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The Effect of the Colorado Family Planning Initiative on Pregnancy Behaviors and Adverse Birth Outcomes: An Economic Analysis

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An Economic Analysis

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Introduction

This research project explores the effects of the Colorado Family Planning Initiative (CFPI) on maternal pregnancy behaviors and adverse birth outcomes. The Colorado Family Planning Initiative, explained in further detail below, provided Title X Clinics in Colorado with funding for intrauterine devices and contraceptive implants. The policy aimed to reduce unplanned pregnancies for low-income women and teens. Understanding the impacts of this policy provides extremely helpful information for reproductive policy, as well as potential to reduce use of social welfare funding for single mothers and babies with adverse birth outcomes.

My analysis is the first to examine the effects of the CFPI by analyzing changes in individual behavior during pregnancy and postpregnancy periods. To do this, I examine each year's maternal cohort and cohort of infants.

To analyze the effects of the policy during pregnancy, I examine year-to-year changes in behaviors of pregnant women, including smoking, drinking, and breastfeeding. If the Initiative reduced unintended pregnancies, as a result risky pregnancy behaviors should be reduced as well.

Finally, I examine the effects of the policy on the following adverse birth outcomes: low birth weight, preterm birth, congenital abnormalities, and abnormal conditions at birth. Again, if the policy reduced unintended pregnancies, and a higher percentage of pregnant women received appropriate prenatal care or engaged in better health behaviors during pregnancy, we expect a lower prevalence of adverse birth outcomes.

Background

The CFPI aimed to reduce unplanned pregnancies for low-income women and teens by providing Title X clinics, a major source of reproductive care for low-income females, with $23 million over 5 years. The funding was used to increase usage of long-acting reversible contraceptives, or LARCs. LARCs provided by the program included contraceptive implants and IUDs, which remain effective until removed or for 3-10 years, depending on the device. LARCs have a much lower failure rate than other methods of contraception, but barriers such as lack of information and high initial cost prevent low-income women and teens in the United States from using them. LARCs have typical use failure rates ranging from 0.05% for contraceptive implants to 0.8% for the ParaGard IUD, as opposed to 18% for male condoms and 9% with contraceptive pills (Phelps, Murphy, and Godfrey 2014).

The CFPI targeted low-income women and teens by providing funding to Title X clinics. Title X refers to Title X of the Public Health Service Act. The Colorado Department of Public Health (2015) explains,

> "Title X is the only federal grant program dedicated solely to providing individuals with comprehensive family planning and related preventive health services. The Title X program is designed to provide access to contraceptive services, supplies and information to all who want and need them. By law, priority is given to persons from low-income families."

Title X clinics charge women on a sliding-scale basis of ability to pay. Clinics provide family planning services at no charge for clients whose incomes are at or below 100% of the poverty line, a schedule of discounts for clients who earn between 101% and 250% of the poverty line, and full charge for patients with incomes more than 250% of

the poverty level. In 2015, 87% of patients who received family planning at Title X Clinics had incomes at or below 150% of the federal poverty line (2015 Annual Report). While clinics request verification of income, they must accept self-declared income of patients (Klingler).

The initiative presented a drastic change in availability of LARCs for Title X clients. According to Greta Klingler, prior to the initiative,

> "[a]ll clinics were offering IUDs, but usually in very limited quantity. Some were only able to purchase a few per year. A few clinics were providing the implant in the same manner. Many weren't offering it at all given that it was still fairly new to the market and they hadn't all been trained in insertion techniques (required to actually order/prescribe the device)."

According to Lindo and Packham, (2015), 20 out of 28 agencies had not provided IUDs prior to the initiative, and 16 clinics offered implants for the first time due to the initiative.

LARCs have a high upfront cost, usually $400-1000, which presents a disproportionately high barrier to use for low-income patients. Since many clinics could not afford to purchase LARCs prior to the initiative, and patients could not afford them elsewhere, LARCs were effectively inaccessible to low-income women.

Anyone may visit a Title X Clinic, and anyone could obtain a LARC at no cost during the initiative, regardless of income. Insertion fees were charged on the sliding-scale basis through the initiative, but the devices themselves were free. However, the fact that all women, not just low-income women, received the devices for free may initially seem contrary to the policy's goals. Since Title X Clinics have always provided

contraception at no charge to the poorest women, the initiative seems to cause the greatest change in the affordability of LARCs for women with incomes above 250% of the poverty line. However, providing the funding only to Title X Clinics mitigated this concern due to the demographics of patients at Title X Clinics, the vast majority of whom are low-income.

All Title X Clinics in Colorado received funding and began activities for the CFPI in January of 2009. The initiative provided funding to all Title X clinics in Colorado for training on counseling and insertion of LARCS, as well as the LARC devices themselves. LARC usage rate increased from less than 3% in 2008 to nearly 25% in 2014 (Lindo and Packham 2015).

The Initiative has already been deemed a success for several reasons. The CFPI resulted in increased use of LARCs, reduced the abortion rate, and reduced the teen birth rate, as described in the literature review below.

Literature Review

The CFPI allows study of the effects of public provision of contraceptives in the United States. The following reviews the relevant literature on the economics of contraception, public provision thereof, and its impacts on birth rates, abortion rates, and infant health outcomes.

The primary issue on the subject of public provision of contraceptives is whether it is cost effective. To determine cost effectiveness, Mavranzouli (2009) analyses factors such as health benefits, health harms, unintended pregnancy outcomes, social welfare costs, and costs and savings associated with contraceptive use. Mavranezouli establishes that all contraceptives are cost effective from a public payer perspective, but some are

more cost effective than others. Specifically, Mavranezouli finds that sterilization and long-acting reversible contraceptives (LARCs) are the most cost effective options for contraception. Frost et al. (2008) confirm the cost effectiveness of public provision of contraceptives: their study estimates that for every $1 the public sector spends on family planning programs and contraception, $4.02 is saved in averted Medicaid birth costs.

The public provision of contraceptives to teens and low-income women is of special interest, because low-income women and teenagers are most likely to impose disproportionately high social welfare costs when faced with unintended pregnancies (Lindo and Packham 2015). Teenagers disproportionately impose costs on family, communities, and public assistance programs when they become pregnant. This is exacerbated by the fact that 75% of teen births are unintended at conception (Lindo and Packham 2015). So, from a normative perspective, reducing the rate of unintended pregnancies for teenagers benefits social welfare.

While normatively, it is beneficial for teenagers and low-income women to have access to contraception, many women lack access. As Moskosky et al. (2011) establish, nationwide on-site availability of LARCs at Title X Clinics ranges from 35.7% for implants to 59.7% for the Paraguard IUD. Due to high initial costs and low availability, only 5% of American teenagers use LARC methods, despite their low failure rate and long-term cost effectiveness (Lindo and Packham 2015).

Several studies have examined the impact of expanding access to free or low-cost family planning services, including contraception. Kearney and Levine (2009) evaluate Medicaid policy changes that expanded family planning services. They find that income-based family planning waivers reduce births, especially teen births due to an increase in

use of contraception. Similarly, Bailey (2012) finds that family planning programs in the United States reduce the general fertility rate by roughly 2%, delay early pregnancies, and increase contraceptive use. Furthermore, Bailey finds that federal family planning expenditure reduced childbearing among poor women by 19-30% over 10 years.

While Kearney and Levine and Bailey evaluate public sector spending to provide increased contraceptive access, Raissian and Lopoo (2014) review expansion of private coverage. Raissian and Lopoo find that overall, mandating prescription contraception coverage for private insurers does not affect contraceptive use.

