The Educational Impact of Expanded Contraceptive Access

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Abstract: There is limited rigorous evidence on how control over one's fertility affects the life course of women in the contemporary United States. A lack of adequate data and challenges in research design limit researchers' ability to isolate the impact. This study focuses on impacts of fertility control on education by taking advantage of a natural experiment in the state of Colorado to estimate the population-level effect of expanded access to contraception on female high school graduation or postsecondary educational enrollment. This preliminary analysis focuses on high school graduation and shows that increases in access to contraception through the Colorado Family Planning Initiative increased the likelihood of high school graduation by age 22.

Introduction

Over the last 50 years, women's access to fertility control has increased dramatically. Nonetheless, there is limited rigorous evidence on how control over one's fertility affects the life course of women in the contemporary United States. A lack of adequate data and challenges in research design limit the ability to isolate the impact. This study focuses on impacts of fertility control on education, which is well-known to be critical to women's life course trajectories, such as lifetime earnings (Tamborini, Kim, & Sakamoto, 2015) and mortality (Lawrence, Rogers, & Zajacova, 2016). Yet there is little empirical evidence about the impact of fertility control on educational attainment beyond the effect of the initial expansion of access to oral contraceptives and the expansion of Title X in the 1970s (Bailey & Lindo, 2017; Hicks-Courant & Schwartz, 2016; Bailey, 2013; Goldin & Katz, 2002).

In this study, we take advantage of a natural experiment to estimate the population-level effect of expanded access to contraception on female high school graduation or postsecondary educational enrollment. The natural experiment consisted of a statewide initiative to improve access to the full range of contraceptive methods at all Colorado Title X family planning clinics in 2009. We are able to estimate the effect of this program using individual-level, longitudinally linked data from the full 2010 Census and the 2009-2017 American Community Surveys (ACS). We anticipate that these analyses will advance academic and policy debates regarding the impact of family planning on women overall and the relative impact on women from different racial and ethnic groups.

Background

Beginning in November 2009, The Colorado Family Planning Initiative (CFPI) provided funding, training, and support to ensure that all Title X family planning clinic clients in Colorado could choose any FDA-approved method of contraception, regardless of cost. A large component of the Initiative was the provision of free or dramatically reduced-cost long-acting reversible contraceptive (LARC) devices and provider training on LARC insertion to all Title X family planning clinics in Colorado (Philliber Research Associates & Bixby Center for Global Reproductive Health, 2010; Ricketts, Klingler, & Schwalberg, 2014). No comparable program was implemented in any U.S. state at that time. In the six years following the implementation of CFPI, both fertility and abortion rates in Colorado fell substantially compared to prevailing trends and compared to other states (Kelly, Lindo, & Packham, 2019; Lindo & Packham, 2017;

Ricketts et al., 2014). Yet effects on other outcomes, such as socioeconomic outcomes which may be impacted by fertility, are still unknown. CFPI thus offers a natural experiment through which to assess the educational impacts of expanded access to the means of controlling fertility.

It is only now possible to study the effect of CFPI on educational attainment at the individual level because of the availability of population-based samples longitudinally linked by the U.S. Census Bureau and the timing of CFPI. We use restricted data from the 2010 Census and the ACS data from Colorado and other states. Using these data, we construct longitudinal information on women inside and outside of Colorado, allowing us to compare educational outcomes of cohorts of women with improved access to highly-effective contraception through CFPI to cohorts who experienced no change in contraception access.

Methods and materials

In order to construct longitudinal data on young women who were and were not exposed to CFPI, we merge the 2010 Census, which is the full population of the United States, to all ACS respondents from the years 2009-2017. The ACS is a nationally representative survey that includes approximately 1.5% of the population in each year. The ACS captures educational attainment for all individuals in the sample, allowing us to observe this outcome for a population-representative sample of young women in each cohort and from all states, regardless of whether they moved. The 2010 Census data and ACS data were linked with the Census Bureau-provided Protected Identification Key (PIK).

