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How Much Can Expanding Access to Long-Acting Reversible Contraceptives Reduce Teen Birth Rates?†

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We estimate the degree to which expanding access to long-acting reversible contraceptives (LARCs) can reduce teen birth rates by analyzing Colorado's Family Planning Initiative, the first large-scale policy intervention to expand access to LARCs in the United States. Using a difference-in-differences approach, we find that the $23M program reduced the teen birth rate in counties with clinics receiving funding by 6.4 percent over 5 years. These effects were concentrated in the second through fifth years of the program and in counties with relatively high poverty rates. State-level synthetic control estimates offer supporting evidence but suffer from a lack of power. (*JEL* H75, I18, I32, J13)

Despite a near continuous decline over the past 20 years, the teen birth rate in the United States continues to be 6 to 12 times that of other developed countries (Kearney and Levine 2012). Two types of economic arguments support the view that the high rate of teenage childbearing in the United States should be a focus of public policy. The first is based on the idea that teenagers are often not well-positioned to take care of children; as a result, teen childbearing disproportionately imposes costs on family, friends, communities, and public assistance programs. Unless teenagers fully internalize such costs when they make decisions, we would expect them to have children "too often" from a social welfare perspective. The second type of argument focuses on the costs that teenagers' choices impose on teens themselves. Although such arguments carry little weight where standard economic models of behavior can be applied, the extremely high rates of unintended pregnancies among sexually active teens—more than twice the rate of older women (Finer 2010)—suggest that *homo economicus* does *not* apply to teens making choices about sexual activities. It also suggests that policies aimed at reducing unintended pregnancies

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have the potential to improve teenagers' welfare while reducing the negative externalities associated with teenage childbearing.

There is a long history of policies and initiatives in the United States geared toward reducing unintended pregnancies, particularly among teens.[1] These approaches typically involve attempts: (i) to delay or reduce the frequency of sexual intercourse; and/or (ii) to increase the use of contraceptives or promote the use of more effective contraceptives. That said, the results of such policies have often been disappointing. Less than half of published studies that use experimental or quasi-experimental approaches to evaluate comprehensive sex education programs report significant effects on the initiation of sex, frequency of sex, or contraceptive use (Kirby 2008).[2] A randomized control trial of the Parent's Speak Up National Campaign, which promotes parent-child communication about waiting to have sex, finds no effect on adolescent's beliefs that "waiting to have sex is the best way to prevent health risks like pregnancy or HIV/STDs" (Palen et al. 2011). Moreover, it is not clear whether the wave of state policies expanding access to birth control pills during the 1960s and 1970s reduced teen pregnancies (Guldi 2008; Bailey 2006; Ananat and Hungerman 2012; Myers 2012). That said, family planning programs appear to offer significant promise where these other policies do not. Bailey (2012) shows that the establishment of federal family planning programs in the 1960s and 1970s reduced teen birth rates 2.3 percent after six to ten years. Kearney and Levine (2009) provide more recent evidence on the effects of family planning services in their study of state Medicaid policy changes that expanded access to higher income women during the 1990s and 2000s. They find that these policy changes reduced teen childbearing by over 4 percent and argue that this effect was accomplished by increased use of contraceptives.

The research described above indicates that family planning services do play a critical role in averting unintended pregnancies and births among teenagers. Yet, with over three-quarters of teen births unintended at conception (Mosher, Jones, and Abma 2012), it would seem that there may be some scope for such services to play an even larger role.[3] And because half of those births are to teens using contraception (CDC 2012), many have argued that leveraging more effective contraceptives could be key. In particular, long-acting reversible contraceptives (LARCs), which include both subdermal implants and intrauterine devices (IUDs), are extremely effective at preventing pregnancy. Whereas incorrect and/or inconsistent use of birth control pills, injectables, patches, and rings leads to failure rates between 6 and 9 percent and failure rates of 18 percent for condoms, LARC methods have failure rates of less than 1 percent because they do not require the user to do anything for at least

[1] See Bailey, Guldi, and Hershbein (2013) for an overview of reproductive health policies and various approaches to estimating their causal effects.

[2] Kirby's (2008) review considers 48 studies of comprehensive programs. It also considers nine abstinence programs, four of which have experimental designs. While some of the nonexperimental studies reviewed found significant effects on the initiation of sex and frequency of sex, the experimental studies did not. Moreover, *none* of the studies found significant effects on contraceptive use. More recently, Carr and Packham (2017) show that state-level abstinence-based sex education mandates have no effect on birth rates or abortion rates.

[3] "Unintended" in this context typically refers to situations in which a child was born to a mother who did not want a child (or another child) or who instead wanted to have a child at a later date.

three years after the initial procedure.[4] The American College of Obstetricians and Gynecologists' (ACOG) Committee on Adolescent Health Care and the American Academy of Pediatrics both have stated that LARC methods should be "first-line recommendations" for all adolescents (in 2012 and 2014, respectively). LARCs also were the focus of the Centers for Disease Control and Prevention's April 2015 report, "Preventing Teen Pregnancy." That said, only 5 percent of American teens who use contraceptives use a LARC method.[5] This low rate of use appears to be due in large part to a lack of awareness, misperceptions about safety, and costs. When these barriers were removed 70 percent of participants aged 14–20 in the St. Louis Contraceptive CHOICE Project chose a LARC method (Mestad et al. 2011). Nonetheless, a fundamental policy question remains unanswered: how much can expanding access to LARCs reduce teen birth rates?

To answer this question, we consider the first large-scale policy intervention to promote and improve access to LARCs in the United States. Specifically, we examine the Colorado Family Planning Initiative (CFPI), a $23 million program funded by an anonymous donor that began in 2009 with the primary goal of helping women gain access to LARCs through Title X clinics. Although this program did not involve an explicit focus on teenagers, teenagers represent a disproportionate share of female Title X clients.[6] Moreover, the state of Colorado has pointed to the subsequent 40 percent reduction in its teen birth rate as evidence of the program's success.[7] However, the fact that teen birth rates fell significantly throughout the United States during the same period suggests that other factors probably contributed to the decline observed in Colorado. The goal of this paper is to separate out the effects of the policy initiative from the effects of these other factors in order to better understand the way in which a major investment in LARCs can affect teen outcomes.

We use detailed administrative data on contraceptive use among teens visiting clinics participating in the CFPI to highlight the large increase in LARC use following the implementation of the program. We then estimate the effects of the CFPI on teen birth rates using both a difference-in-differences design that compares changes in Colorado counties with Title X clinics to changes observed in other US counties with Title X clinics and we supplement this analysis with a state-level synthetic-control design.

The results of these analyses suggest that the success of the CFPI may have been overstated by time-series comparisons, but that it has led to reductions in teen birth rates. The county-level difference-in-differences estimates indicate that the CFPI reduced teen birth rates in affected counties by 6.4 percent over 5 years, driven by larger effects in counties with relatively high poverty rates and in its second through

[4] Failure rates are calculated as the number out of every 100 women who experienced an unintended pregnancy within the first year of typical use. See http://www.cdc.gov/reproductivehealth/UnintendedPregnancy/Contraception.htm.

[5] Authors' calculation using the 2011–2013 Survey of National Survey of Family Growth.

[6] At the clinics receiving CFPI funding, females aged 15–19 represented 24 percent of all female clients of childbearing age (15–44). In the counties where these clinics are located, females aged 15–19 represented just 16 percent of the female childbearing age (15–44) population.

[7] They also attribute reductions in the teen abortion rate and WIC caseloads to the initiatives. The press release with these statements can be accessed at: http://www.colorado.gov/cs/Satellite/GovHickenlooper/CBON/1251655017027.

fifth years. For counties with poverty rates above Colorado's median, the estimates indicate an effect of 8.7 percent over five years, driven by an effect of 10.4 percent in the CFPI's second through fifth years. State-level synthetic control estimates are somewhat larger in magnitude, suggesting an effect of 9.6 percent statewide over 5 years, but this estimate is not statistically significant, which highlights that this approach is lacking in power in this context. As all of these estimates are based on births to all teenagers, they can be thought of as intent-to-treat estimates that thus understate the effects on teenagers who use Title X clinics and teenagers receiving LARCs through the initiative.

The remainder of this paper is organized as follows. In the next section, we discuss LARCs in the context of the contraceptive options that are presently available to teenagers in the United States. We then provide further details on the CFPI and present results that highlight its impact on LARC use in Colorado. Next we describe the empirical approaches we use to estimate the effects of the program on teen birth rates. We then discuss the results of our analysis before providing some concluding thoughts.

I. Background

A. *Long-Acting Reversible Contraceptives (LARCs)*

LARCs include intrauterine devices (IUDs) and subdermal implants. IUDs are flexible, T-shaped devices that must be inserted and removed by a doctor. The most popular IUDs include the copper IUD, Paragard, and the plastic IUD, Mirena, which can protect against pregnancy for 12 and 5 years, respectively. For both types of IUD the primary mechanism of action is the prevention of fertilization by inhibiting sperm motility. Subdermal implants, such as Implanon and Nexplanon, consist of a matchstick-sized rod that contains etonogestrel. The rod is inserted into the inside of the nondominant upper arm and can remain in place for up to three years.

Table 1 provides information on the various contraceptive options that are currently available and shows that implants and IUDs are as effective at preventing pregnancy as sterilization. During the first year of typical use, fewer than 1 in 1,000 women using an IUD or implant become pregnant. This is true with respect to "perfect use" and "typical use" of these methods because they require nothing of the user after an initial doctor's visit for insertion, thus eliminating the potential for user-compliance error. In contrast, oral contraceptives and condoms are not foolproof and have typical-use effectiveness rates of only 91 percent and 82 percent among all women, respectively, and 80 percent and 82 percent among teenagers under the age of 18 (Dinerman et al. 1995; Grady, Hayward, and Yagi 1986). Moreover, because LARCs are invisible, they may be an especially attractive option for teens who do not want their parents to find out they are sexually active. And while LARCs have high upfront costs, they can remain in place for up to 12 years. Therefore, they may be cheaper than other contraceptives in the long run.