However, the same study finds that women with low educational attainment do have a statistically significant increase in contraceptive use. This establishes the importance of targeting low-income women and women with low educational attainment for programs that increase access to contraception. Targeted programs will have the greatest effect in reducing unintended pregnancies and will provide the greatest impact per dollar spent on family planning services.

Harper et al. (2015) study an intervention to increase patient access to LARCs. In a cluster-randomized trial, the study provided training to clinics on LARC methods, counseling for patients, and insertion skills. They find that by removing information barriers to LARCs, selection of LARC methods by patients increases and pregnancy rates decrease. The results of this study show that removing informational barriers to accessing contraception can have a positive result, even when prices of contraception remain constant. Thus, reducing information barriers to LARC access is an important factor in reducing unintended pregnancy rates.

Blumenthal et al. (2013) measure the impact of an initiative to reduce both information and cost barriers to LARCs, especially IUDs, in 13 different developing countries. The initiative focused on supply side intervention to increase IUD and implant use, similar to the CFPI. Like Harper et al., Blumenthal finds high demand for LARCs when barriers to access are removed.

Two studies have specifically evaluated the impact of expansion of LARC access on abortion rates within the United States. Ricketts et al. (2014) find that abortion rates for 15-19-year-olds had a statistically significant decline of 34%, and that a 5% decrease in abortion rates was due to the CFPI. Biggs et al. (2015) study a nearly identical initiative in Iowa. They find that an increase of 1 LARC user per 100 women was associated with a 4% reduction in abortion rates each year.

Two studies have focused on the CFPI in respects to reducing teen birth rates. Lindo and Packham evaluate the CFPI using a difference-in-difference approach comparing Title X clinics in Colorado to Title X clinics in other states. Lindo and Packham find that the CFPI significantly increased LARC usage in Colorado, and as a result prevented over 900 unintended teen pregnancies. They also conclude that the initiative reduced teen birth rates by 4-6% in is first year and by as much as 16-17% in its third and fourth years (Lindo and Packham 2015). According to Ricketts et al. (2014), the CFPI generated a high and statistically significant decline in fertility rates for low-income 15-19-year-olds.

Ricketts et al. and Goldthwaite et al. evaluate the CFPI's effects on adverse birth. Ricketts et al. (2014) find that the CFPI was associated with a statistically significant decline in high-risk births. The decline is consistent with expectations, because high-risk

Comment [J1]: Do they actually observe LARC usage?

Comment [CY2R1]: From Lindo and Packham: "This number is based on the estimated e1ect of 5% across 2009–2012, an average of 156,000 teen females living in Colorado counties with Title X clinics over these years, and a birth rate of 30 per 1,000 teen females during these years."
So…maybe?

births are associated with young, low-income women with less than a high-school education (Ricketts, Klingler, and Schwalberg 2014). This population overlaps significantly with the target population of the CFPI. Goldthwaite et al. (2015) extends the analysis to adverse birth outcomes. The study finds that the CFPI caused a statistically significant decrease in the odds of preterm birth, but no statistically significant decrease in low birth weight.

Existing literature finds that public provision of LARCs is highly cost-effective and can reduce costs of unintended pregnancy on social welfare systems. It also finds high latent demand for LARCs when barriers to access are removed. Expanding access to LARCs is an effective way to reduce unintended pregnancies and adverse birth outcomes, particularly among low-income women and teens.

Data

My research uses data from the Colorado Health Information Data (CoHID) birth data set. The CoHID data set collects all birth certificate data for a given year into one data set. The birth data set includes information on the birth month and year of each infant born from 2007-2014, as well as infant characteristics including birth weight, estimated gestational age, and congenital abnormalities. Data analyzed also includes maternal characteristics including race, age, education, income, and census block of residence of the mother.

Previous analysis of the CFPI measures change over time using a binary variable to indicate whether the policy was in effect that year. Studies that have included distance as a factor have previously measured access in terms of living in a county with a Title X clinic. However, given the differing sizes and irregular shapes of counties, this is

imprecise. For example, a woman might lie one mile outside of a county with a Title X clinic, but due to the shape of the county, could be closer than a woman living on the other side of the county. A more precise measure of distance-based access could provide a clearer picture of whom the policy impacted.

I geocoded the locations of Title X clinics and, using a CSV file, overlaid them on a shapefile of census blocks in Colorado. I then created a subset of my larger dataset listing only census blocks containing the residence of at least one woman who gave birth between 2007-2014. I located the centroid of each census block containing the residence of a mother who gave birth. Using GIS software and vector analysis tools, I calculated the distance from the centroid of a given census block to the address of the nearest Title X clinic. This method yielded the distance in feet. I converted that distance into miles to increase ease of interpretation. The distance variable created, while approximate, provides a more precise measure of access in distance than any other analysis of the CFPI to date.

Descriptive Statistics

To evaluate the initial effects of the program, I searched for differences in maternal characteristics and outcomes of interest before and after the program. To evaluate changes in maternal characteristics, I used Pearson's Chi-Squared Test. Tests on maternal race, age, education, and income found statistically significant changes in the composition of mothers after the policy at a test size of .001 (Table 1). This demonstrates that after the policy, the demographic composition of mothers changed.

Table 1

Maternal Race	**Pre-CFPI**	**Post-CFPI**	**Total**
	No.	No.	No.

White Non-Hispanic	106,761.00	186,625.00	293,386.00
White Hispanic	51,431.00	75,763.00	127,194.00
Black	7,877.00	15,033.00	22,910.00
Asian/Pacific Islander	5,771.00	11,818.00	17,589.00
Native American	1,285.00	2,230.00	3,515.00
Other	4,109.00	8,558.00	12,667.00
Total	177,234.00	300,027.00	477,261.00

Pearson chi2(5) = 998.7055 Pr = 0.000

Maternal Education	**Pre-CFPI**	**Post-CFPI**	**Total**
	No.	No.	No.
Less than 9th Grade	9,537.00	10,872.00	20,409.00
Some High School	27,656.00	35,550.00	63,206.00
High School	37,055.00	60,907.00	97,962.00
Some College	36,402.00	64,438.00	100,840.00
Associate's Degree	11,446.00	23,030.00	34,476.00
Bachelor's Degree	37,143.00	68,860.00	106,003.00
Master's Degree	14,166.00	28,387.00	42,553.00
Doctoral or Professional Degree	3,828.00	7,983.00	11,811.00
Total	177,233.00	300,027.00	477,260.00

Pearson chi2(7) = 2868.2477 Pr = 0.000

Income	**Pre-CFPI**	**Post-CFPI**	**Total**
	No.	No.	No.
$0-14,999	37,745.00	68,814.00	106,559.00
$15,000-24,999	20,563.00	34,205.00	54,768.00
$25,000-34,999	15,295.00	26,644.00	41,939.00
$35,000-49,999	14,837.00	26,625.00	41,462.00
50,000-74,999	22,885.00	39,664.00	62,549.00
$75,000 or more	39,197.00	76,829.00	116,026.00
Total	150,522.00	272,781.00	423,303.00

Pearson chi2(5) = 299.8897 Pr = 0.000

Maternal Age	**Pre-CFPI**	**Post-CFPI**	**Total**
	No.	No.	No.
14 or younger	209	194	403
15-19	16,595.00	20,136.00	36,731.00

20-24	40,210.00	61,919.00	102,129.00
25-29	49,164.00	84,753.00	133,917.00
30-34	42,963.00	82,881.00	125,844.00
35-39	22,934.00	40,517.00	63,451.00
40 or older	5,159.00	9,627.00	14,786.00
Total	177,234.00	300,027.00	477,261.00

Pearson chi2(6) = 1826.9820 Pr = 0.000

Summary statistics demonstrate the direction of changes in distribution. Mothers after the policy were less likely to be Hispanic, received higher levels of education, were older, and were wealthier (Table 2). This shift in demographics suggests that after the policy, fewer unplanned pregnancies occurred.

