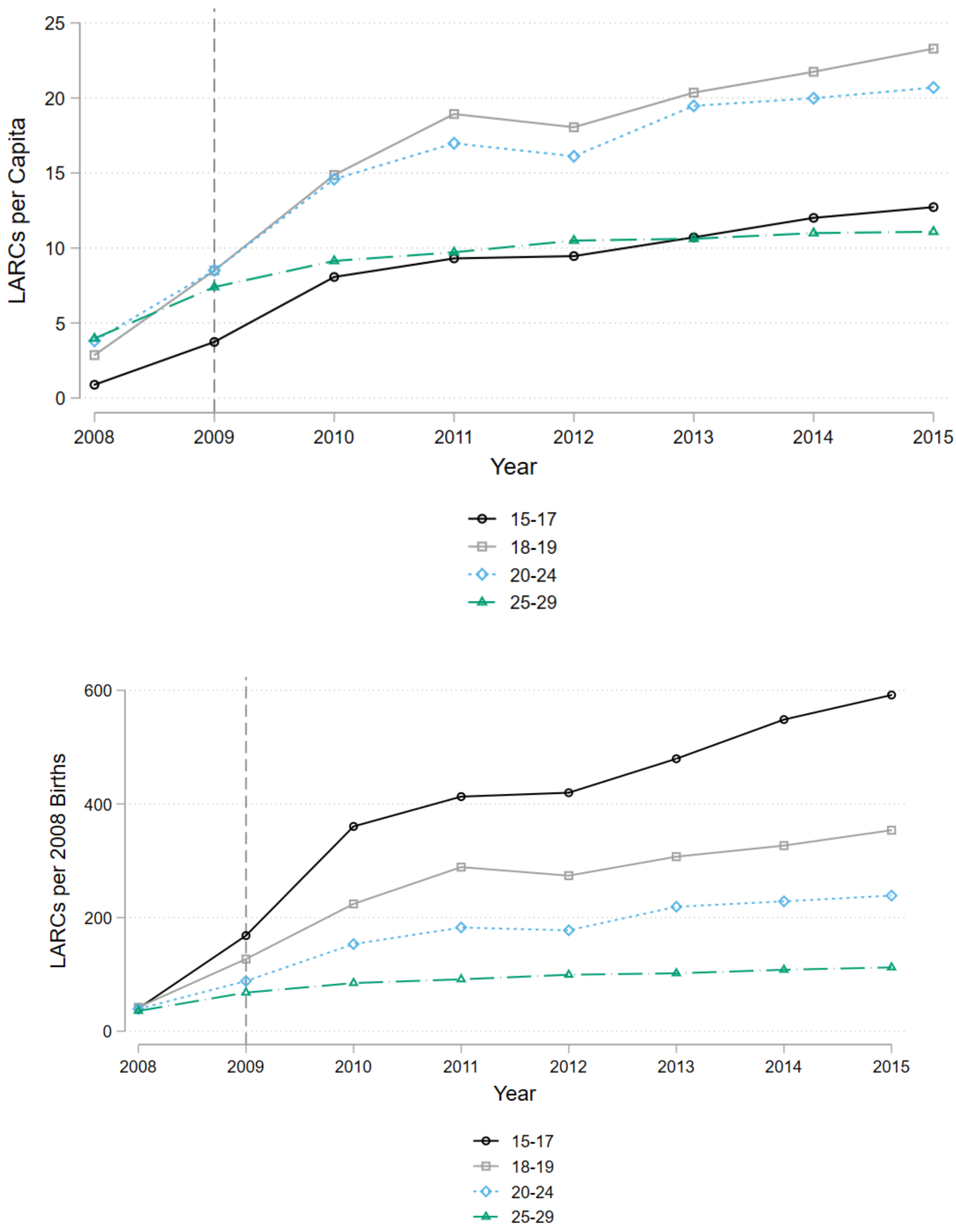
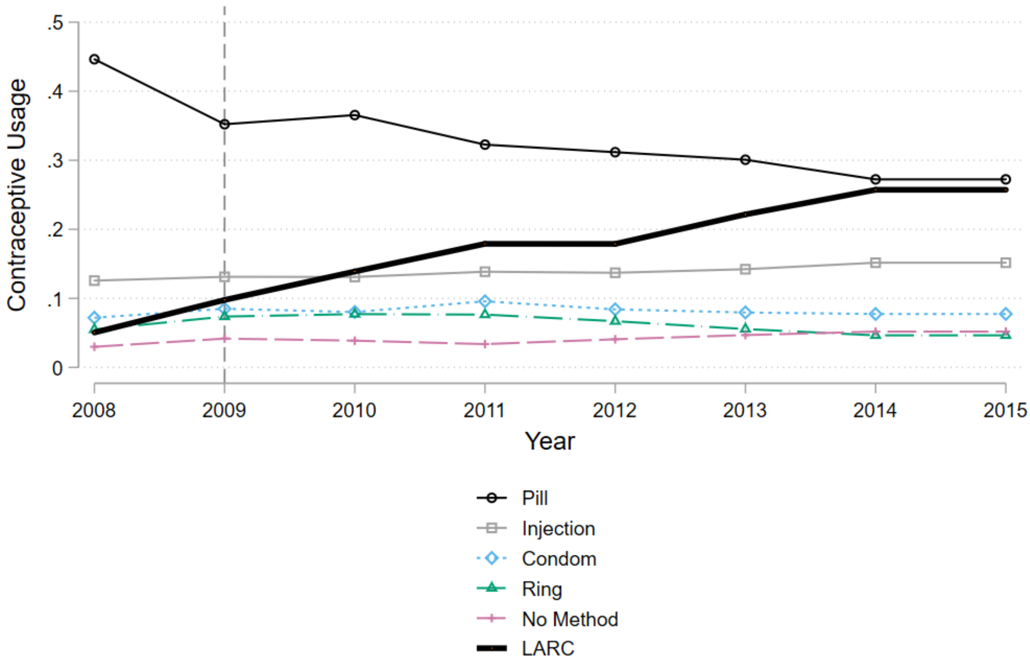
Figure 1
Number of Female Title X Clients Choosing a LARC, By Age



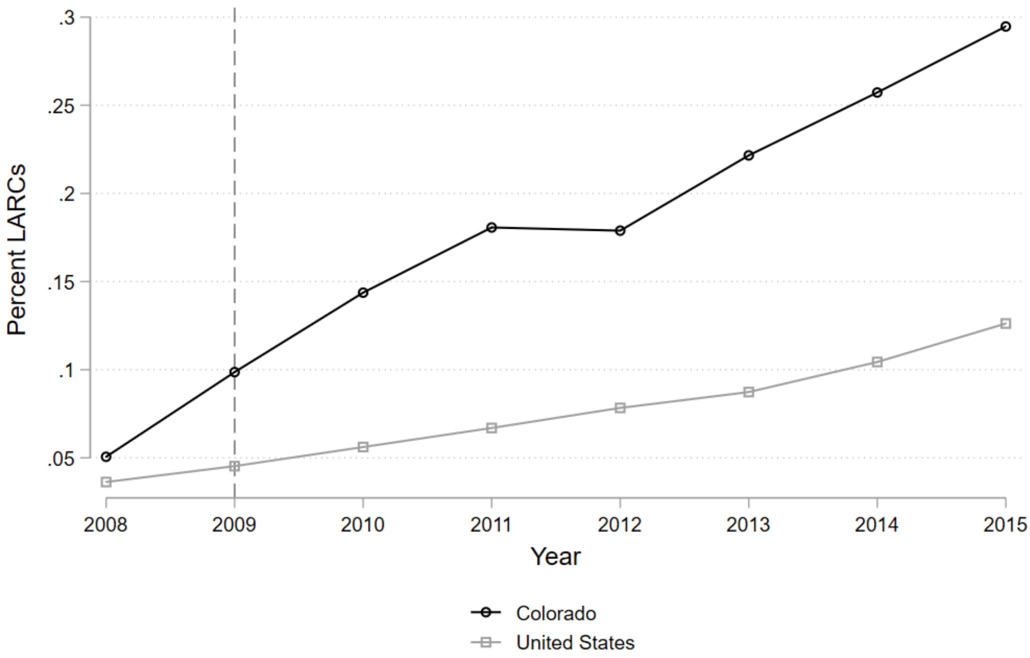
Notes: Authors' calculation based on annual data on Colorado Title X contraception usage by age and method provided by the Colorado Department of Public Health and Environment (DPHE). Zip-code-level population data are from the 2010 American Community Survey. The vertical line, drawn at 2009, represents the year Colorado's Family Planning Initiative was implemented. The top panel displays the number of LARCs chosen by Colorado Title X clients per capita, by age group, from 2008–2015, while the bottom panel displays the number of LARCs chosen by Colorado Title X clients per births in 2008, according to natality data from the Colorado DPHE.