Despite the ease of use and the benefits of LARCs, merely 5 percent of the 3.2 million teenage women using contraceptives in the United States chose an implant or

TABLE 1—EFFECTIVENESS OF VARIOUS METHODS OF CONTRACEPTION

Method	Typical use (%)	Perfect use (%)	Coverage time
Sterilization*	99.9	99.9	Lifetime
Intrauterine device*	99.9	99.9	3–12 years
Implant*	99.9	99.9	3 years
Injection	97	99.9	3 months
NuvaRing*	91	99.7	1 month
Oral contraceptive	91	99.7	1 month
Patch	91	99.7	1 week
Condom	82	98	N/A
No method	15	15	N/A

Notes: Data are from Hatcher et al. (2011).
* indicates methods funded by the Colorado Family Planning Initiative.

IUD in 2013, and only 8.5 percent of all US women using contraceptives choose a LARC (Guttmacher 2014; NSFG 2011–2013). This figure stands in stark contrast to other countries where, for example, 41 percent of women in China use a LARC and in Europe rates vary between 6 percent and 27 percent.[8]

There are several potential explanations for the low rate of LARC use among US teens. First, teens may be unaware that LARCs are a viable option. Second, there may be misconceptions about safety and protecting against sexually transmitted diseases (Bharadwaj et al. 2012). Third, insertion is uncomfortable and sometimes painful, and LARCs may cause side effects, such as menstrual pain and bleeding, spotting, headaches, nausea, and mood changes. Based on their clinical trials, the four IUDs available on the US market (Mirena, Paragard, Sklya, and Liletta) 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.[9] Fourth, teens planning to have children in the near future may prefer alternative methods of contraception that do not require a visit to the doctor (for removal) to restore their ability to become pregnant. Fifth, teens may be discouraged by the high upfront costs of the devices. Out-of-pocket costs for implants and IUDs are upward of $400, and even insured teens may pay up to a $160 copayment to receive a LARC (Trussell et al. 2009; Planned Parenthood 2015).[10] In support of the importance of this consideration, Mestad et al. (2011) find that

[8] See Finer, Jerman, and Kavanaugh (2012) for more details. Rates available for European countries are as follows: Austria, 15 percent; Baltics: 14 percent; Czech Republic, 10 percent; Denmark, 18 percent; France, 17 percent; Germany, 10 percent; Norway, 27 percent; Spain, 6 percent; Sweden, 21 percent; and United Kingdom, 11 percent.

[9] 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 1,000 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).

[10] The Affordable Care Act, which requires insurers to cover all FDA-approved contraceptives, is likely to reduce or eliminate concerns about costs for some women. However, it may not be as impactful for teens that still rely on their parents' health insurance. 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

70 percent of adolescents who are aware of the benefits of LARCs choose a LARC when it is offered at no cost.

Interacting with these demand-side factors, there are two main supply side barriers to LARC access that contribute to the low rate of LARC use among US teens. First, doctors and nurses may themselves be unaware or misinformed about LARC technology, and they must be trained on proper LARC insertion/removal in order to provide them to patients.[11] Second, health clinics that provide free and low-cost contraceptives often cannot afford to offer LARCs to many clients—many Title X clinics do not offer LARCs at all, and those that do usually have to offer them to clients selectively.[12] As discussed in greater detail below, the CFPI sought to improve access to LARCs on a major scale by providing training and assistance to clinics *and* by providing clinics the funding they needed to purchase LARCs to make them available to their clients.

B. *The Colorado Family Planning Initiative and Contraceptive Use*

In January 2009 the Colorado Department of Public Health and Environment (DPHE) implemented the CFPI in an attempt to reduce unintended pregnancy via increased access to long-acting reversible contraception.[13] The Colorado DPHE received \$23 million in provisional funding from an anonymous donor to provide free LARC methods to low-income women in Title X clinics. All of Colorado's 28 agencies accepted funding, which was to be distributed to Title X clinics in 37 counties through June 2015. Money was allocated proportionally to agencies based on their number of clients and the predicted number of LARC insertions in the following year.

The CFPI provided support for three main 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 utilization of

to Prevent Teen and Unplanned Pregnancy 2015b). To the extent that teens are afraid to use private insurance to purchase birth control, the future costs of LARCs are likely to continue to be a significant financial barrier to access.

[11] The importance of this barrier is documented in Harper et al. (2015), which studies LARC take-up among 18–25-year-old women in a randomized control trial that provided clinics with evidence-based training on on how to counsel patients and how to insert IUDs and implants. Harper et al. (2015) also considers pregnancy, though their estimates are based on only 80 additional women choosing LARCs at treatment clinics. Moreover, they do not discuss the degree to which participating clinics and participating individuals from these clinics compare to the broader populations from which they were drawn, which raises additional concerns about generalizability. This concern is highlighted by the fact that participating individuals from clinics in the control arm increased LARC usage by 12 percentage points, which is highly unusual relative to national trends (discussed in Section B). In any case, they do not find a significant effect on pregnancy overall in their one-year followup. Stratifying the estimates by visit type, they find that the intervention reduced pregnancy rates by 51 percent among women attending family planning visits and increased pregnancy rates by 19 percent among women attending abortion care visits. The former estimate is statistically significant while the latter is not, and because of the small sample size, the confidence intervals are large.

[12] Just 39 percent of all Title X clinics in 2010 offered implants, and only 63 percent provided IUDs (FPAR 2013).

[13] 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, Klinger, and Schwalberg (2014).

LARCs and supported the provision of NuvaRing, tubal ligations, and vasectomies. However, the use of the NuvaRing remained fairly constant at roughly 5 percent among teen clients after the CFPI was implemented, and tubal ligations and vasectomies are extremely rare among teens.[14]

Title X clinics receive federal and state funds to provide free or low-cost counseling, sexually transmitted disease screening, and contraceptives. At Colorado Title X clinics anyone 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. Patients who earn between 101 and 250 percent of the poverty level pay a discounted rate; clients earning more than 250 percent of the poverty level pay the full cost of the visit. Agencies must accept verbal communication of income and no verification is required.

In Colorado, 90 percent of Title X clients fall into the "very low income" bracket, meaning that nearly all clients pay nothing for contraceptives and doctor visits. The high upfront costs of LARC devices paired with the sliding fee schedule meant that in the past many clinics could not afford to provide implants and IUDs. At clinics that did supply LARCs prior to the CFPI, the devices were inserted only for women who subjectively were considered the most "at risk" for an unintended pregnancy. The CFPI funding was critical for all Title X clinics to be able to stock and provide these highly effective contraceptives to clients. In 2009, 20 out of 28 agencies offered IUDs for the first time, and 16 agencies offered the implant for the first time. At the end of the first year of the initiative, all agencies offered IUDs and all but one agency offered implants.

Figure 1 shows how the primary method of contraception used by female teenagers (ages 15–19) visiting Colorado Title X clinics has evolved over time. In 2008, the year before the initiative began, LARCs had a usage rate of less than 3 percent, which was lower than usage rates for condoms, injections, rings, and birth control pills. By 2014, LARC take-up among teens had risen to nearly 25 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 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 contraceptive), because condoms are less effective than oral contraceptives.

Notably, these statistics will almost certainly understate the degree to which LARC use has increased among teenagers served by Title X clinics, because they are based on annual clinic *visitors*, and the long-acting quality of LARCs is expected to reduce the likelihood of a return visit to a clinic. This issue is reflected in the fact that a total of 26,703 women of all ages had a LARC inserted between 2009 and 2013, yet only 10,833 of clients visiting a clinic in 2013 had a LARC. Insertion data is not available

[14] NuvaRing is a vaginal ring inserted once a month and left in place for three weeks. Like birth control pills, it prevents pregnancy by releasing estrogen and progestin.

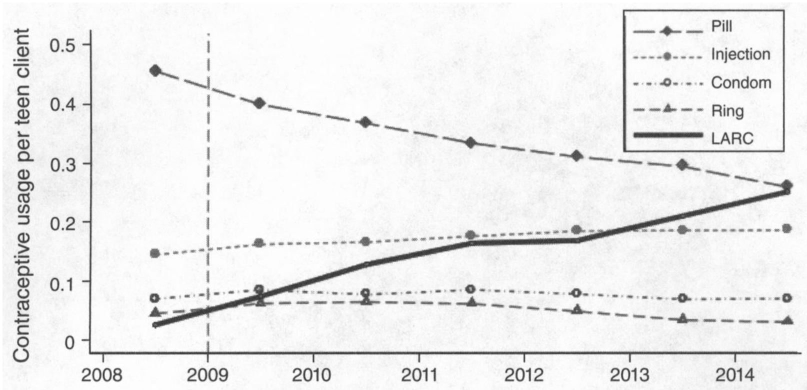

Figure 1. Primary Form of Contraceptive Used by Teens Visiting Title X Clinics in Colorado

Note: The vertical line, drawn at 2009, represents the year Colorado's Family Planning Initiative was implemented.
Source: 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.

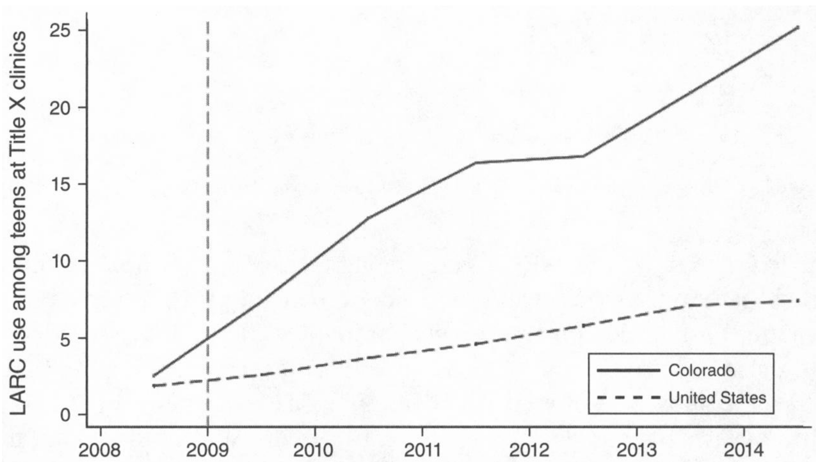

Figure 2. LARC Use among Teens Visiting Title X Clinics, Colorado versus United States Overall

Notes: Note that this figure shows LARC use in Colorado in 2014 for readers' information but the analysis of outcomes only extends through 2013. The vertical line, drawn at 2009, represents the year Colorado's Family Planning Initiative was implemented.