Table 2

Variable	Pre-CFPI	Post-CFPI	Difference
Race			
Black	0.0477109	0.0544184	0.0067075
Asian/Pacific Islander	0.033972	0.040773	0.006801
Native American	0.0100037	0.010609	0.0006053
Other	0.023184	0.0285241	0.0053401
White, Hispanic	0.3122369	0.2797048	-0.0325321
White, Non-Hispanic	0.6023731	0.6220274	0.0196543
Education			
Less than 9th grade	0.0538105	0.0362367	-0.0175738
Some High School	0.1560432	0.1184893	-0.0375539
High School	0.2090751	0.2030051	-0.00607
Some College	0.2053906	0.214774	0.0093834
Associate's Degree	0.0645817	0.0767598	0.0121781
Bachelor's Degree	0.2095716	0.2295127	0.0199411
Master's Degree	0.0799287	0.0946148	0.0146861
Doctoral Degree	0.0215987	0.0266076	0.0050089
Age	27.86584	28.51388	0.64804
Income			
Category	2.545734	2.60344	0.057706
Approximate	40741.2	44835	4093.8

After the policy, mothers were more likely to breastfeed, and less likely to drink, smoke, or have preterm birth or low birth weight. Babies were more likely to be born with congenital abnormalities or adverse conditions at birth.

Table 3

Pregnancy Behavior	Pre-CFPI Mean	Post-CFPI Mean	Difference	P-Value Pr(|T| > |t|)
smoking	0.0859316	0.0747766	0.011155	0.0000
	(0.0006657)	(0.0004802)	(0.0008208)	
drinking	0.0129321	0.0098991	0.0030329	0.0000
	(.0002684)	(.0001807)	(0.0003236)	
breastfeeding	0.86146	0.9160309	-0.0545709	0.0000
	(.0008206)	(.0005063)	(0.0009642)	
Adverse Birth Outcome				
preterm birth	0.0955404	0.085309	0.0102314	0.0000
	(0.0006983)	(0.00051)	(0.0008647)	
low birth weight	0.0883465	0.0858356	0.0025109	0.0030
	(0.0006741)	(0.0005114)	(0.0008462)	
congenital abnormalities	0.0166334	0.0314372	-0.0148038	0.0000
	(.0003038)	(.0003186)	(.0004402)	
abnormal conditions	0.1685568	0.2138141	-0.0452573	0.0000
	(.0008892)	(.0007485)	(.0011623)	

Methods

In order to evaluate whether the impacts of the CFPI were statistically significant, I conducted several hypothesis tests. The null hypotheses are: the Colorado Family Planning Initiative had no impact on birth rates; the Colorado Family Planning Initiative had no impact on maternal demographics; the Colorado Family Planning Initiative had no

impact on maternal behaviors during pregnancy; and the Colorado Family Planning Initiative had no impact on adverse birth outcomes.

The fundamental motivation of this research is to evaluate the CFPI. The CFPI aimed to reduce unplanned pregnancies among low-income women and teens. The available data does not allow testing for the frequency of unplanned pregnancies. Instead, this research searches for evidence of consequences of reduction in unplanned pregnancies. If the CFPI achieved its objectives, a larger proportion of pregnancies should be planned or intended pregnancies after the initiative than before. I rely on the assumption that women who have unwanted pregnancies are more likely to engage in risky pregnancy behaviors and have adverse birth outcomes than women who have intended pregnancies.

Because women who plan their pregnancies want to have babies, it is in their interests to engage in behaviors that will improve the outcome of their pregnancies. Women who intend to become pregnant should be less likely to smoke and drink during pregnancy and more likely to breastfeed. They should also be more likely to take affirmative steps to improve the health of their fetus such as taking prenatal vitamins. Because they engage in better health behaviors during pregnancy, they should be less likely to have babies with adverse health outcomes.

The specific outcomes I evaluated in my research can be divided into health behaviors and birth outcomes. The health behaviors I evaluated were probability of smoking during pregnancy, probability of drinking during pregnancy, and probability of breastfeeding at the time of hospital discharge. The birth outcomes I evaluated were

probability of preterm birth, probability of low birth weight, probability of abnormal conditions at birth, and probability of congenital abnormalities.

For each outcome, I ran five models. The first model was the simplest model, which predicted the probability of an outcome of interest before and after the policy, controlling for distance from the nearest clinic and demographic variables including age, race, education, and income (Tables 4 and 5). Women were divided into mutually exclusive and exhaustive categorical variables for income. I expected the policy to have the least impact on the wealthiest women, because they were the least likely to be patients at Title X clinics, and also the least likely to face a cost barrier to LARC devices. Thus, for all models, I used the highest income group as the reference group. For similar reasons, I used women with graduate degrees as the reference group for education. This model was a probit model with the baseline equation of $\Pr(Y = 1|X) = \varphi(X^T\beta)$. For all outcomes of interest, this model indicates a statistically significant result for the policy.

The next sets of models aimed to determine whether the policy had differential effects for income groups and geographical proximity to clinics (Tables 6-13). I first interacted the distance variable with the CFPI dummy variable to determine whether distance from the nearest Title X clinic had a different effect on outcomes after the policy than before (Tables 6 and 7). If the policy effected pregnancy behaviors or adverse birth outcomes by making it easier for women to avoid pregnancy, then I expected it would have a stronger impact for women who could easily access clinics than those who could not.

I interacted the CFPI dummy with different income categories to determine whether the policy had stronger effects for some income groups than others (Tables 8 and

9). Because the policy targeted low-income women, I expected low-income women to have a stronger change in outcomes after the policy than before, especially compared to higher-income women.

My next set of equations included both distance and income interactions (Tables 10 and 11). This allowed me to determine whether both income and distance influenced the impact of the policy when controlling for the other.

My final set of equations included all interaction terms from previous models as well as a triple interaction term of distance*income group*CFPI (Tables 12 and 13). This allowed me to determine whether distance from the clinic had a differential effect on different income groups before and after the policy.

Initial Results:

Pregnancy Behaviors

Results from baseline models show that probability of smoking during pregnancy decreased as education increased (Table 4), which is consistent with expectations. Probability of smoking during pregnancy also decreased as income increased. Age and race also impacted the probability of smoking during pregnancy, with white women being most likely to smoke during pregnancy. The model also indicated that increased distance from the nearest clinic was associated with an increased probability of smoking. Mothers were less likely to smoke during pregnancy after the Initiative when controlling for age, race, education, and income. All results in this model were statistically significant (see Table 4).

Drinking during pregnancy was also influenced by race, income, and education (Table 4). Race appeared to have some influence, as Native American women were

slightly more likely to drink during pregnancy than white women, and black, Hispanic, and Asian women were slightly less likely to drink during pregnancy. Education appeared to have little impact except for the least educated women, those with less than a 9^{th} grade education. These women were less likely to drink during pregnancy. Women with an annual income of less than $25,000 were slightly more likely to drink during pregnancy, and those with an income of less than $15,000 were most likely to drink during pregnancy. Overall, women were less likely to drink during pregnancy after the initiative.