Figure 2
Primary Form of Contraceptive Used By Females Aged 15–29 Visiting Title X Clinics in Colorado



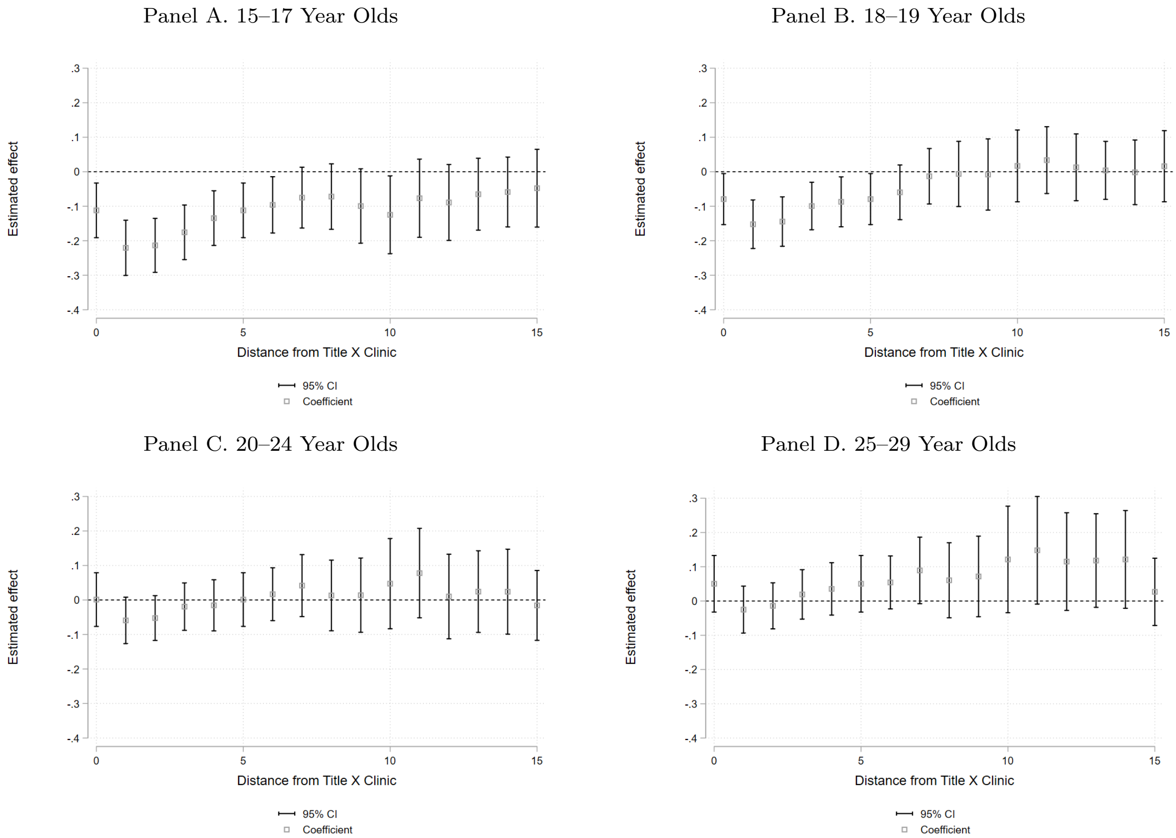
Notes: Authors' calculation based on annual data on Colorado Title X contraception usage by age and method provided by the Colorado Department of Public Health and Environment. The vertical line, drawn at 2009, represents the year Colorado's Family Planning Initiative was implemented.

Figure 3
Percent Female Clients Aged 15–29 Visiting Title X Clinics Choosing a LARC, Colorado versus United States



Notes: Numbers for Colorado are based on annual data on Colorado Title X contraception usage by age and method provided by the Colorado Department of Public Health and Environment. Numbers for the United States overall are from the Department of Health and Human Services Title X Family Planning Annual Reports, United States 2008–2015. The vertical line, drawn at 2009, represents the year Colorado's Family Planning Initiative was implemented.

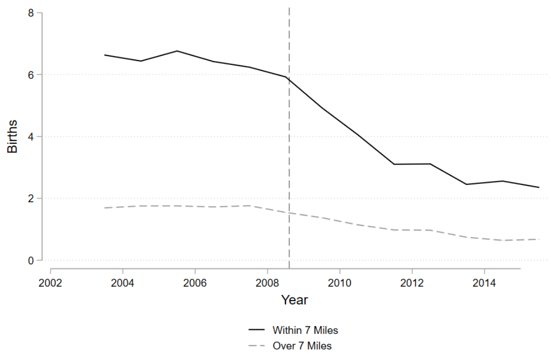
Figure 4
Estimated Effects of the CFPI on Births by Rolling 5-Mile Distance Bins



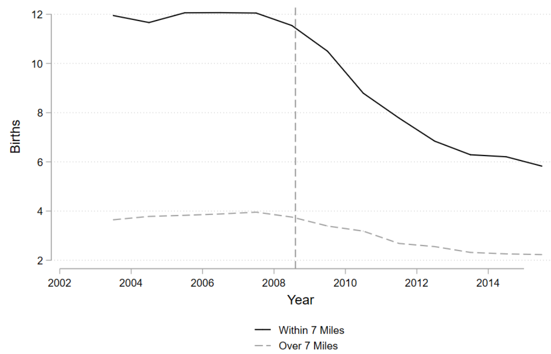
Notes: Coefficients and their respective 95% confidence intervals are generated from a regression estimated using OLS-IHS transformation, as specified in Equation 2, using rolling 5-mile distance bins to define treatment. A x-axis value of "i" where $i = 0, 1, ...15$ indicates an estimate from a difference-in-differences analysis comparing changes in births in zip codes within i and $(i + 5)$ miles of a Title X clinic to changes in zip codes between $(i + 5)$ and 20 miles from a clinic. Zip codes greater than 20 miles from a Colorado Title X clinic are omitted from this analysis. Standard errors are clustered at the zip-code level.

Figure 5
Births by Distance to a Colorado Title X Clinic

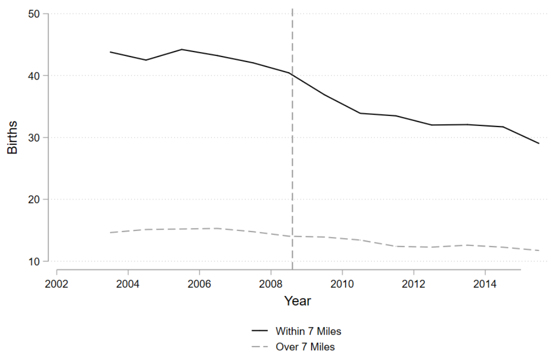
Panel A. 15–17 Year Olds



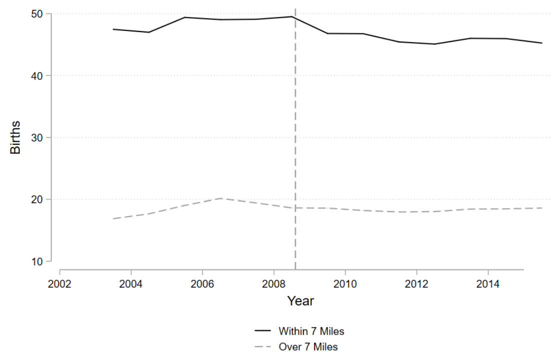
Panel B. 18–19 Year Olds



Panel C. 20–24 Year Olds



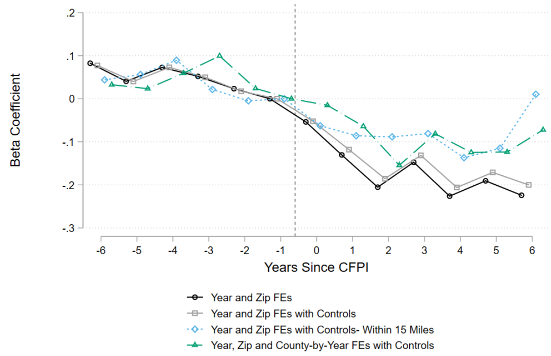
Panel D. 25–29 Year Olds



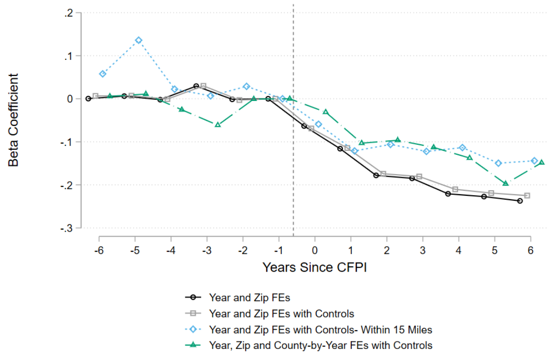
Notes: Numbers for Colorado are authors' calculation based on restricted Natality data by zip code and geocoded clinic locations from the Colorado Department of Public Health and Environment. The vertical line, drawn before 2009, represents the year Colorado's Family Planning Initiative was implemented.