Source: Numbers for Colorado are 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. Numbers for the United States overall are taken from the Title X Family Planning Annual Report, United States 2013.

by age group; however, assuming that the same ratio of visitors using LARCs to cumulative LARC insertions holds for teenagers implies 5,900 insertions between 2009 and 2013. Alternatively, assuming insertions were proportional across the age distribution of childbearing-age (15–44) women visiting the clinics, we would expect 6,409 insertions for teens between 2009 and 2013 (24 percent of 26,703 total insertions).

Further demonstrating this large increase in LARC use, Figure 2 shows that the increase in LARC use among teens visiting Colorado clinics stands apart from what has happened across the United States as a whole. In particular, despite starting at

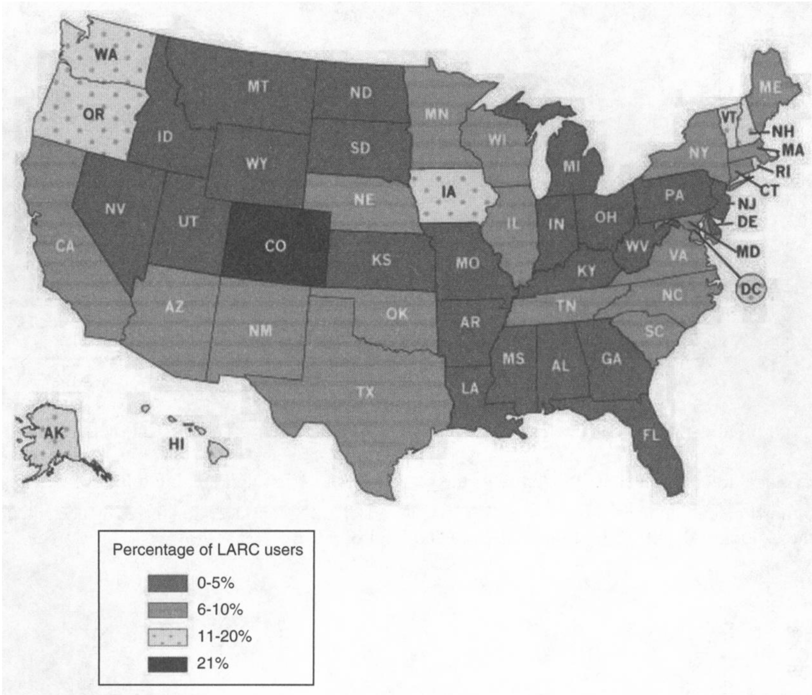

FIGURE 3. LARC USE AMONG TEENS VISITING TITLE X CLINICS BY STATE, 2013

Source: Reproduced from the Title X Family Planning Annual Report, United States (2013)

the same low rate in 2008, LARC usage among teens visiting Title X clinics across the United States only grew to approximately 6 percent by 2013 versus 21 percent for Colorado. Further demonstrating what an outlier Colorado has become in promoting the use of LARCs among teens visiting Title X clinics, Figure 3 presents a state-by-state comparison of teen LARC usage by Title X clients in 2013. It shows that only six states have LARC usage above 11 percent, and Colorado has the highest usage rate at over 21 percent. As a whole, these statistics support the notion that Colorado clinics were successful at introducing teens to highly effective contraceptive methods after the implementation of the CFPI.

Figure 4 shows the number of teen females visiting a Title X clinic in Colorado per 1,000 teen females over time. This is of interest because an increase in the number of clients after the program was implemented could suggest that CFPI attracted new clients to Title X clinics. We note, however, that we may not expect this to be the case for most of the years covered by our analysis because the CFPI has only recently been the subject of significant media attention. 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 May 6, 2013 in *Windsor Now!* headlined "Plan B still banned from county clinics."[15] We could

[15] 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.

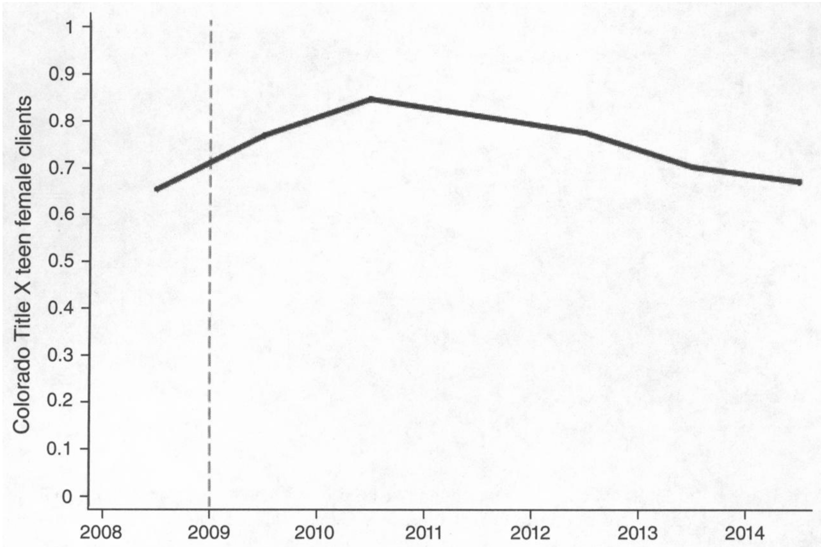

Figure 4. Teen Female Visitors to Colorado Title X Clinics over Time, per 1,000 Teen Females

Source: Authors' calculation based on annual data on Colorado Title X clients and contraception usage by age and method provided by the Colorado Department of Public Health and Environment.

find no further mention of the initiative in the media until the middle of 2014 when it became a major international story. In any case, Figure 4 does show an increase in teens visiting clinics after the implementation of the program, but the fact that we only have one year of data prior to the implementation implies that we cannot rule out that this is a continuation of a preexisting trend. We also note that visits per capita subsequently decreased in every year from 2010–2014 despite the continuation of the program and the steadily growing number of teen visitors using LARCs.

II. Empirical Approach

This section details the data used in our analysis and our strategies for estimating the causal effects of the CFPI.

A. *Data*

Because all Colorado Title X agencies accepted CFPI funding, our primary identification strategy defines all Colorado counties with Title X clinics in 2008 (the year before the CFPI was implemented) as treated.[16,17] We can identify such counties based on clinic addresses in the Colorado Department of Public Health and

[16] Measures of treatment intensity at the county level are unavailable and cannot be constructed because funding data are available at the agency level and most agencies have clinics across several counties.

[17] We note that anyone can receive services at these funded clinics and, thus, the residents of nearby counties may have been affected by the CFPI as well. However, the nearby counties have such low populations that any effects on these counties are likely to represent a very small share of the effect of the initiative. For context, note that the 151,859 teenage females live in the counties we define as treated, on average from 2009–2013, while only while only 1,565 teenage females live in the adjacent counties.

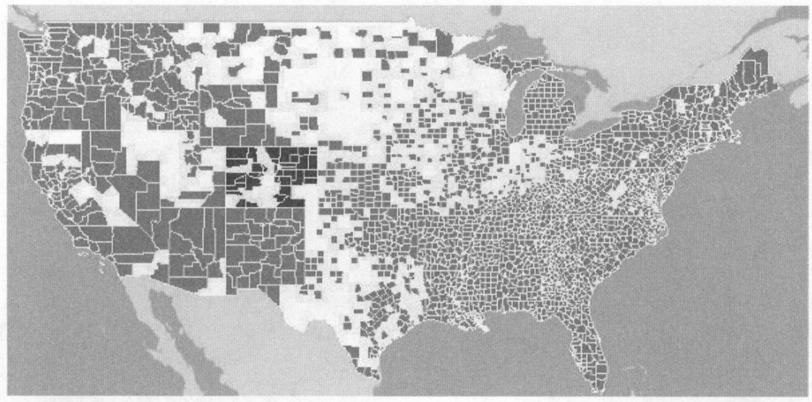

FIGURE 5. COUNTIES WITH TITLE X CLINICS

Notes: The above figure highlights counties that contain at least one Title X clinic as of 2009. The locations of Title X clinics in Colorado were obtained from Colorado's Department of Public Health and Environment's Directory of Family Planning Services. Counties with Title X clinics outside of Colorado were identified by geocoding the addresses of such clinics listed in the US Department of Health and Human Service's 340B Database. Counties in the darker shading represent counties with Title X clinics in Colorado.

Environment's Directory of Family Planning Services. For comparison, we identify counties with Title X clinics in 2008 outside of Colorado by geocoding the addresses of such clinics listed in the US Department of Health and Human Service's 340B Database. According to the National Family Planning and Reproductive Health Association, over 90 percent of Title X clinics participate in the 340B Drug Pricing Program and thus would be reflected in the database (NFPRHA 2013).[18] Figure 5 depicts counties identified as having, versus not having, at least one Title X clinic using this approach. In total, 72 percent of counties are identified as having a Title X clinic in 2008, accounting for 93 percent of the population of female teenagers in the United States.[19]

To estimate the effect of the initiative on teen births, we use restricted-use natality files provided by the National Center for Health Statistics from 2002–2013.[20] These data consist of a record of every birth taking place in the United States over this time period. They include information on the mother's age and the county of the birth, both of which are critical to our analysis, in addition to other details on the mother, the father, and the child. We assign births to the year of conception based on the mother's last menstrual period where available; otherwise we assume a gestation period of nine months. This approach results in incomplete data on births conceived in 2014; thus, we restrict our analysis to 2002–2013 after using the 2014 natality file to construct our measure of teen births conceived in 2013. We use these

[18] For Colorado, one of 37 counties would have been excluded from the analysis if we solely used data from the 340B Database.

[19] As an alternative to defining treatment and control counties based on whether a relevant clinic is located in the county, we have also considered defining treatment (control) counties as those in which a majority of the residents (based on the 2010 census) live within 25 miles of relevant clinic. This approach yields nearly identical results, which are available upon request.

[20] The choice of the initial year used for the analysis is motivated by the fact that Broomfield County, Colorado, split off from Adams, Boulder, Jefferson, and Weld counties in November of 2001.

data in conjunction with population counts from the National Cancer Institute's Surveillance, Epidemiology, and End Results Program (SEER) in order to consider teen birth rates in our analysis.[21]

To control for time-varying county characteristics, we use the aforementioned SEER data to construct measures of teen demographics (fraction of 15–19-year-old females, fraction black, and fraction Hispanic at each age). We measure county-level economic conditions using unemployment rates from the Bureau of Labor Statistics. Lastly, we include two indicator variables to help capture the broader policy environment around access to contraceptives in a state and year: whether over-the-counter access to emergency contraceptives is permitted, and whether private insurance plans covering prescription drugs are required to cover any FDA-approved contraceptive. These variables are constructed using data collected from the National Conference of State Legislatures (2012), the National Women's Law Center (2010), and Zuppann (2011).