Taking an intent-to-treat approach (i.e. estimating the effect of CFPI on all female Colorado residents at the program's initiation) and employing a difference-in-differences framework, we identify female respondents in ACS years 2009-2017 from two sets of birth cohorts (See Figure 1) and assign them a state of residence at the onset of CFPI based on their state of residence in the 2010 Census (April 1, 2010), which occurred roughly four months after the implementation of CFPI.

We construct two cohorts, an intervention cohort and a comparison cohort. The intervention cohort (orange in Figure 1) includes young women who were 13 to 16 (exact age) at CFPI's onset in Colorado. These women represent the first cohort whose high school graduation might have been impacted by CFPI. Our control cohort (blue in Figure 1) includes young women who were just too old for the onset of CFPI in Colorado to have had an impact on their on-time high school completion (18 to 21 exact age). Figure 1 below illustrates our design.

While our intervention area is all of Colorado (since the intervention was statewide), we conduct three sets of analyses using three different comparison areas: Colorado compared with surrounding states, Colorado compared with states with similar trajectories in female high school graduation rates prior to 2010, and Colorado compared with all other US states. We identified a set of states with parallel trends in the percent of female ACS respondents who reported educational attainments of at least high school graduation at ages 19-22. For the years 2005-2009, we examined aggregate and age-specific rates for all states and we modeled trends over time using ordinary least squares regression. Eight states were not significantly different from Colorado in either estimated initial level or estimated linear time trend in the rates: Idaho, Kentucky, Michigan, Missouri, Montana, New York, Oregon, and Wyoming. States adjacent to Colorado are: Wyoming, Nebraska, Kansas, Utah, Arizona, New Mexico, and Oklahoma.

A key innovation of our method is our link between ACS observations and previous Census-based location information. In order to assess the extent to which our findings may be different from cross-sectional observations, we report the fraction of those observed in our cohorts in Colorado in ACS response who were Colorado residents at 2010 Census and the proportion of those observed in our cohorts as Colorado residents at 2010 Census who were also observed at ACS to be Colorado residents. Our outcome is educational attainment by exact ages 20-23 (age at last birthday of 20-22), operationalized as a binary indicator of attaining high school graduation or equivalent or continuation to college, with 1 for reported attainments indicating high school completion, graduation equivalency degree (GED), or enrollment in postsecondary education and 0 for reported attainment below this level (less education). Attainments are based on reported highest educational attainment in the ACS. Rather than capturing lifetime educational attainment, this outcome considers whether women have reached a baseline level of educational attainment while still in young adulthood.

In order to measure educational attainment at the same ages for our intervention and control cohorts, we observe attainment based on individuals included in ACS years when cohort members were exact ages 20-23 (ages last birthday 20-22). As shown in Figure 1, for the intervention cohort, this includes ACS years 2014-2017, and for the comparison cohort this includes ACS years 2009-2014.

We begin by examining a saturated OLS regression model for attainments by annual birth cohort and age last birthday at observation for the four groups, Colorado, adjacent states, states with parallel trends in high school graduation rates before CFPI, and the rest of the US. We then examine age-adjusted proportions who attained high school graduation or continuation to college in each cohort for the four state groups. Age-adjustment is necessary when comparing the two cohorts because the age-structure of the intervention cohort is truncated. (The cross-hatched area on Figure 1 represents the missing data due to censoring.) Then, separately for each of the three comparisons, we fit individual-level OLS regression models of our binary attainment indicator with and without age, year, and state fixed effects. We also fit these models separately for women who reported they were non-Hispanic white and Hispanic at ACS. The cohort framework we employ here could not generate large enough samples of other race/ethnic groups to generalize our findings for those groups. Models include binary indicators of Colorado residence at 2010 Census and membership in the intervention cohort, as well as an interaction of the two (our difference-in-difference estimator). We interpret the coefficient of the interaction term as the estimated effect of CFPI on high school graduation. Models are weighted to account for complex sample design and age-structure of the cohorts. Models are fit in Stata 15.1 using robust clustered standard errors at the state level.