Figure 6
Difference-in-Differences Estimates of the Effects of the CFPI on Births

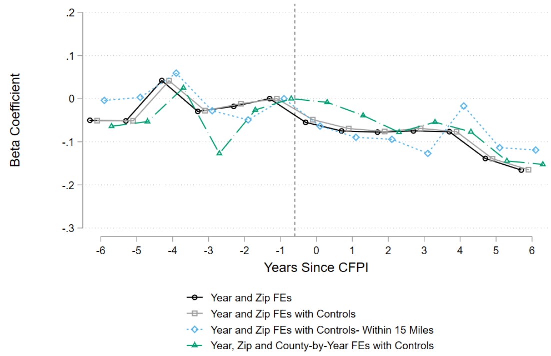
Panel A. 15–17 Year Olds



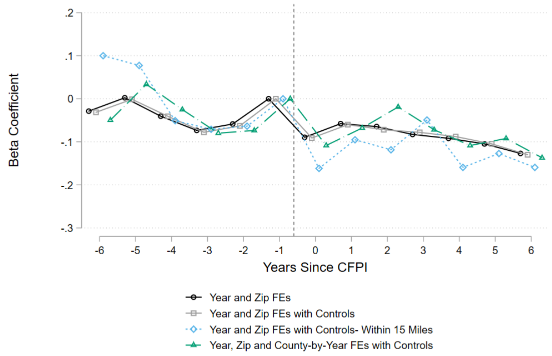
Panel B. 18–19 Year Olds



Panel C. 20–24 Year Olds

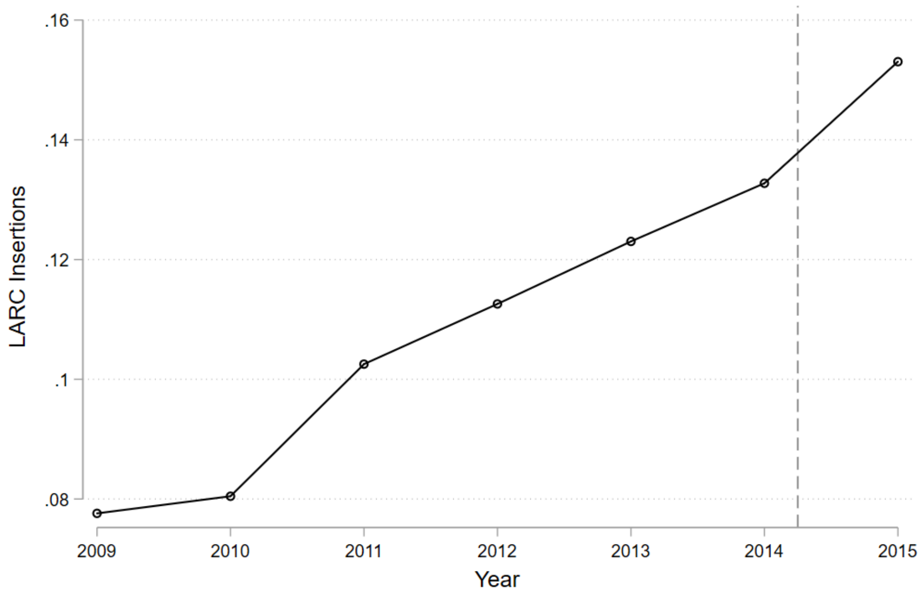


Panel D. 25–29 Year Olds



Notes: Coefficients are generated from estimating our main difference-in-differences model, as specified in Equation 2. The vertical line, drawn before 2009, represents the year Colorado's Family Planning Initiative was implemented. The treatment group includes zip codes withing 0–7 miles of a Title X clinic. The control group includes zip codes further than 7 miles from a clinic. Estimates are relative to 2008.

Figure 7
LARC Insertions Per Client

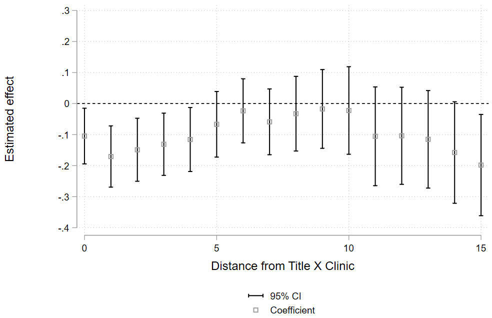


Notes: Authors' calculations based on LARC insertion data from the Colorado Department of Public Health and Environment. The vertical line, drawn before 2015, represents the initiation of media coverage.

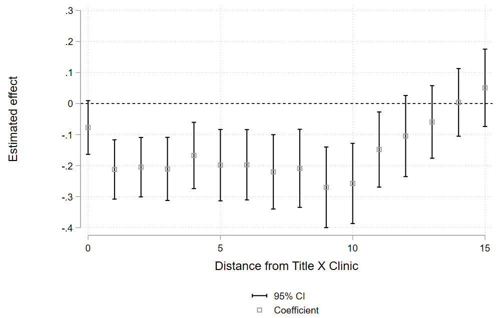
Figure 8

Estimated Effects of the CFPI on Births by Rolling 5-Mile Distance Bins, 2014–2015