The summary statistics for the variables used in our county-level analysis of birth rates are shown in Table A1. In particular, this table separately shows the means for Colorado counties with clinics receiving CFPI funding and counties outside of Colorado with Title X clinics, both before and after the CFPI was implemented. Notably, these statistics highlight that the Colorado counties have a smaller share of teens who are black, a larger share who are white, and relatively low unemployment rates, highlighting the potential importance of controlling for such differences in our identification strategy. In terms of the teen birth rates, these statistics show that teen birth rates were similar in the treated counties and the comparison counties prior to the CFPI, and were approximately 41 per 1,000 annually. There is some evidence of a divergence following the implementation of the CFPI—the teen birth rate declined 32 percent (to 28 per 1,000) in the treated counties and only 24 percent (to 31 per 1,000) in the comparison counties—but it is not statistically significant. While this simple comparison provides some useful evidence on the effect of the CFPI on teen birth rates, the empirical analyses described below consider how these effects vary over time and address a wide set of potential confounders, including differences in trends and differential changes in demographics, economic conditions, and state-wide policies.

B. *Identification Strategies*

Our primary approach for estimating the effects of the Colorado Family Planning Initiative is a difference-in-differences design that uses counties with Title X clinics outside of Colorado as the comparison group for Colorado counties with clinics receiving funding (i.e., those with Title X clinics). The identifying assumption underlying this approach is that the proportional changes in birth rates in the comparison counties provide a good counterfactual for the proportional changes that

[21] SEER population estimates are based on an algorithm that incorporates information from the census, vital statistics, IRS migration files, and the Social Security database. Note that we omit from the analysis one county that has a Title X clinic and zero teen females in a year.

would have been observed in the Colorado counties in the absence of the initiative. We discuss the validity of this identifying assumption in greater detail below.

Given the discrete nature of the births, and because we sometimes have county-year cells with zero teen births, our preferred approach is to use a Poisson model.[22] In particular, our main results are based on Poisson models of the following form:

$$(1)\ E[TBR_{ct} | CFPI_{c,t-k}, \alpha_c, \alpha_t, X_{ct}] = \exp\left(\sum_{k=1}^{5} \theta_k CFPI_{c,t-k} + \alpha_c + \alpha_t + \beta X_{ct}\right),$$

where TBR_{ct} is the teen birth rate for county c in year t, $CFPI_{c,t-k}$ is an indicator variable that takes a value of one for Colorado counties k years after the CFPI began and zero otherwise, α_c are county fixed effects to control for any systematic differences across counties, α_t are year fixed effects to control for shocks to teen birth rates that are common to all counties in a year, and X_{ct} can include time-varying county or state control variables. Because Poisson models are more typically thought of as considering counts, not rates, we note that this model can be expressed alternatively estimating the natural log of the expected count of births while controlling for the population of female teens and constraining its coefficient to be equal to one. We also present the results of ordinary least squares and weighted least squares analogues to equation (1) (adding one to the count of births for all county-year cells). All analyses allow errors to be correlated within counties over time when constructing standard-error estimates.[23]

Two reasons make it important for the model to allow the estimated effects to vary across years with a set of indicator variables rather than considering the coefficient on a single "posttreatment" indicator. First, the nature of contraceptive choice, sexual activity, and childbearing all would suggest that any effect would appear some time after the program's implementation, even when we assign births to their year of conception. In particular, the share of sexually active teens using LARCs is expected to increase over time as they visit clinics and, more generally, become increasingly aware of this option, as is evident in Figure 1 and 2. Moreover, teen sexual encounters are often irregular, and sexual encounters only lead to pregnancy with some probability.

Second, we estimate models that include county-specific linear trends in order to address concerns that differences in the preexisting trends between counties with Title X clinics in Colorado and counties with Title X clinics in other states might bias the estimates derived from equation (1).[24] As explained in Wolfers (2006), estimates of such trends will be biased—as will the estimates of other parameters—when a model does not fully account for time-varying treatment effects. In plain terms, a time-varying treatment effect implies an effect on trends, which in turn

[22] Like linear models, the Poisson model is not subject to the incidental parameters problem associated with fixed effects because they can be eliminated from the model. We relax the assumption of equality between the conditional mean and variance by calculating sandwiched standard errors.

[23] We note that this approach leads to more conservative estimates than those that instead allow for clustering at the state level. Also, we discuss the results of permutation-based inference in the results section.

[24] We have also examined our main results based on models that allow for county-specific quadratic trends. This alternative approach yields estimated effects that are slightly larger but much less precise, as it leads to standard error estimates 50–75 percent larger than those based on the model with county-specific linear trends.

implies that including trends that are identified in part by the posttreatment data would be "overcontrolling" (i.e., controlling for an endogenous variable), which can lead to significant bias. This source of bias is not an issue if the posttreatment observations do not contribute to the estimates of the trends; this can be accomplished by allowing the estimated effects to vary over time in a fully nonparametric fashion. In our case, it entails allowing the effect to vary across years. Nonetheless, we note that the estimated effects for each year are sometimes imprecise. As a result, we may prefer to focus on their average across years and on the statistical significance of their average across years.

As an alternative strategy to estimate the effects of the CFPI, we use a state-level synthetic control design (Abadie and Gardeazabal 2003; Abadie, Diamond, and Hainmueller 2010), comparing the outcomes of Colorado to the outcomes of a "Synthetic Colorado." The intuition behind our implementation of this strategy is to use data from 2003–2008 to identify the weighted average of comparison states that provides the best match for the outcomes observed in Colorado over this period of time, i.e., the synthetic control. Under the assumption that the synthetic control also provides a good match for the outcomes that would have been expected in Colorado in the absence of the CFPI, the difference between the outcomes observed for Colorado and the outcomes observed for the synthetic control provides an unbiased estimate of the causal effect of the CFPI. We execute this strategy by selecting the non-negative weights for each potential "donor state" to minimize the function:

$$(X_{CO} - X_{SC}W)'V(X_{CO} - X_{SC}W), \tag{2}$$

where X_{CO} is a $(K \times 1)$ vector of variables measuring outcomes from 2003–2008, X_{SC} is a $(K \times J)$ matrix containing the same variables for other states, W is a $(J \times 1)$ vector of weights summing to one, and the diagonal matrix V are the "importance weights" assigned to each variable in X. We include the log teen birth rate observed in 2003, 2005, and 2007 in X. While any number of variables could be included in X, we use these in particular out of our desire to construct a synthetic control that provides a good match for Colorado outcomes in levels and trends without overfitting.[25] Following Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010), the results we report are based on choosing the V so that the log teen birth rate path for Colorado from 2002–2008 is best reproduced by the resulting synthetic control.[26]

To conduct statistical inference, we follow Abadie, Diamond, and Hainmueller (2010) and estimate the distribution of estimated treatment effects under the null hypothesis of no effect by reassigning treatment to each state in the donor pool and applying the same method to estimate a placebo effect for each state. We then calculate the ratio of the post-intervention mean square predicted error to the pre-intervention mean square predicted error, out of respect for the notion that we should

[25] Additional variables we have considered, such as the fraction of the teenage population that is black or Hispanic, or the state unemployment rate, do not meaningfully affect the pre-intervention fit of the synthetic control and have trivial importance weight when importance weights are selected optimally using the procedure discussed below.

[26] The results are nearly identical when we instead assign equal weights to each of the three predictor variables.

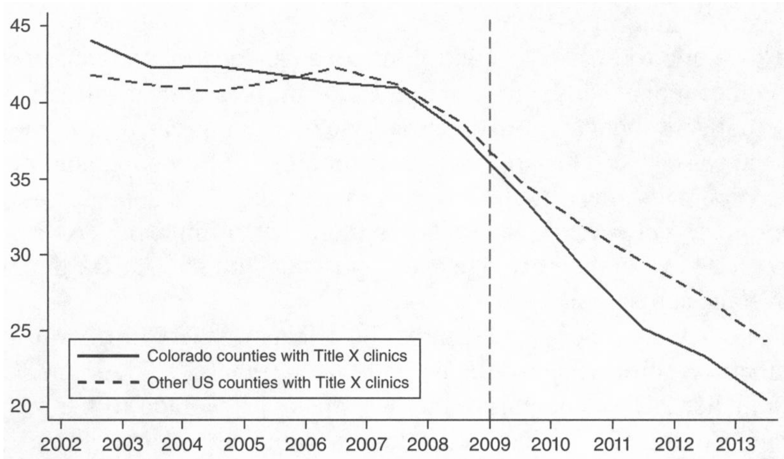

FIGURE 6. AVERAGE TEEN BIRTH RATES IN COUNTIES WITH TITLE X CLINICS

Notes: Teen birth rates—with births assigned to the year of conception based on the mother's last menstrual period—for each county are constructed using the National Center for Health Statistics (NCHS), Division of Vital Statistics Natality Files, and SEER population data. Counties are weighted by their teen female population. The vertical line represents the beginning of the Colorado Family Planning Initiative.

place greater weight on estimated treatment effects when there is a better pre-period match between the treated unit and the synthetic control. To construct a p-value for the effect estimated for Colorado, we consider its rank in this distribution.

III. Analysis of Teen Birth Rates

Before presenting model-based estimates, we present a graphical analysis that corresponds to our difference-in-differences identification strategy. Figure 6 plots the average of teen birth rates across Colorado counties with Title X clinics, which received funding from the CFPI, against the average across other US counties with Title X clinics. Of particular note for the validity of our empirical approach is the fact that the average birth rate for the Colorado counties appears to track that of other US counties fairly well prior to the CFPI. This supports the notion that changes in the latter can provide a good counterfactual for the former. That said, the teen birth rate trend for the Colorado counties is somewhat more negative than that of the non-Colorado counties. This suggests that we may need to control for such trends in our econometric analysis. Figure 6 also suggests that the teen birth rate across Colorado counties diverges from that of other US counties following the CFPI, providing some initial evidence that the CFPI had its intended effect of reducing teen birth rates. In our following discussion of the results, we consider the robustness and statistical significance of this apparent effect.