Results

Table 1 displays rounded sample sizes for each cohort in each geographic group. These numbers represent the total number of individuals observed in each cohort (see Figure 1), based on their residence in the 2010 Census. To be observed, an individual must be a member of the birth cohort, be observed in 2010 Census, and be observed in an ACS year when they are between 20-22 (age last birthday). The exposure cohorts are smaller than the comparison cohorts because of censoring due to follow up and the exposure cohort of residents of Colorado in Census 2010 is the smallest group, with 2100 members.

The benefit of our longitudinal design is demonstrated by the relatively low proportion of those observed in our cohorts in Colorado in ACS responses who were Colorado residents at 2010 Census (proportion 0.589, SE 0.00767) and the much greater proportion of those in our cohorts observed to be Colorado residents at 2010 Census who were also observed to be Colorado residents at ACS (proportion 0.859, SE 0.006496). These proportions demonstrate that observing cross-sectional rates of educational attainment in Colorado (or other states) may not be an accurate representation of former residents' attainment.

Figure 2 displays a heatmap of percent attaining at least a high school degree by age at last birthday and calendar year of observation, by groups of states. The general pattern of greater attainments at all ages over time is apparent from the relatively higher values as years advance. The concentration of higher values among the cohort that was 20 in 2013 in Colorado, especially as they aged, is apparent from the orange blocks on the upper right

Findings indicate that improved access to means of controlling fertility has nontrivial consequences for educational attainment at the population level. In both comparisons of cohort means (Table 2) and individual regression models for the whole population (Table 3), we find that in Colorado, the increase in the likelihood of high school graduation in the intervention cohort compared to the comparison cohort was significantly greater than in comparison groups. The results persist in models with and without fixed effects for age, year, and state and are robust to our variety of comparison areas. Figure 3 displays coefficient estimates for models S1, S2, and S3 (those without fixed effects for year and age). Compared to parallel trends states (our preferred specification), CFPI increased the probability of graduating high school for women by 1.07 percentage points. As displayed in Figure 4A, this represents a 14% decrease in the proportion of women not graduating high school by our observation ages (which was 7.8% before CFPI). We used a variety of comparison groups and robustness analyses to confirm this preliminary finding.

We also find evidence of effects in models stratified by race and ethnicity in individual-level OLS models (Table 4). There are significant effects for non-Hispanic whites (Panel A), though the effect is not significant when Colorado is compared to surrounding states, since the surrounding states start at a lower level. For Hispanic women (Panel B), we see a significant effect of CFPI across all comparison groups. Models indicate that impacts on educational attainment are larger in absolute terms for Hispanic women compared to all women (for example, in parallel trends comparison, 2.3% compared with 0.3%). Because of lower pre-intervention graduation rates among Hispanic women compared with white women, translating these effects into the reduction in the proportion not graduating from high school due to CFPI yields less disparate estimates, a 14% reduction in non-completion among Hispanic women, and an 8.1% reduction in non-completion among non-Hispanic white women.

Conclusion

Our findings indicate that improved access to the means of controlling fertility may have nontrivial consequences for educational attainment at the population level. This finding is consistent with other recent research on the impact of access to high quality family planning on educational attainment (Hicks-Courant & Schwartz, 2016), and it extends the robust literature on the impacts of the initial introduction of oral contraception (Bailey, 2013; Bailey & Lindo, 2017; Goldin & Katz, 2002). While we do not test whether this effect is operating through fertility in the present work, by estimating the effect of access to the means of controlling fertility on educational attainment, our findings also contribute to the large body of work on the relationship between fertility in adolescence and early adulthood and educational attainment (ex. Geronimus & Korenman, 1993; Hotz, McElroy, & Sanders, 2005; Schulkind & Sandler, 2019) by circumventing some questions about endogeneity in this relationship.