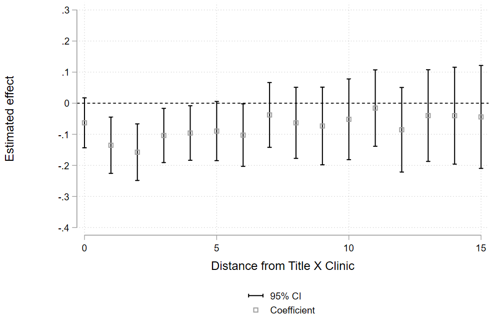
Panel A. 15–17 Year Olds, 2014



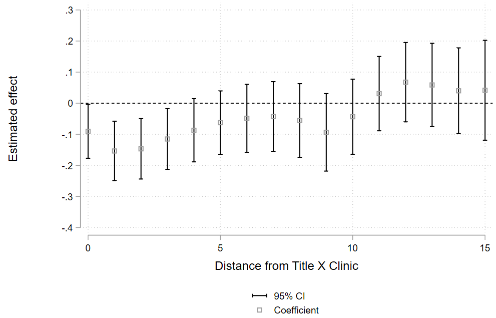
Panel B. 15–17 Year Olds, 2015



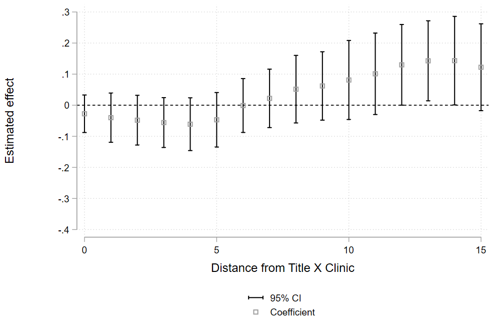
Panel C. 18–19 Year Olds, 2014



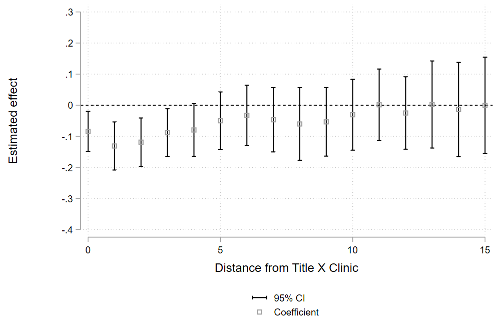
Panel D. 18–19 Year Olds, 2015



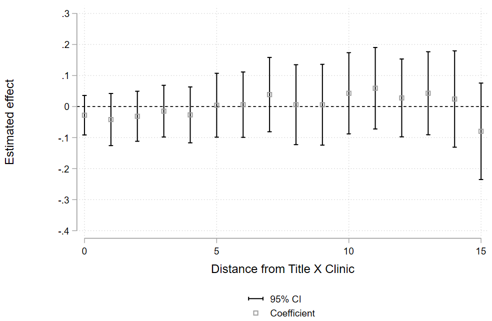
Panel E. 20–24 Year Olds, 2014



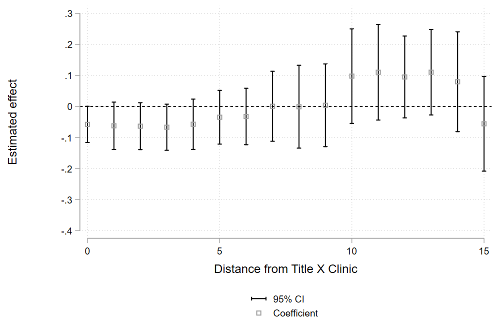
Panel F. 20–24 Year Olds, 2015



Panel G. 25–29 Year Olds, 2014



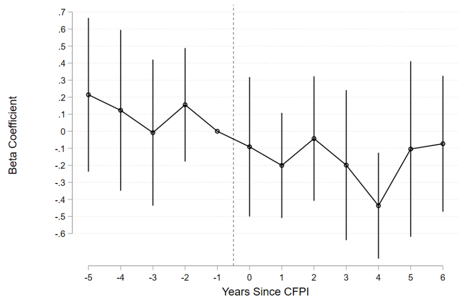
Panel H. 25–29 Year Olds, 2015



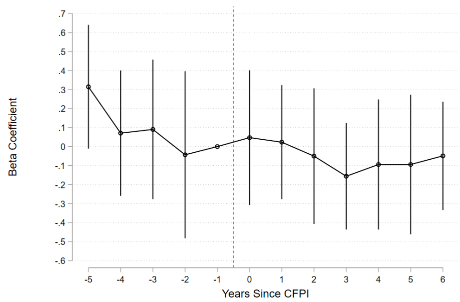
Notes: Coefficients and their respective 95% confidence intervals are generated from a regression estimated using OLS-IHS transformation, as specified in Equation 2, using rolling 5-mile distance bins to define treatment. A x-axis value of "i" where $i = 0, 1, ...15$ indicates an estimate from a difference-in-differences analysis comparing changes in births in zip codes within i and $(i+5)$ miles of a Title X clinic to changes in zip codes between $(i+5)$ and 20 miles from a clinic. Zip codes greater than 20 miles from a Colorado Title X clinic are omitted from this analysis. Standard errors are clustered at the zip-code level.

Figure 9
Estimated Effects on Abortion Rates by the Fraction of the Population Living within 7 Miles of a Title X Clinic

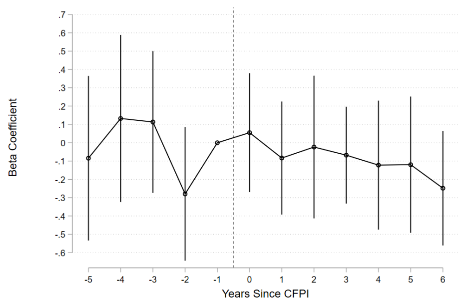
Panel A. 15–19 Year Olds



Panel B. 20–24 Year Olds



Panel C. 25–29 Year Olds



Notes: County-leve abortion data are from the Colorado Department of Public Health and Environment. The outcome variable is the difference between the inverse hyperbolic sine transformations of abortions by age group and female population for the relevant age group. Coefficients are generated from estimating our main difference-in-differences model, as specified in Equation 2, using a continuous measure—the fraction of population in zip codes within 7 miles of a Title X clinic—to measure exposure to the CFPI. Controls include county-level unemployment rates, poverty rates, fractions of individuals aged 15–29 by age, ethnicity, and race, the percent of each age group who are Hispanic, and the percent of each age group who are black. The vertical line, drawn before 2009, represents the year Colorado's Family Planning Initiative was implemented. Estimates are relative to 2008.

Table 1
Summary Statistics

	Within 7 Miles	**Over 7 Miles**
Pre-Treatment (2003–2008)		
Births to Females aged 15-17	7.74	1.79
Births to Females aged 18-19	14.37	3.99
Births to Females aged 20-24	51.61	15.55
Births to Females aged 25-29	58.72	19.50
Percent Poverty Rate	11.56	12.06
Unemployment Rate	0.05	0.05
Population (County)	41888	15678
Percent Hispanic (County)	21.24	18.15
Percent Black (County)	4.80	2.24
Percent White (County)	70.96	77.50
Travel Distance to Nearest Title X Clinic	3.62	34.87
Driving Time to Nearest Title X Clinic	9.24	53.80
Post-Treatment (2009–2015)		
Births to Females aged 15-17	3.89	0.98
Births to Females aged 18-19	9.02	2.79
Births to Females aged 20-24	39.56	13.25
Births to Females aged 25-29	55.48	19.18
Percent Poverty Rate	13.41	14.13
Unemployment Rate	0.07	0.07
Population	53140	20531
Percent Hispanic (County)	22.50	19.63
Percent Black (County)	5.07	2.65
Percent White (County)	69.25	75.52
Travel Distance to Nearest Title X Clinic	3.62	34.87
Driving Time to Nearest Title X Clinic	9.24	53.80

Notes: Birth data are from the Colorado Department of Public Health and Environment. Unemployment rates are from the BLS. Zip-Code-level population data are from the 2010 ACS. Column 1 shows the means for treated zip codes in our sample, i.e., Colorado zip codes within 7 miles of a Title X clinic. Column 2 displays the means for the comparison zip codes, i.e., zip codes in Colorado further than 7 miles from a Title X clinic.

Table 2
The Effect of CFPI on Births

	15–17 Year Olds		18–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect of Initiative in First Year	-0.099**	-0.091**	-0.069	-0.074*	-0.037	-0.029	-0.056	-0.052
	(0.044)	(0.044)	(0.043)	(0.044)	(0.038)	(0.039)	(0.037)	(0.037)
Effect of Initiative in Second Year	-0.176***	-0.165***	-0.121***	-0.127***	-0.057	-0.052	-0.025	-0.020
	(0.047)	(0.048)	(0.045)	(0.045)	(0.039)	(0.040)	(0.040)	(0.040)
Effect of Initiative in Third Year	-0.251***	-0.233***	-0.183***	-0.183***	-0.060	-0.063	-0.031	-0.038
	(0.049)	(0.049)	(0.044)	(0.044)	(0.039)	(0.039)	(0.037)	(0.037)
Effect of Initiative in Fourth Year	-0.193***	-0.182***	-0.190***	-0.188***	-0.057	-0.059	-0.050	-0.047
	(0.052)	(0.052)	(0.046)	(0.046)	(0.045)	(0.045)	(0.040)	(0.040)
Effect of Initiative in Fifth Year	-0.271***	-0.259***	-0.226***	-0.220***	-0.059	-0.067	-0.059	-0.058
	(0.061)	(0.061)	(0.052)	(0.053)	(0.046)	(0.046)	(0.045)	(0.045)
Effect of Initiative in Sixth Year	-0.236***	-0.225***	-0.233***	-0.225***	-0.121***	-0.134***	-0.072	-0.079*
	(0.060)	(0.061)	(0.051)	(0.052)	(0.042)	(0.043)	(0.045)	(0.047)
Effect of Initiative in Seventh Year	-0.269***	-0.252***	-0.243***	-0.229***	-0.148***	-0.159***	-0.094**	-0.104**
	(0.058)	(0.058)	(0.053)	(0.054)	(0.043)	(0.044)	(0.041)	(0.042)
Average effect	-0.213	-0.201	-0.181	-0.178	-0.077	-0.080	-0.055	-0.057
P-value (test average effect = 0)	0.000	0.000	0.000	0.000	0.012	0.009	0.075	0.070
Average effect in years 6-7	-0.253	-0.238	-0.238	-0.227	-0.134	-0.146	-0.083	-0.091
P-value (test average effect in years 6-7 = 0)	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.021
Observations	7644	7644	7644	7642	7644	7644	7644	7644
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects. Controls include zip-code-level unemployment rates and poverty rates and county-level fractions of individuals aged 15–29 by age, ethnicity, and race, the percent of each age group who are Hispanic, and the percent of each age group who are black. Standard errors are clustered at the zip-code level.