Table 2 presents model-based estimates from the same comparison shown in Figure 6, based on the Poisson model described in equation (1). Column 1 shows the estimated effects from the baseline model (only controlling for county and year fixed effects). These estimates indicate that the CFPI reduced teen birth rates by 4–10 percent in its first and second years and that the effect grew to 16–18 percent

TABLE 2—POISSON ESTIMATES OF THE EFFECT OF THE CFPI ON TEEN BIRTH RATES, DIFFERENCE-IN-DIFFERENCES USING COUNTIES WITH TITLE X CLINICS OUTSIDE COLORADO FOR COMPARISON

	(1)	(2)	(3)	(4)	(5)
Effect of initiative in first year	−0.042	0.005	−0.008	−0.009	−0.013
	(0.032)	(0.017)	(0.016)	(0.016)	(0.016)
Effect of initiative in second year	−0.103	−0.044	−0.050	−0.051	−0.056
	(0.034)	(0.022)	(0.021)	(0.021)	(0.021)
Effect of initiative in third year	−0.170	−0.101	−0.101	−0.108	−0.104
	(0.037)	(0.026)	(0.025)	(0.026)	(0.026)
Effect of initiative in fourth year	−0.163	−0.083	−0.077	−0.083	−0.076
	(0.051)	(0.036)	(0.037)	(0.038)	(0.038)
Effect of initiative in fifth year	−0.180	−0.088	−0.087	−0.094	−0.073
	(0.064)	(0.051)	(0.051)	(0.052)	(0.052)
Average effect	−0.132	−0.062	−0.065	−0.069	−0.064
p-value (test average effect = 0)	0.001	0.022	0.015	0.011	0.017
Average effect in years 2–5	−0.154	−0.079	−0.079	−0.084	−0.077
p-value (test average effect in years 2–5 = 0)	0.001	0.011	0.010	0.007	0.013
Observations	27,072	27,072	27,072	27,072	20,376
Counties	2,256	2,256	2,256	2,256	1,698
County and year fixed effects	Yes	Yes	Yes	Yes	Yes
County linear time trends	No	Yes	Yes	Yes	Yes
Economic and demographic controls	No	No	Yes	Yes	Yes
Contraceptive policy controls	No	No	No	Yes	Yes
Restricted sample	No	No	No	No	Yes

Notes: Estimates are based on annual data on counties from 2002–2013. Births are assigned to the year of conception based on the mother's reported last menstrual period. The control for economic conditions is the county unemployment rate and demographic control variables include percent of teens who are black, percent of teens who are Hispanic, and the fraction of teens by age and race. Contraceptive policy controls are state-by-year variables indicating whether over-the-counter access to emergency contraceptives are permitted and whether private insurance plans that cover prescription drugs are required to cover any FDA-approved contraceptive. The restricted sample omits counties in states with major funding cuts to family planning (Texas, New Jersey, Montana, New Hampshire, Maine), in states blocking clinics affiliated with abortion providers from access to Title X funds (Kansas, New Hampshire, North Carolina, Tennessee, Wisconsin, Indiana, Texas), in states attempting to block clinics affiliated with abortion providers from access to Medicaid funds (Indiana, Arizona), and in Iowa, which also had an initiative emphasizing LARCs. Robust standard errors clustered at the county level are shown in parentheses.

by its third, fourth, and fifth years. In column 2, we show estimates after also controlling for county-specific linear trends in order to address potential concerns that Colorado counties with Title X clinics and other US counties with Title X clinics differ in their preexisting teen birth rate trends. Those estimates are smaller than the ones in column 1, reflecting the fact that the birth rate trend for the Colorado counties was somewhat more negative than the trend for the non-Colorado counties. Nonetheless, the estimates continue to indicate that the CFPI reduced teen birth rates after its first year: by 4 percent in its second year, 10 percent in its third year, 8 percent in its fourth year, and 9 percent in its fifth year. These estimates imply that the CFPI significantly reduced teen birth rates, by an estimated 6.2 percent across 5 years or 7.9 percent across its second through fifth years.

Columns 3–5 of Table 2 show the robustness of the results to the inclusion of control variables and to the use of a restricted sample of counties. Specifically, column 3 shows results that additionally control for county unemployment rates and for a rich set of demographic control variables, including the percent of teens who are black, the percent of teens who are Hispanic, and the fraction of teens by age and race/ethnicity. The inclusion of these variables leaves the estimates largely unchanged.

Columns 4 and 5 address the fact that other state-level policies affecting access to contraceptives changed during the sample period, which could bias the estimated effects of the CFPI. Specifically, column 4 presents estimates that additionally control for whether over-the-counter access to emergency contraceptives is permitted and whether private insurance plans covering prescription drugs are required to cover any FDA-approved contraceptive. Column 5 presents estimates based on a restricted sample of counties, omitting those counties in states that have significantly cut funding for family planning, counties in states that passed legislation to deny clinics affiliated with abortion providers access to Title X or Medicaid funds during the period of our analysis, and counties in Iowa, which also had an initiative emphasizing LARCs from 2007–2012.[27] These modifications to the analysis do not meaningfully change any of the estimates.

Because the CFPI was intended to help those with low income gain access to LARCs, one would reasonably expect its effects to be largest in counties with a relatively large share of low-income individuals. We investigate this hypothesis by separately considering the effects for counties with poverty rates above the median of Colorado counties with Title X clinics and those with poverty rates below this median.[28] Although this approach balances the number of Colorado counties contributing to each estimate, it is noteworthy that Colorado is a relatively low-poverty state. Thus, the median used here (12.2 percent) is higher than the median across non-Colorado counties with Title X clinics (15.6 percent).

Table 3 presents the results of this analysis, restricting attention to estimates based on models with county-specific linear trends, which were earlier demonstrated to be important. These estimates indicate that the CFPI reduced teen birth rates by approximately 8 percent over 5 years in Colorado's counties with poverty rates above its median. As before, these effects are concentrated in the second through fifth years of the program. The estimated effects for Colorado's counties with lower poverty rates point in the same direction, but they are less than half as large as the estimates for higher poverty counties and are not statistically significant at conventional levels.

In Table 4, we show the results from Poisson models that also include indicator variables for Colorado counties prior to the beginning of the CFPI. We do this in order to verify that prior to the initiative the teen birth rate in the Colorado counties receiving funding did not deviate from expected levels relative to the teen birth rate in other US counties with Title X clinics, which otherwise would cast doubt on the notion that the latter provide a good comparison group for our purposes. Indeed, the coefficient estimates on the lead terms are routinely close to zero and are never statistically significant, whether we focus on all counties (columns 1–4), counties with poverty rates above the Colorado median (columns 5–8), or counties with poverty

[27] States with major funding cuts prior to 2013 include Texas, New Jersey, Montana, New Hampshire, and Maine. States blocking access to Title X funds include Kansas, New Hampshire, North Carolina, Tennessee, Wisconsin, Indiana, and Texas between 2010 and 2012. States attempting (but failing) to block Medicaid reimbursement include Indiana and Arizona in 2012 and 2013.

[28] We use each county's poverty rate averaged across 2002–2013 so that this approach maintains a balanced panel.

Table 3—Poisson Estimates of the Effect of the CFPI on Teen Birth Rates by County Poverty Rates, Difference-in-Differences Using Counties with Title X Clinics Outside Colorado for Comparison

	Counties with poverty rate > Colorado median				Counties with poverty rate ≤ Colorado median			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effect of initiative in first year	0.001	−0.010	−0.010	−0.016	0.011	−0.004	−0.006	−0.008
	(0.019)	(0.018)	(0.017)	(0.017)	(0.030)	(0.030)	(0.030)	(0.029)
Effect of initiative in second year	−0.056	−0.064	−0.064	−0.071	−0.028	−0.028	−0.030	−0.032
	(0.015)	(0.015)	(0.015)	(0.015)	(0.043)	(0.042)	(0.042)	(0.042)
Effect of initiative in third year	−0.115	−0.120	−0.129	−0.124	−0.074	−0.063	−0.047	−0.064
	(0.033)	(0.031)	(0.032)	(0.032)	(0.039)	(0.041)	(0.043)	(0.043)
Effect of initiative in fourth year	−0.103	−0.102	−0.111	−0.102	−0.041	−0.025	−0.010	−0.028
	(0.042)	(0.042)	(0.043)	(0.043)	(0.059)	(0.059)	(0.060)	(0.060)
Effect of initiative in fifth year	−0.137	−0.142	−0.151	−0.122	−0.019	−0.006	0.009	−0.010
	(0.057)	(0.056)	(0.057)	(0.058)	(0.070)	(0.070)	(0.071)	(0.071)
Average effect	−0.082	−0.088	−0.093	−0.087	−0.030	−0.025	−0.017	−0.028
p-value (test average effect = 0)	0.003	0.001	0.001	0.002	0.500	0.570	0.710	0.526
Average effect in years 2–5	−0.103	−0.107	−0.114	−0.104	−0.040	−0.031	−0.020	−0.033
p-value (test average effect in years 2–5 = 0)	0.002	0.001	0.001	0.002	0.415	0.535	0.697	0.503
Observations	19,668	19,668	19,668	14,976	7,404	7,404	7,404	5,400
Counties	1,639	1,639	1,639	1,248	617	617	617	450
County and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County linear time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Contraceptive policy controls	No	No	Yes	Yes	No	No	Yes	Yes
Restricted sample	No	No	No	Yes	No	No	No	Yes

Note: See Table 2.

rates below the Colorado median (columns 9–12). Moreover, these results show that the estimated effects of the initiative are robust to the inclusion of these lead terms (though less precise), providing additional support for the validity of the research design.

Table 5 presents estimates of the effect of the initiative using weighted least squares (WLS), where each cell is weighted by the teen female population it represents, and ordinary least squares (OLS), where each cell is given equal weight. These alternatives to the Poisson model require an ad hoc solution to address the fact that the natural log of the teen birth rate is undefined for county-year cells with zero teen births; we address this issue by adding one to the birth count for all cells. The WLS estimates are much more precise than the OLS estimates, but both are less precise than the Poisson estimates. In addition, the WLS estimates are somewhat smaller in magnitude than the Poisson estimates, whereas the OLS estimates are much larger. As described in Solon, Haider, and Wooldridge (2015), this pattern can reflect circumstances in which there are relatively large effects for relatively low weight (i.e., low teen female population) observations. We explore this potential heterogeneity directly in Table 6, which presents Poisson, WLS, and OLS estimates of the effects for counties that average fewer than 1,000 teen females per year.[29]

[29] Table A2 in the Appendix presents similar estimates for counties that average *more* than 1,000 teen females per year.