Our stratified models also indicate that, in the case of CFPI's expansion of access to highly effective contraceptive methods in Title X clinics in Colorado, impacts on educational attainment may be greater among Hispanic women than among white women. The greater impact on Hispanic women is consistent with their roughly 3-times greater rate of utilization of Title X services compared to white women in Colorado in the early years of CFPI (Colorado Department of Public Health and Environment, 2017). If a causal effect of access to the means of controlling fertility on educational attainment is operating through fertility, this greater impact among Hispanic women could also be because they have lower abortion ratios than do white women (Kost, Maddow-Zimet, & Arpaia, 2017). Further investigation of this stratification and other axes of stratification of the effects of access to the means of controlling fertility are warranted.

Our findings are limited by a variety of factors, including our inability to estimate the effect of CFPI for race/ethnic subgroups other than non-Hispanic white women and Hispanic women. Our design, which relies on the 2010 Census as a baseline, also limits the number of covariates we may include in our models, since that census questionnaire was very brief. Importantly, our analysis also relies on the assumptions of the difference-in-differences design, and the extent to which our comparison groups truly had parallel trends in our outcome is a key assumption. We use a variety of comparison groups in part to address this limitation, but it remains.

Decades of scholarship have demonstrated an association between fertility and subsequent life course outcomes, but the causal relationships between access to the means of controlling fertility and the subsequent life course have been extremely difficult to identify. These relationships are important because many public programs are designed to improve access to the means of controlling fertility and are justified on the basis of their long-term benefits. The natural experiment upon which we base our study design, coupled with our access to longitudinally-linked restricted data, have allowed us to begin to address these important questions.