*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table 3
The Effect of CFPI on Births by Zip Code Poverty Rate

	15–17 Year Olds		18–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	Low Pov.	High Pov.	Low Pov.	High Pov.	Low Pov.	High Pov.	Low Pov.	High Pov.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect of Initiative in First Year	-0.115	-0.062	-0.078	-0.050	-0.033	-0.036	-0.082	-0.032
	(0.081)	(0.056)	(0.080)	(0.053)	(0.059)	(0.052)	(0.070)	(0.041)
Effect of Initiative in Second Year	-0.126	-0.166***	-0.199**	-0.065	-0.135**	-0.004	-0.145**	0.083*
	(0.090)	(0.055)	(0.088)	(0.052)	(0.061)	(0.052)	(0.066)	(0.049)
Effect of Initiative in Third Year	-0.184**	-0.252***	-0.219***	-0.149***	-0.131*	-0.021	-0.033	-0.056
	(0.076)	(0.067)	(0.079)	(0.054)	(0.067)	(0.046)	(0.065)	(0.046)
Effect of Initiative in Fourth Year	-0.134	-0.185***	-0.134*	-0.230***	-0.188**	0.045	-0.077	-0.040
	(0.083)	(0.067)	(0.074)	(0.058)	(0.074)	(0.058)	(0.072)	(0.046)
Effect of Initiative in Fifth Year	-0.226**	-0.255***	-0.139	-0.261***	-0.195**	0.021	-0.140*	-0.014
	(0.114)	(0.073)	(0.089)	(0.067)	(0.082)	(0.057)	(0.084)	(0.052)
Effect of Initiative in Sixth Year	-0.152	-0.256***	-0.339***	-0.155***	-0.270***	-0.024	-0.161*	-0.046
	(0.106)	(0.078)	(0.098)	(0.059)	(0.078)	(0.050)	(0.087)	(0.051)
Effect of Initiative in Seventh Year	-0.275**	-0.225***	-0.335***	-0.159**	-0.280***	-0.075	-0.194***	-0.031
	(0.110)	(0.069)	(0.091)	(0.066)	(0.079)	(0.052)	(0.069)	(0.052)
Average effect	-0.173	-0.200	-0.206	-0.153	-0.176	-0.013	-0.119	-0.019
P-value (test average effect = 0)	0.010	0.000	0.000	0.000	0.001	0.701	0.052	0.528
Average effect in years 6-7	-0.214	-0.241	-0.337	-0.157	-0.275	-0.050	-0.178	-0.038
P-value (test average effect in years 6-7 = 0)	0.025	0.000	0.000	0.005	0.000	0.249	0.013	0.373
Observations	3796	3848	3796	3846	3796	3848	3796	3848

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects, and demographic and economic controls. "High Pov." zip codes are defined as zip codes with poverty rates above the 2010 Colorado median poverty rate. "Low Pov." zip codes are zip codes with poverty rates at or below the 2010 Colorado median poverty rate. Standard errors are clustered at the zip-code level.
*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table 4
The Effect of CFPI on Births by Race and Ethnicity

	15–17 Year Olds			18–19 Year Olds			20–24 Year Olds			25–29 Year Olds		
	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Effect of Initiative in First Year	-0.087**	-0.091**	-0.097**	0.040	0.006	-0.089**	-0.008	0.034	-0.065*	-0.002	0.005	-0.076**
	(0.043)	(0.044)	(0.043)	(0.042)	(0.004)	(0.042)	(0.039)	(0.039)	(0.039)	(0.036)	(0.039)	(0.038)
Effect of Initiative in Second Year	-0.134***	-0.165***	-0.168***	-0.127***	-0.002	-0.097**	-0.073*	-0.057	-0.046	0.010	0.023	-0.021
	(0.050)	(0.048)	(0.046)	(0.047)	(0.007)	(0.047)	(0.041)	(0.038)	(0.042)	(0.040)	(0.040)	(0.037)
Effect of Initiative in Third Year	-0.163***	-0.233***	-0.235***	-0.184***	0.006*	-0.146***	-0.063	-0.086**	-0.057	0.012	-0.011	-0.054
	(0.045)	(0.049)	(0.050)	(0.049)	(0.004)	(0.045)	(0.043)	(0.040)	(0.036)	(0.038)	(0.045)	(0.039)
Effect of Initiative in Fourth Year	-0.138***	-0.182***	-0.223***	-0.188***	0.006	-0.227***	-0.078*	-0.118***	-0.110**	-0.025	-0.018	-0.066
	(0.051)	(0.052)	(0.049)	(0.052)	(0.004)	(0.045)	(0.044)	(0.040)	(0.043)	(0.039)	(0.043)	(0.043)
Effect of Initiative in Fifth Year	-0.170***	-0.259***	-0.320***	-0.177***	0.002	-0.253***	-0.131***	0.002	-0.152***	-0.038	0.014	-0.050
	(0.053)	(0.061)	(0.060)	(0.052)	(0.005)	(0.052)	(0.047)	(0.043)	(0.052)	(0.046)	(0.041)	(0.042)
Effect of Initiative in Sixth Year	-0.150***	-0.225***	-0.290***	-0.216***	0.006	-0.234***	-0.119**	-0.072*	-0.181***	-0.079*	0.033	-0.004
	(0.054)	(0.061)	(0.055)	(0.053)	(0.004)	(0.051)	(0.046)	(0.042)	(0.045)	(0.044)	(0.044)	(0.042)
Effect of Initiative in Seventh Year	-0.204***	-0.252***	-0.244***	-0.268***	0.003	-0.241***	-0.157***	-0.085**	-0.214***	-0.105**	0.082*	-0.044
	(0.059)	(0.058)	(0.053)	(0.061)	(0.005)	(0.050)	(0.046)	(0.043)	(0.045)	(0.042)	(0.049)	(0.046)
Average effect	-0.149	-0.201	-0.225	-0.160	0.004	-0.184	-0.090	-0.055	-0.118	-0.033	0.018	-0.045
P-value (test average effect = 0)	0.000	0.000	0.000	0.000	0.369	0.000	0.002	0.043	0.000	0.289	0.509	0.112
Average effect in years 6-7	-0.177	-0.238	-0.267	-0.242	0.004	-0.238	-0.138	-0.079	-0.198	-0.092	0.058	-0.024
P-value (test average effect in years 6-7 = 0)	0.000	0.000	0.000	0.000	0.348	0.000	0.001	0.029	0.000	0.016	0.133	0.525
Observations	7644	7644	7644	7642	3885	7642	7644	7644	7644	7644	7644	7644

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects, and demographic and economic controls. Standard errors are clustered at the zip-code level.

*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table 5
The Effect of CFPI on Births Typically Involving Relatively High Costs

	All Births	Low Birthweight	Very Low Birthweight	5-Min. Apgar Score < 9
	(1)	(2)	(3)	(4)
Effect of Initiative in First Year	-0.048	-0.058	-0.045	0.032
	(0.035)	(0.051)	(0.064)	(0.055)
Effect of Initiative in Second Year	-0.056	-0.066	-0.091	0.086
	(0.039)	(0.058)	(0.064)	(0.055)
Effect of Initiative in Third Year	-0.078**	-0.155***	-0.034	-0.048
	(0.039)	(0.050)	(0.052)	(0.063)
Effect of Initiative in Fourth Year	-0.051	-0.135**	-0.104	0.000
	(0.044)	(0.057)	(0.067)	(0.058)
Effect of Initiative in Fifth Year	-0.073	-0.096*	-0.011	-0.054
	(0.048)	(0.052)	(0.061)	(0.057)
Effect of Initiative in Sixth Year	-0.115**	-0.142**	-0.158**	-0.164***
	(0.046)	(0.060)	(0.064)	(0.062)
Effect of Initiative in Seventh Year	-0.132***	-0.182***	-0.185***	-0.306***
	(0.042)	(0.051)	(0.058)	(0.060)
Average effect	-0.079	-0.119	-0.090	-0.065
P-value (test average effect = 0)	0.020	0.000	0.004	0.123
Average effect in years 6-7	-0.124	-0.162	-0.172	-0.235
P-value (test average effect in years 6-7 = 0)	0.002	0.000	0.000	0.000
Observations	7644	6355	6355	6355

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects, and demographic and economic controls. "Total Births" include all births to women aged 15-29. "Low Birthweight" indicates the number of infants within a zip code born under 2500 grams. "Very Low Birthweight" indicates the number of infants within a zip code born under 1500 grams. "5-Min. Apgar" measures the number of infants scoring less than a 9 out of 10 on the 5-Minute Apgar test.