The coefficients for income variables in this category have a smaller magnitude on drinking than those for smoking(Table 4). Furthermore, the distance from a Title X clinic only has significant effects at a test size of 0.1, while all other outcomes find a statistically significant effect of distance at test sizes of .05 or .001. The constant term for drinking is much lower than that of smoking. This lower constant term demonstrates that overall, a mother is much less likely to drink during pregnancy than to smoke during pregnancy.

As drinking during pregnancy is the leading cause of preventable birth defects in infants (Waterman, Pruett, and Caughey 2013) numerous public health campaigns have been launched to discourage women from drinking during pregnancy. Because most women have been alerted to the dangers of drinking while pregnant, it makes sense that women as a group are much less likely to drink than smoke while pregnant, and that less variation among women exists in this behavior. This is confirmed by summary statistics showing that even prior to the initiative, only 1.29% of mothers drank during pregnancy, but 8.59% of mothers smoked during pregnancy. The statistically significant decrease in

probability of drinking during pregnancy after the initiative supports the idea that women with planned pregnancies will engage in better pregnancy behaviors to protect the health of their fetuses. As the initiative reduced the number of unplanned pregnancies, the women who gave birth after the program were less likely to drink during pregnancy.

While breastfeeding at the time of hospital discharge is technically a post-pregnancy behavior, I analyze it alongside drinking and smoking during pregnancy (Table 4). This is because, like drinking and smoking, breastfeeding is an individual-level choice of the mother which impacts the health of the child. White or Hispanic women were most likely to breastfeed at the time of discharge, and higher levels of education were associated with an increased likelihood of breastfeeding. Black, Native American, and Asian women were all less likely to breastfeed than white women. Lower incomes were associated with decreased likelihood of breastfeeding.

Distance from a Title X clinic influenced the probability of breastfeeding as well; women further away from the nearest clinic were less likely to breastfeed. A possible explanation for this is that women who were close to Title X clinics took advantage of the program, and thus did not have unwanted pregnancies. The women closest to clinics who *did* have pregnancies intended to be pregnant, and were more likely to engage in behaviors that improved the health of their babies, such as breastfeeding. The probability of breastfeeding increased after the initiative, again supporting the idea that women with planned or wanted pregnancies are more likely to engage in behaviors to improve the health of their babies.

Table 4

VARIABLES	smokepreg	drinkpreg	breastfedbinary
m_ed_nohs	0.817***	-0.341***	-0.493***

	(0.0573)	(0.0565)	(0.0275)
m_ed_hs	**1.267*** **	**-0.0214**	**-0.664*** **
	(0.0546)	(0.0386)	(0.0248)
m_ed_somehs	**1.336*** **	**-0.0402**	**-0.745*** **
	(0.0550)	(0.0415)	(0.0255)
m_ed_somecollege	**1.066*** **	**0.0262**	**-0.494*** **
	(0.0544)	(0.0372)	(0.0246)
m_ed_assoc	**0.917*** **	**-0.0626**	**-0.411*** **
	(0.0551)	(0.0407)	(0.0257)
m_ed_babs	**0.307*** **	**-0.0316**	**-0.170*** **
	(0.0549)	(0.0355)	(0.0242)
m_ed_mams	**0.134** **	**-0.0280**	**-0.0769*** **
	(0.0582)	(0.0379)	(0.0258)
m_race_black	**-0.463*** **	**-0.148*** **	**-0.101*** **
	(0.0135)	(0.0277)	(0.0116)
m_race_asianpac	**-0.737*** **	**-0.369*** **	**-0.0770*** **
	(0.0244)	(0.0400)	(0.0145)
m_race_nativeam	**-0.135*** **	**0.271*** **	**-0.0807*** **
	(0.0261)	(0.0425)	(0.0240)
m_race_other	**-0.166*** **	**-0.0766**	**-0.0259**
	(0.0234)	(0.0469)	(0.0161)
m_race_hispanic	**-0.807*** **	**-0.250*** **	**0.0201*** **
	(0.00826)	(0.0164)	(0.00684)
m_age	**0.00752*** **	**0.0114*** **	**-0.00851*** **
	(0.000598)	(0.00112)	(0.000516)
income_0_14999	**1.005*** **	**0.202*** **	**-0.301*** **
	(0.0138)	(0.0212)	(0.0105)
income_15000_24999	**0.791*** **	**0.102*** **	**-0.136*** **
	(0.0143)	(0.0230)	(0.0113)
income_25000_34999	**0.627*** **	**0.0173**	**-0.0970*** **
	(0.0149)	(0.0243)	(0.0117)
income_35000_49999	**0.480*** **	**-0.000814**	**0.00650**
	(0.0152)	(0.0230)	(0.0118)
income_50000_74999	**0.287*** **	**-0.00893**	**0.0166**
	(0.0147)	(0.0189)	(0.0103)
postcfpi	**-0.0709*** **	**-0.122*** **	**0.304*** **
	(0.00651)	(0.0116)	(0.00548)
distance_miles	**0.00191*** **	**0.00106***	**-0.00647*** **
	(0.000281)	(0.000558)	(0.000242)
Constant	**-2.949*** **	**-2.528*** **	**1.960*** **
	(0.0578)	(0.0514)	(0.0293)
Observations	423,289	423,289	423,289

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Adverse Birth Outcomes

Several demographic variables influence the probability of preterm birth (Table 5). Race, age, and income are influential, with low-income, black, and Asian women all having a slightly higher risk of preterm birth. Mothers who are highly educated, with a baccalaureate degree or higher, have a slightly diminished risk of preterm birth. Distance has a small but statistically significant coefficient demonstrating that increased distance from a Title X clinic is associated with a higher risk of preterm birth. My analysis finds a decreased probability of preterm birth after the initiative (Table 5). This corroborates the findings of Goldthwaite et. al on preterm birth.

Probability of low birth weight is influenced by education, race, age, and income as well (Table 5). Poor women are at the highest risk of having a baby with a low birth weight. Black and Asian women again see an elevated risk compared to white women, and increased education is associated with lower probability of low birth weight. Distance from the nearest clinic also has a small but statistically significant effect; as distance from a clinic increases, so do odds of low birth weight. I do find a statistically significant reduction in probability of low birth weight after the initiative (Table 5). This runs counter to Goldthwaite's et. al's findings, which failed to reject a null hypothesis that the initiative had no effect on low birth weights. This may be due to differences in methodology and sample, as Goldthwaite et. al used only data from 2008 and 2012.

I also studied the changes in probability of abnormal conditions at birth and congenital abnormalities (hereafter birth defects). In the tables below, caAny refers to any congenital abnormality reported on the birth certificate. [A]bcAny refers to any abnormal condition reported at birth. Congenital abnormalities and abnormal conditions do not

overlap, in that no condition is considered both a congenital abnormality and an abnormal condition at birth. Black, Asian, and Hispanic women were more likely to have babies with birth defects, as were low-income women. My models demonstrate a statistically significant increase in probability of birth defects (Table 5). This is counterintuitive, especially because the probability of drinking during pregnancy decreased after the initiative. The effects of the initiative should have been to reduce the instance of birth defects, not to increase them.