TABLE 4—POISSON ESTIMATES OF LEAD TERMS IN DIFFERENCE-IN-DIFFERENCES MODEL USING COUNTIES WITH TITLE X CLINICS OUTSIDE COLORADO FOR COMPARISON

	All counties				Counties with poverty rate > Colorado median				Counties with poverty rate ≤ Colorado median			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Effect of initiative in first year	−0.013	−0.010	−0.002	−0.030	−0.016	−0.007	−0.012	−0.048	−0.008	−0.011	0.018	0.002
	(0.016)	(0.019)	(0.029)	(0.037)	(0.017)	(0.019)	(0.031)	(0.039)	(0.029)	(0.039)	(0.054)	(0.067)
Effect of initiative in second year	−0.056	−0.053	−0.043	−0.076	−0.071	−0.059	−0.065	−0.107	−0.032	−0.035	−0.001	−0.019
	(0.021)	(0.023)	(0.032)	(0.038)	(0.015)	(0.018)	(0.028)	(0.045)	(0.042)	(0.048)	(0.059)	(0.062)
Effect of initiative in third year	−0.104	−0.100	−0.088	−0.126	−0.124	−0.110	−0.117	−0.165	−0.064	−0.067	−0.029	−0.050
	(0.026)	(0.029)	(0.043)	(0.054)	(0.032)	(0.029)	(0.047)	(0.063)	(0.043)	(0.054)	(0.074)	(0.086)
Effect of initiative in fourth year	−0.076	−0.072	−0.059	−0.101	−0.102	−0.087	−0.094	−0.148	−0.028	−0.032	0.011	−0.012
	(0.038)	(0.036)	(0.055)	(0.060)	(0.043)	(0.034)	(0.062)	(0.068)	(0.060)	(0.070)	(0.088)	(0.093)
Effect of initiative in fifth year	−0.073	−0.067	−0.053	−0.100	−0.122	−0.105	−0.113	−0.173	−0.010	−0.014	0.034	0.008
	(0.052)	(0.050)	(0.071)	(0.077)	(0.058)	(0.047)	(0.077)	(0.086)	(0.071)	(0.083)	(0.103)	(0.109)
One year before initiative		0.005	0.012	−0.011		0.017	0.013	−0.017		−0.005	0.019	0.006
		(0.015)	(0.018)	(0.029)		(0.021)	(0.022)	(0.037)		(0.019)	(0.032)	(0.047)
Two years before initiative			0.011	−0.008			−0.006	−0.030			0.035	0.025
			(0.021)	(0.026)			(0.028)	(0.031)			(0.025)	(0.039)
Three years before initiative				−0.024				−0.030				−0.013
				(0.018)				(0.024)				(0.026)
Average effect	−0.064	−0.060	−0.049	−0.087	−0.087	−0.074	−0.080	−0.128	−0.028	−0.032	0.006	−0.014
p-value (test average effect = 0)	0.017	0.029	0.264	0.091	0.002	0.001	0.076	0.023	0.526	0.565	0.930	0.862
Average effect in years 2–5	−0.077	−0.073	−0.061	−0.101	−0.104	−0.090	−0.098	−0.149	−0.033	−0.037	0.004	−0.018
p-value (test average effect in years 2–5 = 0)	0.013	0.019	0.209	0.070	0.002	0.001	0.055	0.018	0.503	0.540	0.964	0.831
Observations	20,376	20,376	20,376	20,376	14,976	14,976	14,976	14,976	5,400	5,400	5,400	5,400
Counties	1,698	1,698	1,698	1,698	1,248	1,248	1,248	1,248	450	450	450	450
County and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County linear time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contraceptive policy controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Restricted sample	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: See Table 2.

There are 21 such counties in Colorado with Title X clinics and the estimates are fairly imprecise; however, they provide some suggestive evidence that the effects are comparatively large for small counties and thus serve to demonstrate why the OLS estimates are relatively large in magnitude.

TABLE 5—WLS AND OLS ESTIMATES OF THE EFFECT OF THE CFPI ON TEEN BIRTH RATES, DIFFERENCE-IN-DIFFERENCES USING COUNTIES WITH TITLE X CLINICS OUTSIDE COLORADO FOR COMPARISON

	All counties		Counties with poverty rate > Colorado median		Counties with poverty rate ≤ Colorado median	
	WLS (1)	OLS (2)	WLS (3)	OLS (4)	WLS (5)	OLS (6)
Effect of initiative in first year	−0.015	−0.048	−0.029	−0.040	0.003	−0.075
	(0.023)	(0.068)	(0.017)	(0.080)	(0.037)	(0.108)
Effect of initiative in second year	−0.046	−0.041	−0.072	−0.135	−0.019	0.054
	(0.027)	(0.054)	(0.019)	(0.065)	(0.044)	(0.084)
Effect of initiative in third year	−0.093	−0.258	−0.109	−0.342	−0.063	−0.131
	(0.030)	(0.077)	(0.041)	(0.106)	(0.044)	(0.111)
Effect of initiative in fourth year	−0.063	−0.135	−0.080	−0.104	−0.029	−0.126
	(0.043)	(0.087)	(0.052)	(0.094)	(0.062)	(0.136)
Effect of initiative in fifth year	−0.023	−0.211	−0.055	−0.257	−0.005	−0.145
	(0.056)	(0.089)	(0.082)	(0.121)	(0.070)	(0.121)
Average effect	−0.048	−0.138	−0.069	−0.176	−0.023	−0.085
p-value (test average effect = 0)	0.121	0.029	0.053	0.021	0.621	0.385
Average effect in years 2−5	−0.056	−0.161	−0.079	−0.209	−0.029	−0.087
p-value (test average effect in years 2–5 = 0)	0.101	0.016	0.070	0.013	0.556	0.380
Observations	20,496	20,496	15,060	15,060	5,436	5,436
Counties	1,708	1,708	1,255	1,255	453	453
County and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County linear time trends	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Contraceptive policy controls	Yes	Yes	Yes	Yes	Yes	Yes
Restricted sample	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See Table 2 but note that these estimates are based on the weighted least squares and ordinary least squares analogues to the Poisson model. For the weighted estimates, cells are weighted by the population of female teens.

As an additional check on our main results, we also conduct statistical inference based on permutation tests. This analysis is motivated by earlier work demonstrating that standard methods of statistical inference can overstate statistical significance when there are a small number of treated units relative to the number of control units (Conley and Taber 2011). Kaestner (2016) shows this to be relevant in a panel-data analysis of 14 treated counties and 513 control counties. In our case, we have 37 treated counties and 1,717 control counties in our restricted sample, with fewer observations when we consider high- and low-poverty counties separately. We address this potential issue by repeatedly reassigning treatment to counties at random and obtaining the estimated effects using our preferred specification (i.e., the Poisson model with the full set of controls applied to the restricted set of counties). We then compare the distribution of "placebo estimates" obtained by randomization to our true estimate: the fraction of randomization-generated placebo estimates that suggest larger reductions in the teen birth rate than our true estimate provides a p-value.[30] We find that placebo estimates of the average effect across five years are

[30] Due to computational constraints, we perform 200 replications.

TABLE 6—ESTIMATES OF THE EFFECT OF THE CFPI ON TEEN BIRTH RATES FOR COUNTIES WITH ≤ 1,000 TEEN FEMALES, DIFFERENCE-IN-DIFFERENCES USING COUNTIES WITH TITLE X CLINICS OUTSIDE COLORADO FOR COMPARISON

	All counties			Counties with poverty rate > Colorado median			Counties with poverty rate ≤ Colorado median		
	Poisson (1)	WLS (2)	OLS (3)	Poisson (4)	WLS (5)	OLS (6)	Poisson (7)	WLS (8)	OLS (9)
Effect of initiative in first year	−0.111	−0.116	−0.050	−0.089	−0.142	−0.082	−0.194	−0.125	−0.063
	(0.095)	(0.099)	(0.114)	(0.114)	(0.101)	(0.124)	(0.177)	(0.177)	(0.199)
Effect of initiative in second year	0.006	0.022	−0.000	−0.006	−0.078	−0.176	0.034	0.120	0.193
	(0.081)	(0.080)	(0.094)	(0.100)	(0.112)	(0.095)	(0.155)	(0.132)	(0.151)
Effect of initiative in third year	−0.326	−0.265	−0.342	−0.338	−0.359	−0.540	−0.206	−0.086	0.037
	(0.141)	(0.117)	(0.142)	(0.212)	(0.184)	(0.160)	(0.185)	(0.185)	(0.237)
Effect of initiative in fourth year	−0.106	−0.123	−0.104	0.015	0.001	−0.165	−0.185	−0.162	0.106
	(0.152)	(0.141)	(0.158)	(0.159)	(0.132)	(0.143)	(0.242)	(0.234)	(0.284)
Effect of initiative in fifth year	−0.214	−0.193	−0.231	−0.190	−0.191	−0.410	−0.137	−0.127	0.090
	(0.155)	(0.141)	(0.162)	(0.197)	(0.165)	(0.190)	(0.251)	(0.250)	(0.258)
Average effect	−0.150	−0.135	−0.145	−0.122	−0.154	−0.275	−0.138	−0.076	0.073
p-value (test average effect = 0)	0.178	0.170	0.217	0.383	0.199	0.020	0.451	0.661	0.723
Average effect in years 2–5	−0.160	−0.140	−0.169	−0.130	−0.157	−0.323	−0.124	−0.064	0.106
p-value (test average effect in years 2–5 = 0)	0.187	0.183	0.180	0.402	0.235	0.013	0.517	0.728	0.620
Observations	9,252	9,252	9,252	7,908	7,908	7,908	1,344	1,344	1,344
Counties	771	771	771	659	659	659	112	112	112
County and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County linear time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contraceptive policy controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Restricted sample	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See Table 2 but note that these estimates are based on the weighted least squares and ordinary least squares analogues to the Poisson model. For the weighted estimates, cells are weighted by the population of female teens.

only greater than our actual estimate 2 percent of the time. Restricting attention to high-poverty counties, where the effects appear to be greatest, we find that placebo estimates of the average effect across 5 years are only greater than our actual estimate 1 percent of the time.