*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively. Standard errors are clustered at the zip-code level.

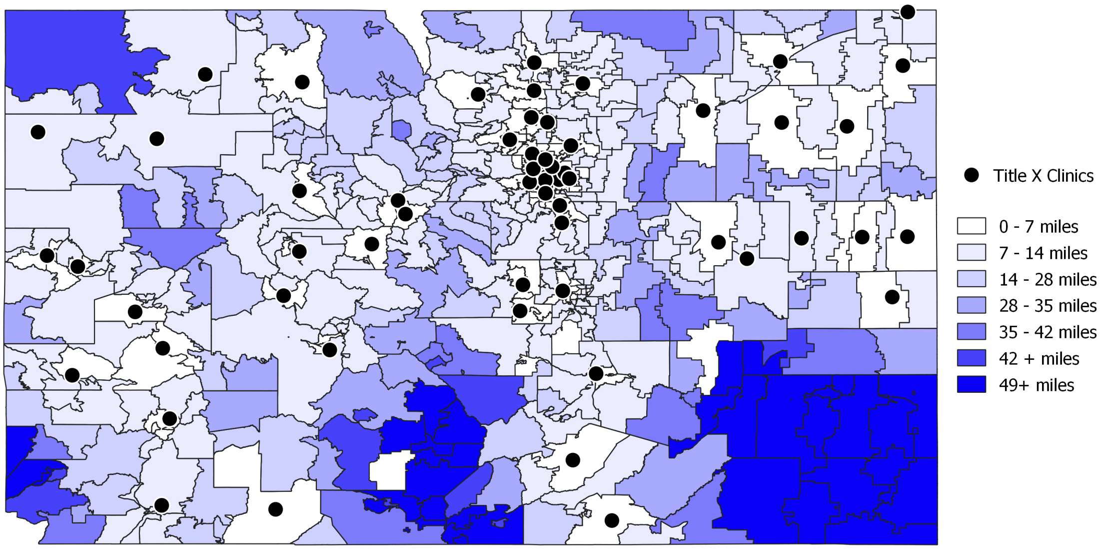
Table 6
The Effect of CFPI on Abortion Rates
County-level analysis based on share of the population within 7 miles of a clinic

	15–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	(1)	(2)	(3)	(4)	(5)	(6)
Effect of Initiative in First Year	-0.171	-0.321***	-0.053	-0.095	0.108	0.033
	(0.125)	(0.117)	(0.174)	(0.180)	(0.146)	(0.198)
Effect of Initiative in Second Year	-0.277*	-0.396***	-0.086	-0.124	-0.039	-0.041
	(0.161)	(0.140)	(0.167)	(0.169)	(0.167)	(0.176)
Effect of Initiative in Third Year	-0.138	-0.262	-0.165	-0.144	0.014	0.038
	(0.171)	(0.216)	(0.179)	(0.192)	(0.251)	(0.278)
Effect of Initiative in Fourth Year	-0.281	-0.358*	-0.263	-0.219	-0.039	-0.045
	(0.220)	(0.189)	(0.171)	(0.198)	(0.180)	(0.179)
Effect of Initiative in Fifth Year	-0.523***	-0.532***	-0.201	-0.134	-0.087	-0.090
	(0.176)	(0.164)	(0.168)	(0.173)	(0.218)	(0.189)
Effect of Initiative in Sixth Year	-0.202	-0.220	-0.198	-0.169	-0.079	0.004
	(0.243)	(0.219)	(0.193)	(0.202)	(0.212)	(0.234)
Effect of Initiative in Seventh Year	-0.158	-0.227	-0.163	-0.130	-0.208	-0.133
	(0.227)	(0.266)	(0.182)	(0.211)	(0.204)	(0.222)
Average effect	-0.250	-0.331	-0.161	-0.145	-0.047	-0.033
P-value (test average effect = 0)	0.048	0.006	0.187	0.254	0.769	0.852
Average effect in years 6-7	-0.180	-0.223	-0.181	-0.149	-0.144	-0.064
P-value (test average effect in years 6-7 = 0)	0.362	0.301	0.281	0.428	0.444	0.765
Observations	370	370	463	463	409	409
Controls	No	Yes	No	Yes	No	Yes

Notes: Estimates are based on restricted zip-code-level abortion data from the Colorado Department of Public Health and Environment for the state of Colorado from 2004–2015. The outcome variable is the difference between the inverse hyperbolic sine transformations of abortions by age group and female population for the relevant age group. The fraction treated indicates the percent of the population living in zip codes within 7 miles of a clinic. All specifications include year and county fixed effects. Controls include county-level unemployment rates and poverty rates and county-level fractions of individuals aged 15–29 by age, ethnicity, and race, the percent of each age group who are Hispanic, and the percent of each age group who are black. Standard errors are clustered at the county level.
*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Appendix

Figure A1
Distance from Population Centroid to Nearest Title X Clinic



Notes: "Distance" indicates travel distance, in miles, according to Google map data. Authors' calculation of zip-code centroid distance to the nearest clinic is based on geocoded data of Title X clinics from the Colorado Department of Public Health and Environment directory.

Table A1
The Effect of CFPI on Births by Urbanicity

	15–17 Year Olds		18–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect of Initiative in First Year	-0.128	-0.052	0.026	-0.136**	0.030	-0.007	-0.060	-0.102*
	(0.119)	(0.057)	(0.122)	(0.057)	(0.097)	(0.053)	(0.102)	(0.054)
Effect of Initiative in Second Year	-0.234*	-0.108*	0.006	-0.115**	0.055	-0.087	-0.119	-0.017
	(0.129)	(0.061)	(0.114)	(0.058)	(0.084)	(0.054)	(0.080)	(0.058)
Effect of Initiative in Third Year	-0.277**	-0.148**	-0.186*	-0.131**	-0.042	-0.091	-0.089	-0.032
	(0.126)	(0.067)	(0.097)	(0.058)	(0.087)	(0.056)	(0.091)	(0.058)
Effect of Initiative in Fourth Year	-0.073	-0.150**	-0.118	-0.173***	0.016	-0.091	-0.142	-0.029
	(0.100)	(0.065)	(0.107)	(0.062)	(0.099)	(0.062)	(0.087)	(0.058)
Effect of Initiative in Fifth Year	-0.139	-0.242***	-0.259*	-0.160**	-0.078	-0.037	-0.072	-0.050
	(0.117)	(0.078)	(0.139)	(0.063)	(0.112)	(0.060)	(0.109)	(0.061)
Effect of Initiative in Sixth Year	-0.173	-0.135*	-0.261*	-0.154**	-0.063	-0.167***	-0.139	-0.045
	(0.150)	(0.076)	(0.133)	(0.067)	(0.107)	(0.060)	(0.115)	(0.065)
Effect of Initiative in Seventh Year	-0.245**	-0.120	-0.093	-0.189***	-0.024	-0.190***	-0.060	-0.136**
	(0.113)	(0.078)	(0.126)	(0.068)	(0.112)	(0.058)	(0.096)	(0.061)
Average effect	-0.181	-0.136	-0.127	-0.151	-0.015	-0.096	-0.097	-0.059
P-value (test average effect = 0)	0.036	0.006	0.076	0.000	0.825	0.030	0.138	0.236
Average effect in years 6-7	-0.209	-0.127	-0.177	-0.172	-0.043	-0.179	-0.100	-0.091
P-value (test average effect in years 6-7 = 0)	0.080	0.061	0.108	0.004	0.669	0.001	0.297	0.119
Observations	3757	3887	3755	3887	3757	3887	3757	3887

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects, and demographic and economic controls. Data on urbanicity is from the University of North Dakota's Rural Health Center. "Urban" zip codes include metropolitan areas, while "Rural" zip codes include micropolitan areas, small towns, and rural areas. Standard errors are clustered at the zip-code level.
*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table A2
Difference-in-Difference Estimates for Compositional Changes between Treated and Comparison Zip Codes, 2000–2010

IHS(Number of Women aged 15-19)	0.000
	(0.167)
Percent White (Non-Hispanic Women aged 15-29)	0.033
	(0.031)
Percent Black (Non-Hispanic Women aged 15-29)	-0.004
	(0.006)
Percent Hispanic (Women aged 15-29)	-0.019
	(0.013)
Predicted IHS(Births to Women aged 15-19)	-0.059
	(0.107)