Table 5

VARIABLES	pretermbirth	lowbirthweight	caAny	abcAny
m_ed_nohs	-0.0595**	-0.0856***	-0.102***	0.0265
	(0.0235)	(0.0239)	(0.0339)	(0.0188)
m_ed_hs	0.0444**	0.0447**	-0.104***	-0.0659***
	(0.0193)	(0.0196)	(0.0295)	(0.0161)
m_ed_somehs	0.0684***	0.0873***	-0.0772**	-0.0225
	(0.0204)	(0.0206)	(0.0307)	(0.0169)
m_ed_somecollege	0.0578***	0.0244	-0.141***	-0.0942***
	(0.0188)	(0.0190)	(0.0289)	(0.0157)
m_ed_assoc	0.0251	-0.0164	-0.106***	-0.0870***
	(0.0202)	(0.0205)	(0.0310)	(0.0168)
m_ed_babs	-0.0414**	-0.0510***	-0.115***	-0.0939***
	(0.0179)	(0.0182)	(0.0276)	(0.0149)
m_ed_mams	-0.0516***	-0.0361*	-0.131***	-0.0654***
	(0.0192)	(0.0194)	(0.0298)	(0.0159)
m_grace_black	0.126***	0.230***	0.326***	0.275***
	(0.0120)	(0.0116)	(0.0156)	(0.00976)
m_grace_asianpac	0.0454***	0.139***	0.133***	0.0816***
	(0.0140)	(0.0136)	(0.0205)	(0.0116)
m_grace_nativeam	-0.0213	-0.0158	0.00686	-0.0227
	(0.0273)	(0.0274)	(0.0396)	(0.0220)
m_grace_other	-0.0212	-0.0196	-0.228***	-0.0691***
	(0.0181)	(0.0184)	(0.0285)	(0.0141)
m_grace_hispanic	-0.0281***	-0.0615***	0.147***	0.129***
	(0.00734)	(0.00742)	(0.0105)	(0.00590)
m_age	0.0122***	0.0107***	0.00926***	0.0111***
	(0.000535)	(0.000539)	(0.000785)	(0.000440)
income_0_14999	0.106***	0.165***	0.360***	0.373***
	(0.0105)	(0.0106)	(0.0159)	(0.00862)

income_15000_24999	**0.0192***	**0.0451*****	**0.195*****	**0.184*****
	(0.0113)	(0.0114)	(0.0175)	(0.00927)
income_25000_34999	**0.0281****	**0.0305*****	**0.182*****	**0.154*****
	(0.0115)	(0.0117)	(0.0179)	(0.00951)
income_35000_49999	**-0.0264****	**-0.0238****	**0.105*****	**0.0815*****
	(0.0112)	(0.0114)	(0.0179)	(0.00925)
income_50000_74999	**-0.0308*****	**-0.0396*****	**0.0207**	**-0.000884**
	(0.00938)	(0.00962)	(0.0158)	(0.00793)
postcfpi	**-0.0664*****	**-0.0186*****	**0.301*****	**0.212*****
	(0.00569)	(0.00579)	(0.00957)	(0.00480)
distance_miles	**0.000901*****	**0.000660****	**-0.00288*****	**0.00291*****
	(0.000280)	(0.000285)	(0.000471)	(0.000223)
Constant	**-1.708*****	**-1.719*****	**-2.527*****	**-1.475*****
	(0.0252)	(0.0255)	(0.0380)	(0.0209)
Observations	423,289	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

I believe that the rise in birth defects is not attributable to the CFPI, but is likely the result of another factor. This is further explored in the "Discussion" section below.

Further Results:

I attempted to further understand the effects of the policy by adding interaction terms to my models. Interaction terms did not have a notable influence on control variables such as race, age, and education. Control variables are omitted from tables of further results for brevity.

I first interacted distance from the nearest Title X clinic with the CFPI dummy variable, to determine if distance from the nearest Title X clinic had a differential effect on outcome variables before and after the policy. If the policy was influential, it should have been most influential for women who were close by and could easily access the clinics. The model with distance interaction terms presents no statistically significant evidence for a differential effect of distance before and after the policy, except for

congenital abnormalities (Tables 6 and 7). The lack of a differential effect of distance before and after the policy suggests that being close to a Title X clinic was helpful in preventing unwanted pregnancies both before and after the policy. Potential explanations for this phenomenon are explored in the "Discussion" section.

The coefficient of the distance and CFPI interaction on congenital abnormalities is negative and of a larger magnitude than the distance coefficient (Table 6). This indicates that after the policy, increased distance from a Title X clinic *reduced* the odds of congenital abnormalities. This result is again counterintuitive, and points to an external factor influencing congenital abnormalities.

Table 6

VARIABLES	smokepreg	drinkpreg	breastfedbinary
income_0_14999	**1.005*** **	**0.202*** **	**-0.301*** **
	(0.0138)	(0.0212)	(0.0105)
income_15000_24999	**0.791*** **	**0.102*** **	**-0.136*** **
	(0.0143)	(0.0230)	(0.0113)
income_25000_34999	**0.627*** **	**0.0173**	**-0.0970*** **
	(0.0149)	(0.0243)	(0.0117)
income_35000_49999	**0.480*** **	**-0.000814**	**0.00651**
	(0.0152)	(0.0230)	(0.0118)
income_50000_74999	**0.287*** **	**-0.00893**	**0.0166**
	(0.0147)	(0.0189)	(0.0103)
postcfpi	**-0.0692*** **	**-0.122*** **	**0.301*** **
	(0.00755)	(0.0136)	(0.00635)
distance_miles	**0.00207*** **	**0.00106**	**-0.00677*** **
	(0.000452)	(0.000867)	(0.000373)
distance_postcfpi	**-0.000252**	**-9.90e-07**	**0.000511**
	(0.000573)	(0.00112)	(0.000485)
Constant	**-2.950*** **	**-2.528*** **	**1.962*** **
	(0.0578)	(0.0516)	(0.0294)
Observations	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7

VARIABLES	pretermbirth	lowbirthweight	caAny	abcAny
income_0_14999	**0.106*** **	**0.165*** **	**0.359*** **	**0.373*** **
	(0.0105)	(0.0106)	(0.0160)	(0.00862)
income_15000_24999	**0.0192***	**0.0451*** **	**0.194*** **	**0.184*** **
	(0.0113)	(0.0114)	(0.0175)	(0.00927)
income_25000_34999	**0.0281** **	**0.0305*** **	**0.183*** **	**0.154*** **
	(0.0115)	(0.0117)	(0.0179)	(0.00951)
income_35000_49999	**-0.0264** **	**-0.0238** **	**0.105*** **	**0.0815*** **
	(0.0112)	(0.0114)	(0.0179)	(0.00925)
income_50000_74999	**-0.0308*** **	**-0.0396*** **	**0.0214**	**-0.000885**
	(0.00938)	(0.00962)	(0.0158)	(0.00793)
postcfpi	**-0.0664*** **	**-0.0185*** **	**0.345*** **	**0.212*** **
	(0.00666)	(0.00677)	(0.0111)	(0.00558)
distance_miles	**0.000898** **	**0.000667**	**0.00227*** **	**0.00290*** **
	(0.000450)	(0.000463)	(0.000745)	(0.000375)
distance_postcfpi	**5.66e-06**	**-1.08e-05**	**-0.00774*** **	**1.97e-05**
	(0.000571)	(0.000583)	(0.000951)	(0.000463)
Constant	**-1.708*** **	**-1.719*** **	**-2.558*** **	**-1.475*** **
	(0.0253)	(0.0256)	(0.0383)	(0.0210)
Observations	423,289	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Next, I interacted the income categories with the CFPI dummy variable to determine if the initiative was more helpful to low-income women than women with average incomes or above. I found no statistically significant differential effects on smoking or drinking (Table 8). However, I found statistically significant differential effects for low-income women on probability of breastfeeding (Table 8). Coefficients on breastfeeding outcomes suggest that all women were more likely to breastfeed after the policy relative to before the policy.