Finally, we present results from a state-level synthetic control design, the details of which we described in Section B, focusing on the restricted sample of states so that the estimates are not confounded by major changes in family planning policies occurring outside of Colorado. Table A3 in the Appendix shows the weights given to each state to form the synthetic control. While the synthetic control method does not require nonzero weights, in this instance nearly all states contribute to the synthetic control, though the largest weights are given to Delaware, Nebraska, Nevada, New Mexico, and New Hampshire. Table A4 shows the importance weights used for each of the predictor variables: the log of the teen birth rate in 2007, the log of the teen birth rate in 2005, and the log of the teen birth rate in 2003. It also shows the mean of each of these variables for Colorado, the synthetic control, and the donor pool as a whole. We note that the importance weights were selected so that the log teen birth rate path for Colorado from 2002–2008 is best reproduced by the resulting synthetic control. Interestingly, this approach assigns very high weight to the log teen birth rate in 2007 (0.841), little weight to the log teen birth rate in 2005 (0.157), and

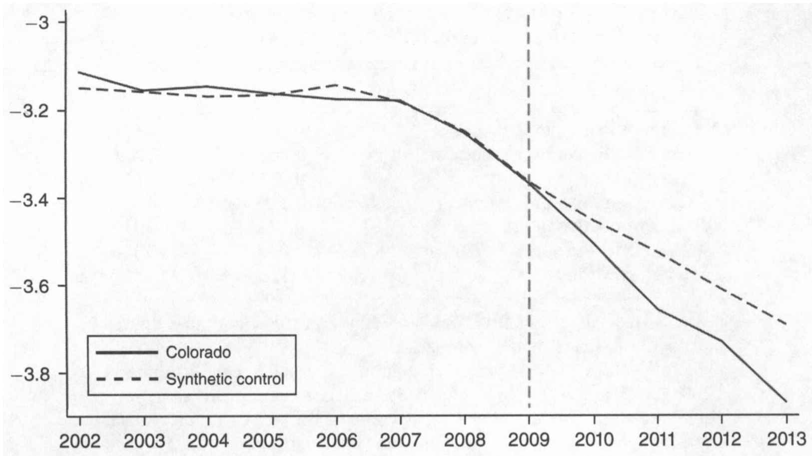

Figure 7. Teen Birth Rates in Colorado versus Synthetic Colorado

Notes: Synthetic controls are constructed as the weighted average of states that minimizes $(X_{CO} - X_{SC}W)' \times V(X_{CO} - X_{SC}W)$, where X_{CO} is a (3×1) vector containing Colorado's teen birth rate in 2003, 2005, and 2007; X_{SC} is a (3×39) matrix containing the same variables for states in the donor pool; W contains the weight for each state; and the diagonal matrix V contains the "importance weights" assigned to each variable in X. Following Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010), V is chosen such that the the log teen birth rate path for Colorado from 2002–2008 is best reproduced by the resulting synthetic control. The donor pool of states includes all states included in the "restricted sample" of our other analyses. That is, it omits counties in states with major funding cuts to family planning (Texas, New Jersey, Montana, New Hampshire, Maine), in states blocking clinics affiliated with abortion providers from access to Title X funds (Kansas, New Hampshire, North Carolina, Tennessee, Wisconsin, Indiana, Texas), in states attempting to block clinics affiliated with abortion providers from access to Medicaid funds (Indiana, Arizona), and in Iowa, which also had an initiative emphasizing LARCs.

almost no weight to the log teen birth rate in 2003 (0.002). Despite this asymmetry, the resulting synthetic control that uses these weights is very similar to Colorado in all three variables. Moreover, the results of our analysis are nearly identical if we instead assign equal weights to each of the three predictor variables.

Figure 7 shows how the teen birth rate in Colorado evolved over time relative to its synthetic control. Two main features of this figure stand out. First, the log teen birth rate of the synthetic control provides a good match for Colorado prior to the CFPI. It is particularly notable that this is the case for 2002, 2004, 2006, and 2008 since the log birth rates in these years were not used as predictor variables in constructing the synthetic control. Second, the two series diverge following the CFPI, indicating that the initiative reduced teen birth rates relative to what we would have expected based on the synthetic control. We report the corresponding set of estimated effects and permutation-based p-values in Table 7. The estimates are larger than those based on our difference-in-differences approach, indicating an effect of 9.6 percent across the first 5 years of the initiative *statewide*; however, they are not statistically significant at conventional levels. That this strategy finds economically significant but not statistically significant effects highlights its lack of power. Given the distribution of estimates generated by the permutation tests estimating "placebo effects" for each state used in the analysis, which we show in Figure 8, it would take an effect on birth rates averaging approximately 22 percent over 5 years to produce a p-value less than 0.05.

Table 7—State-Level Synthetic Control Estimates of the Effects of the CFPI on log Teen Birth Rates

	Estimate	p-value
Effect of initiative in first year	−0.004	0.974
Effect of initiative in second year	−0.053	0.436
Effect of initiative in third year	−0.131	0.077
Effect of initiative in fourth year	−0.119	0.205
Effect of initiative in fifth year	−0.176	0.103
Average effect in years 1–5	−0.096	0.154
Average effect in years 2–5	−0.120	0.154

Notes: The synthetic control for Colorado is constructed as the weighted average of states that minimizes $(X_{CO} - X_{SC}W)'V(X_{CO} - X_{SC}W)$, where X_{CO} is a (3×1) vector containing Colorado's teen birth rate in 2003, 2005, and 2007; X_{SC} is a (3×39) matrix containing the same variables for states in the donor pool; W contains the weight for each state; and the diagonal matrix V contains the "importance weights" assigned to each variable in X. Following Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010), V is chosen such that the log teen birth rate path for Colorado from 2002–2008 is best reproduced by the resulting synthetic control. The donor pool of states includes all states included in the "restricted sample" of our other analyses. That is, it omits states with major funding cuts to family planning (Texas, New Jersey, Montana, New Hampshire, Maine), states blocking clinics affiliated with abortion providers from access to Title X funds (Kansas, New Hampshire, North Carolina, Tennessee, Wisconsin, Indiana, Texas), states attempting to block clinics affiliated with abortion providers from access to Medicaid funds (Indiana, Arizona), and Iowa, which also had an initiative emphasizing LARCs. Permutation-based p-values are based on the distribution of estimated treatment effects obtained by reassigning treatment to each state in the donor pool, estimating the effects using the same synthetic control approach, and calculating the ratio of the post-intervention mean square predicted error to the pre-intervention mean square predicted error. The estimated effects for each state in each period from this process are shown in Figure 8.

IV. Conclusion

By analyzing the first large-scale policy intervention to promote and improve access to LARCs in the United States, this paper provides some groundwork for understanding how improving access to LARCs can affect birth rates of one of the highest at-risk groups for unintended pregnancy: teenagers. A back-of-the-envelope calculation based on our estimates suggests that the program prevented approximately 1,478 teen births that would have been conceived between 2009 and 2013.[31] Given that \$20 million of CFPI funding was allocated to these years, with the remainder allocated to 2014 and 2015, this number amounts to approximately \$13,531 per teen birth avoided.[32] However, it is important to keep in mind that LARCs inserted

[31] This number is based on the estimated effect of 6.4 percent across 2009–2013 (Table 2, column 5), an average of 154,000 teen females living in Colorado counties with Title X clinics over these years, and a baseline birth rate of 30 per 1,000 teen females.

[32] Providing some context for these numbers, the National Campaign to Prevent Teen and Unplanned Pregnancy (NCPTUP) estimates that the cost to taxpayers associated with a child born to a teen mother is \$25,230 over 15 years. Their calculation accounts for the fact that costs and programs differ across states and is based on comparisons of children born to teen mothers relative to children born to mothers aged 20–21. That said, we note that the fact that those born to teen mothers tend to have other forms of disadvantage could cause this sort of estimate

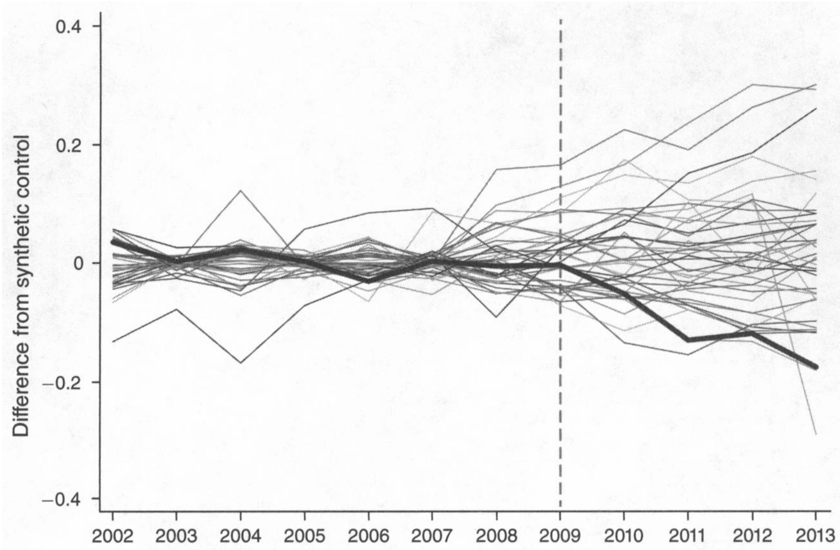

FIGURE 8. RESULTS OF PERMUTATION TESTS FOR SYNTHETIC CONTROL ESTIMATES

Notes: This figure shows the difference between each state and its "synthetic control" in each period, which is used to construct p-values as described in Table 7. The estimates for Colorado are bolded.

over this period of time also would be expected to prevent unintended pregnancies in subsequent years. Moreover, the initiative was intended to promote access to LARCs among low-income women in general, not just teenagers. Thus, in order to provide a more complete understanding of the effects of the program, it will be important for future work to revisit its effects once more data becomes available and to consider its effects on older women. It also will be important to further consider how expanding access to LARCs affects sexual activity and reproductive health more generally. Finally, we note that our results suggest that future work on the effects of expanded access to LARCs may provide useful insights into the effects of unintended pregnancies (or the prevention thereof) on long-run outcomes, such as educational attainment, earnings, and the use of social assistance programs.

to overstate the costs of teen childbearing. However, recent work using miscarriages to identify the causal effect of teen childbearing indicates that having a child as a teenager increases the expected number of births by eight-tenths (Ashcraft, Fernández-Val, and Lang 2013). This finding suggests that a large share of the costs of teen childbearing may be driven by impacts on family size among those from disadvantaged backgrounds, which would suggest that the NCPTUP estimate might actually understate the true costs of teen childbearing.