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Tables and Figures

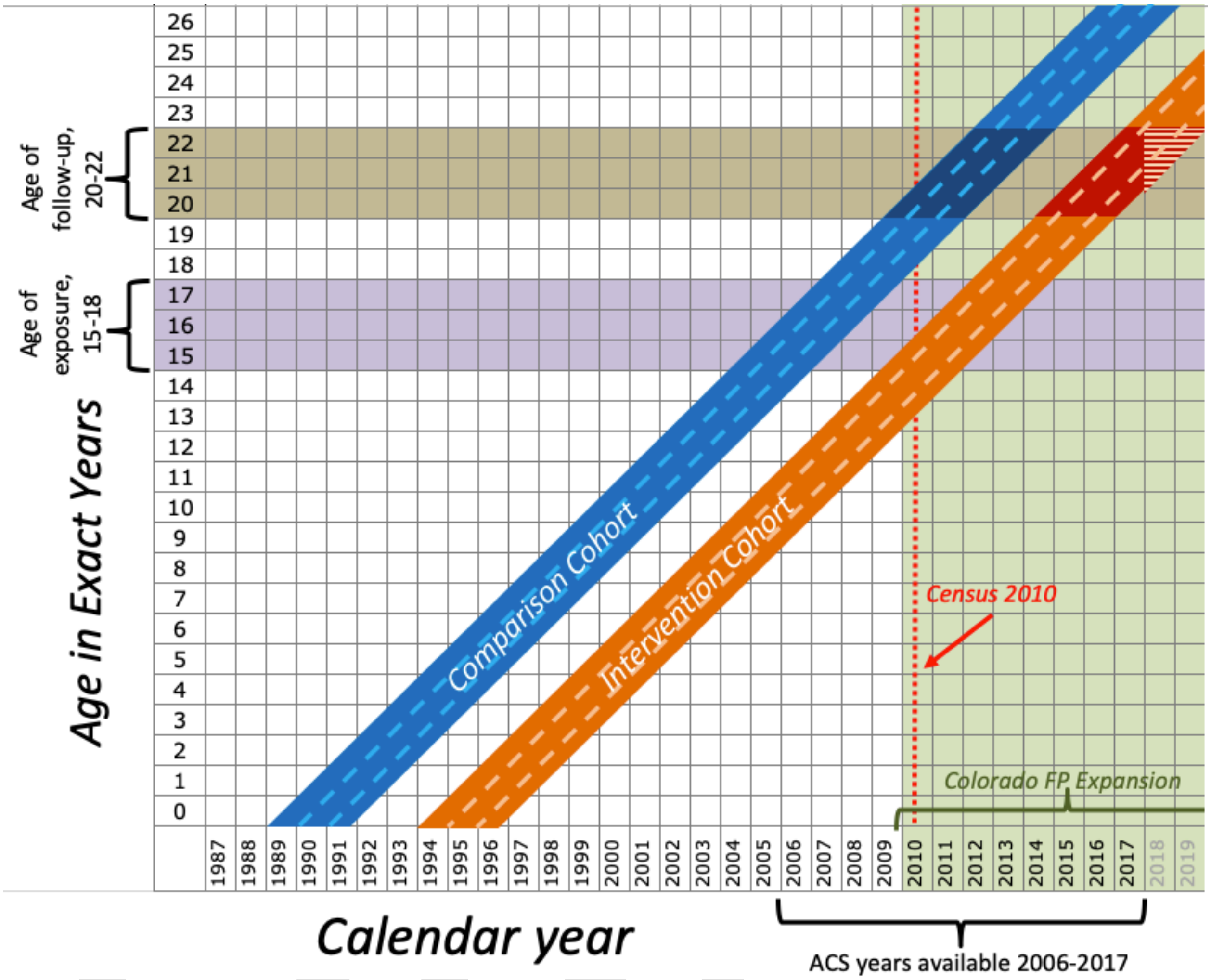

Figure 1. Cohort design.

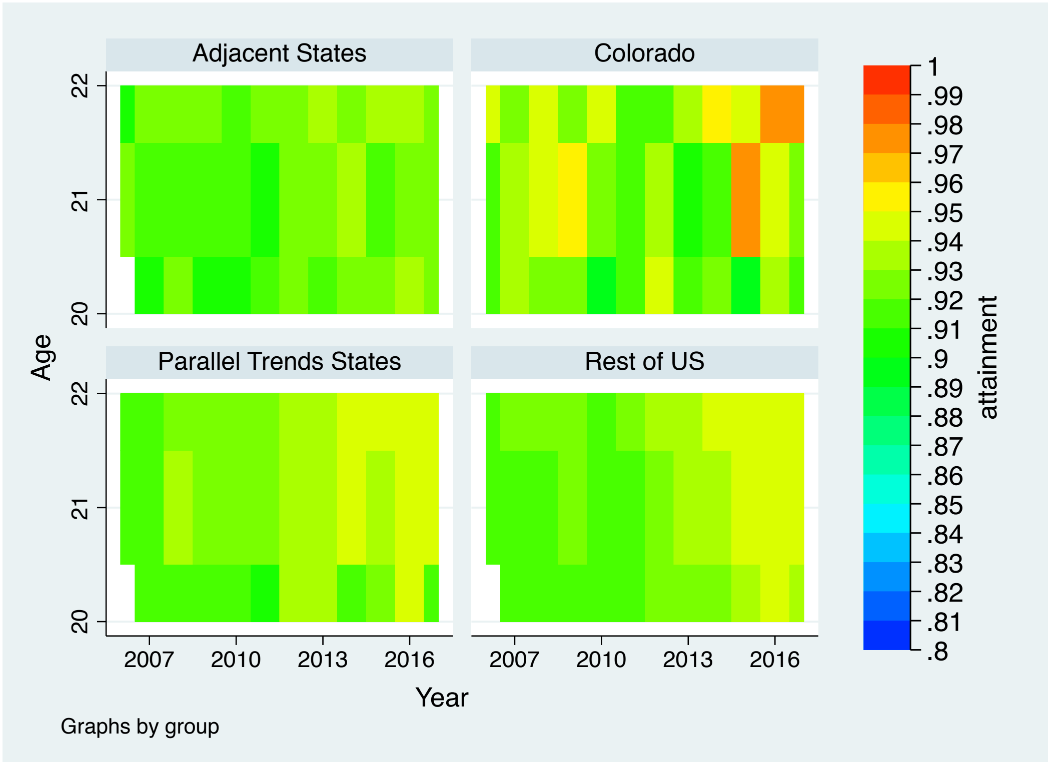

Figure 2. Heatmaps of educational attainment by age at last birthday and calendar year of observation, by groups of states.