Table 8

VARIABLES	smokepreg	drinkpreg	breastfedbinary
income_0_14999	**1.008*** **	**0.225*** **	**-0.188*** **
	(0.0205)	(0.0285)	(0.0138)

income_15000_24999	**0.797*** **	**0.120*** **	**-0.0364** **
	(0.0219)	(0.0327)	(0.0153)
income_25000_34999	**0.660*** **	**0.0328**	**-0.0163**
	(0.0231)	(0.0358)	(0.0165)
income_35000_49999	**0.488*** **	**0.00261**	**0.0863*** **
	(0.0240)	(0.0349)	(0.0170)
income_50000_74999	**0.304*** **	**-0.00954**	**0.0643*** **
	(0.0232)	(0.0291)	(0.0148)
postcfpi	**-0.0567*** **	**-0.106*** **	**0.435*** **
	(0.0219)	(0.0215)	(0.0123)
distance_miles	**0.00192*** **	**0.00105***	**-0.00648*** **
	(0.000281)	(0.000558)	(0.000242)
income_0_14999_postcfpi	**-0.00431**	**-0.0371**	**-0.196*** **
	(0.0242)	(0.0312)	(0.0155)
income_15000_24999_postcfpi	**-0.00918**	**-0.0289**	**-0.178*** **
	(0.0267)	(0.0393)	(0.0187)
income_25000_34999_postcfpi	**-0.0531***	**-0.0257**	**-0.146*** **
	(0.0287)	(0.0445)	(0.0208)
income_35000_49999_postcfpi	**-0.0137**	**-0.00524**	**-0.146*** **
	(0.0300)	(0.0439)	(0.0220)
income_50000_74999_postcfpi	**-0.0272**	**0.00179**	**-0.0872*** **
	(0.0294)	(0.0371)	(0.0199)
Constant	**-2.958*** **	**-2.539*** **	**1.881*** **
	(0.0593)	(0.0529)	(0.0301)
Observations	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

I also found statistically significant differential effects among income groups on preterm birth, low birth weight, and abnormal birth conditions (Table 9). Coefficients on preterm birth and low birth weight suggest that low-income women were *more* likely to have preemies or babies with low birth weights after the policy (Table 9). These results are counterintuitive, because the coefficient on the CFPI dummy variable indicates that among all women, the policy reduced likelihood of low birth weight and preterm birth, and increased likelihood of breastfeeding.

Table 9

VARIABLES	pretermbirth	lowbirthweight	caAny	abcAny

income_0_14999	**0.0689*** **	**0.146*** **	**0.317*** **	**0.268*** **
	(0.0145)	(0.0148)	(0.0262)	(0.0125)
income_15000_24999	**-0.0299***	**0.00945**	**0.238*** **	**0.0999*** **
	(0.0166)	(0.0170)	(0.0297)	(0.0143)
income_25000_34999	**-0.00300**	**-0.00341**	**0.178*** **	**0.0639*** **
	(0.0175)	(0.0182)	(0.0328)	(0.0154)
income_35000_49999	**-0.0556*** **	**-0.0567*** **	**0.0937*** **	**-0.0195**
	(0.0176)	(0.0183)	(0.0347)	(0.0157)
income_50000_74999	**-0.0411*** **	**-0.0461*** **	**0.0496**	**-0.0686*** **
	(0.0148)	(0.0155)	(0.0307)	(0.0136)
postcfpi	**-0.102*** **	**-0.0447*** **	**0.293*** **	**0.112*** **
	(0.0109)	(0.0112)	(0.0214)	(0.00959)
distance_miles	**0.000905*** **	**0.000661** **	**-0.00287*** **	**0.00291*** **
	(0.000281)	(0.000285)	(0.000471)	(0.000223)
income_0_14999_postcfpi	**0.0561*** **	**0.0284***	**0.0565** **	**0.150*** **
	(0.0155)	(0.0157)	(0.0269)	(0.0131)
income_15000_24999_postcfpi	**0.0771*** **	**0.0550*** **	**-0.0615***	**0.122*** **
	(0.0192)	(0.0196)	(0.0325)	(0.0161)
income_25000_34999_postcfpi	**0.0484** **	**0.0522** **	**0.00594**	**0.131*** **
	(0.0210)	(0.0216)	(0.0365)	(0.0179)
income_35000_49999_postcfpi	**0.0456** **	**0.0505** **	**0.0142**	**0.147*** **
	(0.0215)	(0.0222)	(0.0390)	(0.0185)
income_50000_74999_postcfpi	**0.0152**	**0.00937**	**-0.0391**	**0.0984*** **
	(0.0185)	(0.0192)	(0.0352)	(0.0163)
Constant	**-1.682*** **	**-1.700*** **	**-2.519*** **	**-1.399*** **
	(0.0261)	(0.0264)	(0.0412)	(0.0218)
Observations	423,289	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

My next set of results included interaction terms for both distance and the CFPI dummy, and income and the CFPI dummy (Tables 10 and 11). As in previous models, distance interacted with the CFPI dummy yielded no statistically significant results. Including the distance and policy interactions yielded no change in coefficients of income interaction terms (Tables 10 and 11).

Table 10

VARIABLES	smokepreg	drinkpreg	breastfedbinary
income_0_14999	**1.008*** **	**0.225*** **	**-0.188*** **

	(0.0205)	(0.0285)	(0.0138)
income_15000_24999	**0.797*** **	**0.120*** **	**-0.0358** **
	(0.0219)	(0.0327)	(0.0154)
income_25000_34999	**0.660*** **	**0.0328**	**-0.0158**
	(0.0231)	(0.0358)	(0.0165)
income_35000_49999	**0.488*** **	**0.00267**	**0.0871*** **
	(0.0240)	(0.0349)	(0.0170)
income_50000_74999	**0.304*** **	**-0.00951**	**0.0648*** **
	(0.0232)	(0.0291)	(0.0148)
postcfpi	**-0.0554** **	**-0.106*** **	**0.432*** **
	(0.0222)	(0.0223)	(0.0126)
distance_miles	**0.00205*** **	**0.00103**	**-0.00686*** **
	(0.000452)	(0.000866)	(0.000373)
distance_postcfpi	**-0.000220**	**4.90e-05**	**0.000661**
	(0.000574)	(0.00113)	(0.000486)
income_0_14999_postcfpi	**-0.00423**	**-0.0371**	**-0.197*** **
	(0.0242)	(0.0312)	(0.0155)
income_15000_24999_postcfpi	**-0.00892**	**-0.0290**	**-0.179*** **
	(0.0267)	(0.0393)	(0.0187)
income_25000_34999_postcfpi	**-0.0529***	**-0.0258**	**-0.147*** **
	(0.0287)	(0.0446)	(0.0208)
income_35000_49999_postcfpi	**-0.0133**	**-0.00534**	**-0.147*** **
	(0.0300)	(0.0440)	(0.0221)
income_50000_74999_postcfpi	**-0.0270**	**0.00173**	**-0.0881*** **
	(0.0294)	(0.0371)	(0.0199)
Constant	**-2.959*** **	**-2.539*** **	**1.883*** **
	(0.0593)	(0.0531)	(0.0301)
Observations	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11