Notes: Estimates are based on Census data for zip code demographics, showing the difference in differences between treated and comparison zip codes from 2000 to 2010. IHS represents the inverse-hyperbolic-sine transformation. The predicted IHS of births is calculated using estimated coefficients from a regression of IHS(birth count) on zip code demographics from 2010, then multiplying those coefficients by the observed demographics in 2000 and 2010. The regression using 2010 data to evaluate how demographics predict births takes the form of $IHS(births)_{zy} = \alpha + \beta_1 * IHS(No.Females15 - 29)_{zy} + \beta_2 * PctWhite_{zy} + \beta_3 * PctBlack_{zy} + \beta_5 * PctHispanic_{zy}$, where "$PctWhite$" is the percent of females aged 15-29 that are white, etc. This yields an estimated model for $Predicted\ IHS(births)_{zy} = -2.02 + 0.87 * IHS(No.Females15 - 29)_{zy} + 0.05 * PctWhite_{zy} + 0.21 * PctBlack_{zy} + .27 * PctHispanic_{zy}$.
*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table A3

The Effect of CFPI on Births, Using Alternative Measures of Distance

	15–17 Year Olds		18–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. "As the Crow Flies" Distance								
Effect of Initiative in First Year	-0.076*	-0.068	-0.062	-0.066	-0.009	-0.001	-0.005	0.000
	(0.041)	(0.041)	(0.040)	(0.041)	(0.039)	(0.040)	(0.038)	(0.039)
Effect of Initiative in Second Year	-0.183***	-0.175***	-0.113***	-0.119***	-0.021	-0.015	-0.003	0.001
	(0.042)	(0.043)	(0.041)	(0.042)	(0.040)	(0.041)	(0.040)	(0.040)
Effect of Initiative in Third Year	-0.258***	-0.246***	-0.160***	-0.159***	-0.037	-0.040	-0.016	-0.023
	(0.046)	(0.046)	(0.042)	(0.042)	(0.041)	(0.041)	(0.040)	(0.040)
Effect of Initiative in Fourth Year	-0.175***	-0.167***	-0.155***	-0.152***	-0.017	-0.016	-0.050	-0.047
	(0.048)	(0.047)	(0.044)	(0.045)	(0.044)	(0.044)	(0.042)	(0.041)
Effect of Initiative in Fifth Year	-0.293***	-0.284***	-0.200***	-0.193***	-0.044	-0.055	-0.024	-0.023
	(0.054)	(0.054)	(0.047)	(0.048)	(0.045)	(0.044)	(0.045)	(0.045)
Effect of Initiative in Sixth Year	-0.259***	-0.252***	-0.203***	-0.194***	-0.110***	-0.121***	-0.029	-0.035
	(0.054)	(0.055)	(0.047)	(0.048)	(0.042)	(0.042)	(0.047)	(0.047)
Effect of Initiative in Seventh Year	-0.305***	-0.291***	-0.195***	-0.181***	-0.115***	-0.126***	-0.079*	-0.091**
	(0.052)	(0.053)	(0.049)	(0.049)	(0.042)	(0.043)	(0.043)	(0.043)
Average effect	-0.221	-0.212	-0.155	-0.152	-0.050	-0.054	-0.030	-0.031
P-value (test average effect = 0)	0.000	0.000	0.000	0.000	0.094	0.074	0.348	0.328
Average effect in years 6-7	-0.282	-0.272	-0.199	-0.188	-0.113	-0.124	-0.054	-0.063
P-value (test average effect in years 6-7 = 0)	0.000	0.000	0.000	0.000	0.002	0.001	0.165	0.113
Observations	7644	7644	7644	7642	7644	7644	7644	7644
Panel B. Driving Time (In Minutes)								
Effect of Initiative in First Year	-0.045	-0.036	-0.115**	-0.124**	-0.009	-0.001	-0.042	-0.038
	(0.051)	(0.052)	(0.048)	(0.048)	(0.045)	(0.045)	(0.036)	(0.036)
Effect of Initiative in Second Year	-0.153***	-0.134**	-0.007	-0.010	-0.036	-0.029	-0.050	-0.045
	(0.056)	(0.057)	(0.045)	(0.045)	(0.044)	(0.045)	(0.042)	(0.042)
Effect of Initiative in Third Year	-0.219***	-0.190***	-0.154***	-0.150***	-0.036	-0.034	-0.043	-0.044
	(0.059)	(0.060)	(0.052)	(0.052)	(0.040)	(0.040)	(0.039)	(0.039)
Effect of Initiative in Fourth Year	-0.161**	-0.138**	-0.162***	-0.154***	-0.060	-0.055	-0.063	-0.053
	(0.064)	(0.063)	(0.058)	(0.058)	(0.051)	(0.051)	(0.040)	(0.040)
Effect of Initiative in Fifth Year	-0.241***	-0.216***	-0.226***	-0.211***	-0.022	-0.022	-0.059	-0.055
	(0.074)	(0.075)	(0.064)	(0.064)	(0.053)	(0.053)	(0.048)	(0.048)
Effect of Initiative in Sixth Year	-0.204***	-0.178**	-0.156**	-0.137**	-0.055	-0.063	-0.045	-0.048
	(0.072)	(0.074)	(0.063)	(0.064)	(0.046)	(0.047)	(0.049)	(0.051)
Effect of Initiative in Seventh Year	-0.252***	-0.226***	-0.147**	-0.125**	-0.098*	-0.100*	-0.056	-0.061
	(0.071)	(0.073)	(0.062)	(0.063)	(0.050)	(0.052)	(0.044)	(0.045)
Average effect	-0.182	-0.160	-0.138	-0.130	-0.045	-0.043	-0.051	-0.049
P-value (test average effect = 0)	0.000	0.001	0.001	0.001	0.195	0.218	0.112	0.130
Average effect in years 6-7	-0.228	-0.202	-0.151	-0.131	-0.077	-0.081	-0.050	-0.055
P-value (test average effect in years 6-7 = 0)	0.001	0.003	0.007	0.020	0.075	0.069	0.222	0.197
Observations	7644	7644	7644	7642	7644	7644	7644	7644
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects. Controls include zip-code-level unemployment rates and poverty rates and county-level fractions of individuals aged 15–29 by age, ethnicity, and race, the percent of each age group who are Hispanic, and the percent of each age group who are black. Estimates in Panel A are from a model that defines treated zip codes as those within 0–7 miles "as the crow flies" of a Title X clinic, and comparison zip codes as those further than 7 crow flies miles from a Title X clinic. Estimates in Panel B are from a model that defines treated zip codes as those within 0–10 minutes driving time of a Title X clinic, and comparison zip codes as those further than 10 minutes from a Title X clinic. Standard errors are clustered at the zip-code level.

*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table A4

The Effect of CFPI on Births, Using Within 5 miles, 7 Miles, and 10 Miles to Define Treated Zip Codes