Appendix

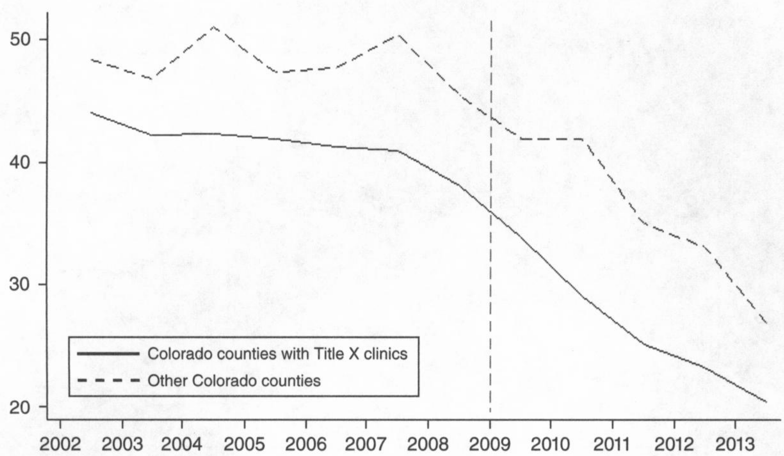

Figure A1. Average Teen Birth Rates in Colorado Counties with and without Title X Clinics

Notes: Teen birth rates—with births assigned to the year of conception based on the mother's last menstrual period—for each county are constructed using the National Center for Health Statistics (NCHS), Division of Vital Statistics Natality Files, and SEER population data. Counties are weighted by their teen female population. The vertical line represents the beginning of the Colorado Family Planning Initiative.

Table A1—Summary Statistics for Counties with Title X Clinics

	Colorado counties $N = 37$	Comparison counties $N = 2{,}219$	Test of equality *p-value*
Panel A. Pretreatment (2002–2008)			
Births per 1,000 females aged 15–19	41.55	41.04	0.932
Percent teens 15 year-olds	19.78	19.98	0.740
Percent teens 16 year-olds	19.87	20.01	0.814
Percent teens 17 year-olds	19.74	19.91	0.768
Percent teens 18 year-olds	20.00	20.03	0.926
Percent teens 19 year-olds	20.61	20.07	0.000
Percent 15 year-olds black	6.11	18.02	0.000
Percent 16 year-olds black	6.01	17.88	0.000
Percent 17 year-olds black	5.94	17.64	0.000
Percent 18 year-olds black	5.71	17.07	0.000
Percent 19 year-olds black	5.47	16.68	0.000
Percent 15 year-olds Hispanic	24.07	18.03	0.169
Percent 16 year-olds Hispanic	23.87	17.91	0.163
Percent 17 year-olds Hispanic	23.77	17.88	0.174
Percent 18 year-olds Hispanic	23.39	18.21	0.208
Percent 19 year-olds Hispanic	23.69	18.82	0.213
Percent 15 year-olds white	88.84	75.67	0.000
Percent 16 year-olds white	88.96	75.76	0.000
Percent 17 year-olds white	88.97	75.93	0.000
Percent 18 year-olds white	88.92	76.25	0.000
Percent 19 year-olds white	88.98	76.43	0.000
County unemployment rate	4.98	5.46	0.003
Emergency contraceptives OTC	0.44	0.54	0.000
Contraceptives insurance mandate	0.00	0.50	0.000

(continued)

TABLE A1—SUMMARY STATISTICS FOR COUNTIES WITH TITLE X CLINICS (*continued*)

	Colorado counties $N = 37$	Comparison counties $N = 2{,}219$	Test of equality *p-value*
Panel B. Posttreatment (2009–2013)			
Births per 1,000 females aged 15–19	26.44	29.62	0.345
Percent teens 15 year-olds	19.33	19.23	0.882
Percent teens 16 year-olds	19.46	19.53	0.914
Percent teens 17 year-olds	19.63	19.84	0.730
Percent teens 18 year-olds	20.41	20.42	0.993
Percent 15 year-olds black	6.58	17.98	0.000
Percent 16 year-olds black	6.55	18.13	0.000
Percent 17 year-olds black	6.70	18.22	0.000
Percent 18 year-olds black	6.77	17.96	0.000
Percent 19 year-olds black	6.57	17.89	0.000
Percent 15 year-olds Hispanic	28.13	21.72	0.158
Percent 16 year-olds Hispanic	27.77	21.49	0.162
Percent 17 year-olds Hispanic	27.54	21.30	0.166
Percent 18 year-olds Hispanic	26.64	21.34	0.210
Percent 19 year-olds Hispanic	26.51	21.63	0.230
Percent 15 year-olds white	87.29	74.72	0.000
Percent 16 year-olds white	87.38	74.60	0.000
Percent 17 year-olds white	87.27	74.53	0.000
Percent 18 year-olds white	87.21	74.71	0.000
Percent 19 year-olds white	87.32	74.64	0.000
County unemployment rate	7.77	8.89	0.000
Emergency contraceptives OTC	1.00	1.00	1.000
Contraceptives insurance mandate	0.60	0.54	0.068

Notes: Births are based on the National Center for Health Statistics (NCHS), Division of Vital Statistics Natality Files. They are assigned to the year of conception based on the mother's reported last menstrual period. Population data, including race, ethnicity, and age are from SEER. Unemployment rates are from the BLS. Column 1 shows the means for treated counties in our sample, i.e., Colorado counties with a Title X clinic. Column 2 displays the means for the comparison counties, i.e., counties outside of Colorado with a Title X clinic. County-year cells are weighted by the teen female population they represent.

TABLE A2—ESTIMATES OF THE EFFECT OF THE CFPI ON TEEN BIRTH RATES FOR COUNTIES WITH > 1,000 TEEN FEMALES, DIFFERENCE-IN-DIFFERENCES USING COUNTIES WITH TITLE X CLINICS OUTSIDE COLORADO FOR COMPARISON

	All counties			Counties with poverty rate > Colorado median			Counties with poverty rate ≤ Colorado median		
	Poisson (1)	WLS (2)	OLS (3)	Poisson (4)	WLS (5)	OLS (6)	Poisson (7)	WLS (8)	OLS (9)
Effect of initiative in first year	−0.009	−0.009	−0.041	−0.016	−0.020	−0.039	−0.000	0.007	−0.049
	(0.016)	(0.024)	(0.029)	(0.016)	(0.017)	(0.031)	(0.029)	(0.038)	(0.046)
Effect of initiative in second year	−0.060	−0.050	−0.078	−0.076	−0.071	−0.112	−0.033	−0.025	−0.047
	(0.021)	(0.028)	(0.034)	(0.015)	(0.020)	(0.034)	(0.043)	(0.046)	(0.055)
Effect of initiative in third year	−0.097	−0.088	−0.140	−0.123	−0.100	−0.168	−0.050	−0.059	−0.101
	(0.027)	(0.032)	(0.038)	(0.035)	(0.048)	(0.061)	(0.043)	(0.046)	(0.050)
Effect of initiative in fourth year	−0.078	−0.062	−0.129	−0.121	0.092	−0.119	−0.011	−0.019	−0.121
	(0.039)	(0.045)	(0.065)	(0.045)	(0.061)	(0.076)	(0.061)	(0.065)	(0.100)
Effect of initiative in fifth year	−0.070	−0.018	−0.172	−0.132	−0.056	−0.181	0.004	0.004	−0.152
	(0.055)	(0.060)	(0.079)	(0.063)	(0.097)	(0.081)	(0.071)	(0.072)	(0.126)
Average effect	−0.063	−0.046	−0.112	−0.094	−0.068	−0.124	−0.018	−0.019	−0.094
p-value (test average effect = 0)	0.026	0.161	0.009	0.001	0.113	0.016	0.690	0.698	0.155
Average effect in years 2–5	−0.076	−0.055	−0.130	−0.113	−0.080	−0.145	−0.023	−0.025	−0.105
p-value (test average effect in years 2–5 = 0)	0.019	0.132	0.007	0.002	0.129	0.016	0.657	0.631	0.149

(*continued*)

Table A2—Estimates of the Effect of the CFPI on Teen Birth Rates for Counties with > 1,000 Teen Females, Difference-in-Differences Using Counties with Title X Clinics Outside Colorado for Comparison (*continued*)

	All counties			Counties with poverty rate > Colorado median			Counties with poverty rate ≤ Colorado median		
	Poisson (1)	WLS (2)	OLS (3)	Poisson (4)	WLS (5)	OLS (6)	Poisson (7)	WLS (8)	OLS (9)
Observations	11,244	11,244	11,244	7,152	7,152	7,152	4,092	4,092	4,092
Counties	937	937	937	596	596	596	341	341	341
County and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County linear time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contraceptive policy controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Restricted sample	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See Table 2 but note that these estimates are based on the weighted least squares and ordinary least squares analogues to the Poisson model. For the weighted estimates, cells are weighted by the population of female teens.

Table A3—State Weights for Synthetic Controls

State	Weight	State	Weight
AL	0.018	MO	0.012
AK	0.018	NE	0.072
AR	0.005	NV	0.242
CA	0.015	NM	0.075
CT	0.012	NY	0.011
DE	0.155	ND	0.007
DC	0.007	OH	0.012
FL	0.021	OK	0.011
GA	0.017	OR	0.010
HI	0.010	PA	0.010
ID	0.012	RI	0.075
IL	0.020	SC	0.013
KY	0.010	SD	0.009
LA	0.015	UT	0.007
MD	0.012	VT	0.007
MA	0.009	VA	0.017
MI	0.016	WA	0.010
MN	0.010	WV	0.010
MS	0.000	WY	0.009

Note: See Table 7.

Table A4—Predictor Variables for Synthetic Control

Variable	Weight	Colorado	Synthetic Colorado	Full donor pool
log teen birth rate, 2007	0.841	−3.180	−3.182	−3.237
log teen birth rate, 2005	0.157	−3.164	−3.167	−3.254
log teen birth rate, 2003	0.002	−3.156	−3.159	−3.263

Note: See Table 7.

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