VARIABLES	pretermbirth	lowbirthweight	caAny	abcAny
income_0_14999	**0.0689*** **	**0.146*** **	**0.316*** **	**0.268*** **
	(0.0145)	(0.0148)	(0.0262)	(0.0125)
income_15000_24999	**-0.0300***	**0.00936**	**0.234*** **	**0.0997*** **
	(0.0166)	(0.0170)	(0.0297)	(0.0143)
income_25000_34999	**-0.00307**	**-0.00350**	**0.172*** **	**0.0637*** **
	(0.0175)	(0.0182)	(0.0328)	(0.0154)
income_35000_49999	**-0.0557*** **	**-0.0568*** **	**0.0851** **	**-0.0197**
	(0.0176)	(0.0183)	(0.0347)	(0.0157)
income_50000_74999	**-0.0411*** **	**-0.0462*** **	**0.0444**	**-0.0687*** **
	(0.0148)	(0.0155)	(0.0308)	(0.0136)
postcfpi	**-0.102*** **	**-0.0441*** **	**0.333*** **	**0.113*** **

	(0.0113)	(0.0117)	(0.0220)	(0.00991)
distance_miles	**0.000959****	**0.000729**	**0.00223*****	**0.00304*****
	(0.000451)	(0.000463)	(0.000747)	(0.000376)
distance_postcfpi	**-8.64e-05**	**-0.000109**	**0.00765*****	**-0.000195**
	(0.000572)	(0.000584)	(0.000953)	(0.000464)
income_0_14999_postcfpi	**0.0562*****	**0.0285***	**0.0565****	**0.150*****
	(0.0155)	(0.0157)	(0.0269)	(0.0131)
income_15000_24999_postcfpi	**0.0772*****	**0.0551*****	**-0.0566***	**0.122*****
	(0.0192)	(0.0196)	(0.0325)	(0.0161)
income_25000_34999_postcfpi	**0.0485****	**0.0524****	**0.0136**	**0.131*****
	(0.0210)	(0.0216)	(0.0365)	(0.0179)
income_35000_49999_postcfpi	**0.0458****	**0.0507****	**0.0259**	**0.147*****
	(0.0215)	(0.0222)	(0.0391)	(0.0185)
income_50000_74999_postcfpi	**0.0153**	**0.00949**	**-0.0314**	**0.0987*****
	(0.0185)	(0.0192)	(0.0352)	(0.0163)
Constant	**-1.682*****	**-1.701*****	**-2.547*****	**-1.400*****
	(0.0262)	(0.0265)	(0.0413)	(0.0218)
Observations	423,289	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The fifth set of models included interactions of distance with the CFPI dummy, income with the CFPI dummy, and a distance, income and CFPI dummy interaction. In this model, the distance and CFPI dummy interaction gained statistical significance at a test size of 0.05 for drinking during pregnancy and smoking during pregnancy. The coefficient of distance_postcfpi on probability of drinking during pregnancy indicates that increased distance from the nearest clinic lowered the probability of drinking during pregnancy after the policy (Table 12). This is unexpected, as increased distance from a clinic should be associated with a slightly higher probability of drinking during pregnancy, particularly after the policy. The coefficient of distance_postcfpi suggests that increased distance from a clinic increased the probability of breastfeeding after the initiative, which also makes little sense, as the women closest to the clinics after the

policy would have been more likely to have planned pregnancies after the initiative, and thus should have been more likely to breastfeed (Table 12).

The interaction of distance, income, and the CFPI dummy offered statistically significant results for probability of drinking during pregnancy and breastfeeding at the time of discharge (Table 12). The coefficient on dist_income_postcfpi for the lowest income group indicates that for low-income women, increased distance from the nearest clinic was associated with a slightly higher chance of drinking during pregnancy and a slightly lower chance of smoking during pregnancy after the policy compared to before. This suggests that after the policy, low-income women living near Title X clinics engaged in healthier behaviors. A probable explanation for this phenomenon is that low-income women in close geographical proximity to Title X clinics stopped having unwanted pregnancies after the initiative, and thus were less likely to engage in risky pregnancy behaviors.

Table 12

VARIABLES	smokepreg	drinkpreg	breastfedbinary
income_0_14999	1.008***	0.224***	-0.188***
	(0.0205)	(0.0285)	(0.0138)
income_15000_24999	0.797***	0.119***	-0.0355**
	(0.0219)	(0.0327)	(0.0154)
income_25000_34999	0.660***	0.0317	-0.0155
	(0.0231)	(0.0358)	(0.0165)
income_35000_49999	0.488***	0.00176	0.0873***
	(0.0240)	(0.0349)	(0.0170)
income_50000_74999	0.304***	-0.0101	0.0649***
	(0.0232)	(0.0291)	(0.0148)
postcfpi	-0.0606**	-0.0755***	0.421***
	(0.0243)	(0.0248)	(0.0141)
distance_miles	0.00206***	0.00103	-0.00687***
	(0.000452)	(0.000866)	(0.000373)
distance_postcfpi	0.000658	-0.00616**	0.00264**

	(0.00180)	(0.00256)	(0.00123)
income_0_14999_postcfpi	**-0.00725**	**-0.0745****	**-0.177*****
	(0.0265)	(0.0340)	(0.0171)
income_15000_24999_postcfpi	**0.000833**	**-0.0574**	**-0.173*****
	(0.0292)	(0.0428)	(0.0204)
income_25000_34999_postcfpi	**-0.0379**	**-0.0508**	**-0.149*****
	(0.0314)	(0.0487)	(0.0228)
income_35000_49999_postcfpi	**0.0133**	**-0.0630**	**-0.145*****
	(0.0329)	(0.0481)	(0.0243)
income_50000_74999_postcfpi	**-0.0108**	**-0.0262**	**-0.0795*****
	(0.0324)	(0.0410)	(0.0220)
dist_income_0_14999_postcfpi	**0.000432**	**0.00727*****	**-0.00337*****
	(0.00182)	(0.00266)	(0.00126)
dist_income_15000_24999_postcfpi	**-0.00155**	**0.00589***	**-0.00133**
	(0.00193)	(0.00303)	(0.00139)
dist_income_25000_34999_postcfpi	**-0.00225**	**0.00543**	**-0.000171**
	(0.00205)	(0.00333)	(0.00151)
dist_income_35000_49999_postcfpi	**-0.00384***	**0.00968*****	**-0.000728**
	(0.00214)	(0.00309)	(0.00157)
dist_income_50000_74999_postcfpi	**-0.00248**	**0.00581***	**-0.00166**
	(0.00216)	(0.00314)	(0.00152)
Constant	**-2.959*****	**-2.543*****	**1.884*****
	(0.0593)	(0.0531)	(0.0301)
Observations	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the fifth set of models, the interaction of distance, income, and the CFPI dummy variable found statistically significant differential effects for women with incomes of $25,000 or less in prevalence of abnormal conditions at birth (Table 13). The coefficients on interactions of distance, CFPI, and low income groups suggest that increased distance from the nearest clinic reduced the odds of abnormal conditions at birth for low-income women after the policy. This is counterintuitive, as it suggests low-income women who lived close to clinics were more likely to have adverse birth outcomes after the policy than before. However, all results for congenital abnormalities and abnormal conditions at birth throughout the study have been contrary to expectations.