	15–17 Year Olds			18–19 Year Olds			20–24 Year Olds			25–29 Year Olds		
	0–7 Miles	0–5 Miles	0–10 Miles	0–7 Miles	0–5 Miles	0–10 Miles	0–7 Miles	0–5 Miles	0–10 Miles	0–7 Miles	0–5 Miles	0–10 Miles
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Effect of Initiative in First Year	-0.091**	-0.079	-0.054	-0.061	-0.111**	-0.061	-0.010	-0.024	-0.007	0.010	-0.033	0.010
	(0.044)	(0.050)	(0.040)	(0.041)	(0.045)	(0.041)	(0.039)	(0.042)	(0.039)	(0.040)	(0.034)	(0.040)
Effect of Initiative in Second Year	-0.165***	-0.126**	-0.136***	-0.118***	-0.054	-0.118***	-0.028	-0.043	-0.028	0.020	-0.036	0.020
	(0.048)	(0.052)	(0.042)	(0.042)	(0.044)	(0.042)	(0.041)	(0.042)	(0.041)	(0.041)	(0.040)	(0.041)
Effect of Initiative in Third Year	-0.233***	-0.183***	-0.180***	-0.163***	-0.158***	-0.163***	-0.034	-0.040	-0.037	-0.007	-0.047	-0.007
	(0.049)	(0.054)	(0.046)	(0.042)	(0.049)	(0.042)	(0.040)	(0.038)	(0.040)	(0.040)	(0.036)	(0.040)
Effect of Initiative in Fourth Year	-0.182***	-0.159***	-0.095**	-0.153***	-0.154***	-0.153***	-0.008	-0.079*	-0.014	-0.030	-0.034	-0.030
	(0.052)	(0.060)	(0.047)	(0.044)	(0.053)	(0.044)	(0.044)	(0.047)	(0.044)	(0.041)	(0.038)	(0.041)
Effect of Initiative in Fifth Year	-0.259***	-0.247***	-0.224***	-0.185***	-0.218***	-0.185***	-0.037	-0.058	-0.044	-0.002	-0.070	-0.002
	(0.061)	(0.070)	(0.055)	(0.047)	(0.058)	(0.047)	(0.045)	(0.048)	(0.045)	(0.046)	(0.044)	(0.046)
Effect of Initiative in Sixth Year	-0.225***	-0.232***	-0.189***	-0.184***	-0.168***	-0.184***	-0.103**	-0.095**	-0.111***	-0.026	-0.058	-0.026
	(0.061)	(0.068)	(0.054)	(0.048)	(0.058)	(0.048)	(0.042)	(0.045)	(0.042)	(0.048)	(0.047)	(0.048)
Effect of Initiative in Seventh Year	-0.252***	-0.201***	-0.244***	-0.191***	-0.198***	-0.191***	-0.122***	-0.154***	-0.131***	-0.073*	-0.088**	-0.073*
	(0.058)	(0.066)	(0.053)	(0.049)	(0.060)	(0.049)	(0.044)	(0.046)	(0.044)	(0.043)	(0.041)	(0.043)
Average effect	-0.201	-0.175	-0.160	-0.151	-0.152	-0.151	-0.049	-0.070	-0.053	-0.016	-0.052	-0.016
P-value (test average effect = 0)	0.000	0.000	0.000	0.000	0.000	0.000	0.110	0.029	0.080	0.625	0.082	0.625
Average effect in years 6-7	-0.238	-0.217	-0.217	-0.188	-0.183	-0.188	-0.112	-0.124	-0.121	-0.050	-0.073	-0.050
P-value (test average effect in years 6-7 = 0)	0.000	0.000	0.000	0.000	0.001	0.000	0.003	0.003	0.002	0.208	0.061	0.208
Observations	7644	7644	7644	7642	7642	7642	7644	7644	7644	7644	7644	7644
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects. Controls include zip-code-level unemployment rates and poverty rates and county-level fractions of individuals aged 15–29 by age, ethnicity, and race, the percent of each age group who are Hispanic, and the percent of each age group who are black. Standard errors are clustered at the zip-code level.

*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table A5
The Effect of CFPI on Births, OLS and WLS Estimates

	15–17 Year Olds		18–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	OLS	WLS	OLS	WLS	OLS	WLS	OLS	WLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect of Initiative in First Year	-0.091**	-0.019	-0.074*	-0.069	-0.029	-0.009	-0.052	-0.063**
	(0.044)	(0.069)	(0.044)	(0.045)	(0.039)	(0.035)	(0.037)	(0.029)
Effect of Initiative in Second Year	-0.165***	-0.023	-0.127***	-0.087*	-0.052	-0.079**	-0.020	-0.016
	(0.048)	(0.070)	(0.045)	(0.049)	(0.040)	(0.037)	(0.040)	(0.032)
Effect of Initiative in Third Year	-0.233***	0.002	-0.183***	-0.076	-0.063	-0.039	-0.038	-0.046
	(0.049)	(0.074)	(0.044)	(0.055)	(0.039)	(0.040)	(0.037)	(0.033)
Effect of Initiative in Fourth Year	-0.182***	-0.018	-0.188***	-0.046	-0.059	-0.042	-0.047	-0.019
	(0.052)	(0.071)	(0.046)	(0.057)	(0.045)	(0.039)	(0.040)	(0.031)
Effect of Initiative in Fifth Year	-0.259***	-0.022	-0.220***	-0.042	-0.067	-0.044	-0.058	-0.035
	(0.061)	(0.086)	(0.053)	(0.059)	(0.046)	(0.038)	(0.045)	(0.032)
Effect of Initiative in Sixth Year	-0.225***	0.083	-0.225***	-0.071	-0.134***	-0.070*	-0.079*	-0.047
	(0.061)	(0.088)	(0.052)	(0.058)	(0.043)	(0.039)	(0.047)	(0.038)
Effect of Initiative in Seventh Year	-0.252***	0.096	-0.229***	-0.105	-0.159***	-0.095**	-0.104**	-0.060*
	(0.058)	(0.090)	(0.054)	(0.069)	(0.044)	(0.046)	(0.042)	(0.035)
Average effect	-0.201	0.014	-0.178	-0.071	-0.080	-0.054	-0.057	-0.041
P-value (test average effect = 0)	0.000	0.807	0.000	0.079	0.009	0.091	0.070	0.150
Average effect in years 6-7	-0.238	0.090	-0.227	-0.088	-0.146	-0.082	-0.091	-0.053
P-value (test average effect in years 6-7 = 0)	0.000	0.255	0.000	0.117	0.000	0.038	0.021	0.117
Observations	7644	7644	7642	7642	7644	7644	7644	7644

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects, and demographic and economic controls. Population weights for weighted least squares specifications in Columns 2, 4, 6, and 8 include the zip code-level female population from 2010, according to the American Community Survey. Standard errors are clustered at the zip-code level.

*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.

Table A6
The Effect of CFPI on Births in Zip Codes with Less Than 2,000 Females

	15–17 Year Olds		18–19 Year Olds		20–24 Year Olds		25–29 Year Olds	
	<2000	≥2000	<2000	≥2000	<2000	≥2000	<2000	≥2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect of Initiative in First Year	-0.175	-0.013	0.069	-0.072	0.057	-0.043	-0.121	-0.064**
	(0.115)	(0.060)	(0.155)	(0.056)	(0.157)	(0.038)	(0.183)	(0.032)
Effect of Initiative in Second Year	-0.139	-0.095	-0.093	-0.087	0.195	-0.103**	-0.179	-0.026
	(0.093)	(0.069)	(0.157)	(0.054)	(0.156)	(0.042)	(0.157)	(0.039)
Effect of Initiative in Third Year	-0.204**	-0.065	-0.225**	-0.081	-0.227	-0.030	-0.126	-0.019
	(0.093)	(0.074)	(0.101)	(0.058)	(0.158)	(0.044)	(0.139)	(0.040)
Effect of Initiative in Fourth Year	-0.149	-0.050	-0.140	-0.057	-0.079	-0.053	-0.258	0.016
	(0.095)	(0.074)	(0.126)	(0.066)	(0.202)	(0.047)	(0.171)	(0.039)
Effect of Initiative in Fifth Year	-0.003	-0.056	-0.208	-0.060	-0.058	-0.060	-0.131	-0.033
	(0.112)	(0.084)	(0.140)	(0.065)	(0.209)	(0.046)	(0.207)	(0.045)
Effect of Initiative in Sixth Year	0.008	0.018	-0.206*	-0.069	-0.163	-0.095**	-0.223	-0.057
	(0.126)	(0.082)	(0.124)	(0.070)	(0.176)	(0.047)	(0.212)	(0.048)
Effect of Initiative in Seventh Year	-0.218**	0.031	-0.055	-0.098	-0.048	-0.157***	-0.064	-0.074*
	(0.092)	(0.080)	(0.138)	(0.069)	(0.179)	(0.049)	(0.165)	(0.044)
Average effect	-0.126	-0.033	-0.123	-0.075	-0.046	-0.078	-0.157	-0.037
P-value (test average effect = 0)	0.075	0.531	0.174	0.076	0.754	0.024	0.287	0.283
Average effect in years 6-7	-0.105	0.024	-0.130	-0.083	-0.105	-0.126	-0.144	-0.066
P-value (test average effect in years 6-7 = 0)	0.253	0.728	0.247	0.166	0.534	0.004	0.421	0.125
Observations	3887	3757	3885	3757	3887	3757	3887	3757

Notes: Estimates are based on restricted Natality files by zip code for the state of Colorado from 2003–2015. All specifications include year and zip code fixed effects, and demographic and economic controls. "<2000" represents a subsample of Colorado zip codes with less than 2,000 total females, according to the 2010 American Community Survey, while "≥2000" represents zip codes with more than 2,000 females. Standard errors are clustered at the zip-code level.
*, **, and *** indicate statistical significance at the ten, five, and one percent levels, respectively.