Table 13

VARIABLES	pretermbirth	lowbirthweight	caAny	abcAny
income_0_14999	0.0690***	0.146***	0.316***	0.270***
	(0.0145)	(0.0148)	(0.0262)	(0.0125)
income_15000_24999	-0.0298*	0.00923	0.234***	0.102***
	(0.0166)	(0.0170)	(0.0297)	(0.0143)
income_25000_34999	-0.00294	-0.00362	0.172***	0.0652***
	(0.0175)	(0.0182)	(0.0328)	(0.0154)
income_35000_49999	-0.0556***	-0.0569***	0.0851**	-0.0187
	(0.0176)	(0.0183)	(0.0347)	(0.0157)
income_50000_74999	-0.0411***	-0.0462***	0.0443	-0.0681***
	(0.0148)	(0.0155)	(0.0308)	(0.0136)
postcfpi	-0.107***	-0.0438***	0.343***	0.0912***
	(0.0124)	(0.0127)	(0.0236)	(0.0107)
distance_miles	0.000959**	0.000732	0.00222***	0.00303***
	(0.000451)	(0.000463)	(0.000747)	(0.000376)
distance_postcfpi	0.000839	-0.000163	-0.00986***	0.00389***
	(0.00111)	(0.00115)	(0.00209)	(0.000879)
income_0_14999_postcfpi	0.0598***	0.0209	0.0673**	0.200***
	(0.0167)	(0.0169)	(0.0287)	(0.0140)
income_15000_24999_postcfpi	0.0784***	0.0554***	-0.0758**	0.147***
	(0.0207)	(0.0210)	(0.0346)	(0.0172)
income_25000_34999_postcfpi	0.0555**	0.0580**	-0.0245	0.129***
	(0.0227)	(0.0234)	(0.0389)	(0.0192)
income_35000_49999_postcfpi	0.0629***	0.0687***	-0.00843	0.134***
	(0.0235)	(0.0242)	(0.0417)	(0.0199)
income_50000_74999_postcfpi	0.0232	0.0157	-0.0801**	0.0941***
	(0.0203)	(0.0210)	(0.0377)	(0.0175)
dist_income_0_14999_postcfpi	-0.000720	0.00133	-0.00271	-0.00921***
	(0.00117)	(0.00120)	(0.00222)	(0.000924)
dist_income_15000_24999_postcfpi	-0.000377	-3.85e-05	0.00387	-0.00466***
	(0.00133)	(0.00138)	(0.00240)	(0.00104)
dist_income_25000_34999_postcfpi	-0.00126	-0.000831	0.00676***	-0.000681
	(0.00145)	(0.00151)	(0.00249)	(0.00111)
dist_income_35000_49999_postcfpi	-0.00273*	-0.00265*	0.00603**	0.000738
	(0.00153)	(0.00160)	(0.00262)	(0.00113)
dist_income_50000_74999_postcfpi	-0.00140	-0.000967	0.00850***	-0.000213
	(0.00142)	(0.00147)	(0.00249)	(0.00109)

Constant	**-1.682*** **	**-1.701*** **	**-2.547*** **	**-1.395*** **
	(0.0262)	(0.0265)	(0.0414)	(0.0218)
Observations	423,289	423,289	423,289	423,289

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Discussion

Overall, the results of this research indicates that the Colorado Family Planning initiative led to decreased rates of negative health behaviors during pregnancy, led to increased rates of positive health behaviors during pregnancy, and had some influence on adverse birth outcomes.

The initiative did not cause women to be more aware of consequences of risky pregnancy behaviors, and likely did not change whether a woman would drink or smoke if she became pregnant. Rather, the initiative provided more effective and accessible contraception to women who did not wish to become pregnant. The decreased probability of risky pregnancy behaviors does not reflect the average woman in the overall population choosing to avoid behaviors which would damage the health of her fetus. Rather, it reflects that the policy reduced the chances of women who would have engaged in risky pregnancy behaviors becoming pregnant in the first place.

The preceding point is critical, because my research does not include changes in birth rates for specific demographics. Detailed population estimates were unavailable for years after 2011, so instead of studying changes in likelihood of becoming pregnant, I examine changes in likelihood of behaviors of pregnant women. The policy itself likely caused changes in the distribution of characteristics of pregnant mothers; however, this is not possible to confirm without more detailed, currently unavailable information on the population of women in Colorado.

Normatively, allowing women to avoid unintended pregnancy is a worthwhile goal because it increases women's life chances, furthers their economic potential, and avoids the negative psychological and physiological effects of pregnancy. State-provided contraception has been empirically shown to be worthwhile. The fact that the initiative also reduced the rate of drinking and smoking among pregnant women shows additional benefits to state-sponsored birth control.

For the most part, interactions of distance and time in the probit models failed to show a statistically significant effect. However, distance and time were separately significant. This could be due to the fact that Title X services provided free contraception both before and after the policy, so the differential effect of providing LARCs instead of oral contraceptives or injections was weak. Another possible explanation is that women had higher incentives to travel to Title X clinics after the CFPI, because they had access to free birth control which would last for years as opposed to weeks or months. Women may have seen the cost of traveling to a clinic as more worthwhile, because they would have to return fewer times with a LARC than with another form of contraception. Thus, women may have been willing to travel a farther distance to a Title X clinic after the policy, which could have confounded the usual effect of increased distance.

The overall improvement in health behaviors among pregnant women should have led to improved birth outcomes for infants. While this is demonstrated to an extent in low birth weight and preterm birth, the surge in congenital abnormalities is troubled.

The number of congenital abnormalities more than tripled from 2009 to 2014, with an increase of over 2,000 birth congenital abnormalities. Similarly, the number of babies with abnormal conditions at birth increased by over 3,000 from 2009 to 2014. The

high increase in frequency as well as probability of abnormal conditions at birth and congenital abnormalities seems too large to attribute to the policy, and has the opposite effect of what was expected.

If the policy caused an increase in rates of congenital abnormalities and birth defects it could be because a larger proportion of pregnant women wanted their children. Women with unplanned pregnancies would be more likely to abort children due to birth defects than women who intended to become pregnant. Thus, mothers who intended to become pregnant should be more likely to remain pregnant despite neonatal indications of birth defects. This could explain some portion of the 5,000 additional children per year born with birth defects after the policy.

Another possible explanation for this increase is Colorado's recent expansion of natural gas development. McKenzie et. al study the effects of increased fetal exposure to natural gas as measured by the number of natural gas wells within a 10 mile radius of maternal residence. They find a statistically significant increase in congenital heart defects and neural tube defects with increased exposure to natural gas. The most exposed fetuses were twice as likely to be born with neural tube defects and had a 30% greater prevalence of congenital heart defects (McKenzie et al. 2014).

The number of natural gas wells in Colorado increased by over 10,000 from 2009 to 2015, according to the Energy Information Administration (2016). The increase in natural gas development and natural gas wells, taken with the link between birth defects and natural gas, provides a plausible alternative explanation for the increase in birth defects. Further research should examine the influence of proximity to gas wells on birth outcomes.

Conclusion

This research examined the effects of the Colorado Family Planning Initiative on pregnancy behaviors and adverse birth outcomes. The results indicate that the policy changed the distribution of pregnant women Through this, the nitiative reduced the probability of risky pregnancy behaviors, increased the probability of breastfeeding, and was associated with a limited reduction in low birth weight and preterm birth. The results also showed an unexpected increase in congenital abnormalities and abnormal conditions at birth.

This research finds the CFPI is effective when controlling for for age, race, education, and income. However, the CFPI likely *caused* at least some portion of changes in age, race, education, and income of mothers. Controlling for these factors, then, underestimates the true effects of the initiative. Further research will likely show stronger benefits from the policy.

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