Cohort	Colorado	Adjacent States	Parallel trends states	Rest of US
Comparison	2900	14000	34000	237000
Exposure	2100	10500	24500	182000

Table 1. Sample sizes by cohort and group

	Colorado				Adjacent States				Parallel trends states				Rest of US			
Cohort	Mean	SE	95% CI		Mean	(SE)	95% CI		Mean	(SE)	95% CI		Mean	(SE)	95% CI	
Comparison	0.9225	0.006521	0.9098	0.9352	0.92	0.003065	0.9140	0.9260	0.9255	0.001888	0.9218	0.9292	0.9232	0.0009132	0.9214	0.9250
Exposure	0.9468	0.00634	0.9344	0.9592	0.9248	0.003867	0.9173	0.9323	0.9391	0.002178	0.9349	0.9433	0.9433	0.001004	0.9413	0.9453

Table 2. Proportion of women attaining high school graduation by ages 20-22

Models for all races/ethnicities												
	Model S1: Whole US				Model S2: Adjacent States				Model S3: Parallel Trends States			
	Beta	Robust SE	95% CI		Beta	Robust SE	95% CI		Beta	Robust SE	95% CI	
Colorado	0.017	0.00118	0.0147	0.0192	0.0182	0.0024	0.0135	0.0228	-0.00566	0.00144	-0.0085	-0.0029
Post	0.0179	0.00277	0.0125	0.0232	0.00411	0.00548	-0.0066	0.0145	0.0137	0.00336	0.0071	0.0201
Colorado*Post	0.00637	0.00277	0.0010	0.0116	0.0202	0.00548	0.0095	0.0306	0.0106	0.00336	0.0040	0.0170
Constant	0.905	0.00118	0.9027	0.9072	0.904	0.0024	0.8993	0.9086	0.928	0.00144	0.9252	0.9307
Age fixed effects												
Year fixed effects												
State fixed effects	Yes				Yes				Yes			
N	356000				30500				64000			
R-squared	0.00452				0.00372				0.00107			
	Model S4: Whole US				Model S5: Adjacent States				Model S6: Parallel Trends States			
	Beta	Robust SE	95% CI		Beta	Robust SE	95% CI		Beta	Robust SE	95% CI	
Colorado	0.017	0.0012	0.0147	0.0193	0.018	0.00241	0.0133	0.0226	-0.00589	0.00143	-0.0087	-0.0032
Post	-0.0102	0.00511	-0.0202	-0.0005	-0.0166	0.0133	-0.0425	0.0087	-0.0242	0.013	-0.0496	0.0006
Colorado*Post	0.0065	0.00278	0.0011	0.0118	0.0204	0.00544	0.0098	0.0308	0.0107	0.00345	0.0040	0.0173
Constant	0.904	0.004	0.8962	0.9116	0.912	0.00872	0.8950	0.9286	0.928	0.00795	0.9125	0.9431
Age fixed effects	Yes				Yes				Yes			
Year fixed effects	Yes				Yes				Yes			
State fixed effects	Yes				Yes				Yes			
N	356000				30500				64000			
R-squared	0.00548				0.00495				0.00259			

Table 3. Age-standardized OLS models

Panel A: Whites alone												
	Model A1: Whole US				Model A2: Adjacent States				Model A3: Parallel Trends States			
	Beta	Robust SE	95% CI		Beta	Robust SE	95% CI		Beta	Robust SE	95% CI	
Colorado	0.0462	0.000683	0.0449	0.0475	0.0101	0.00343	0.0034	0.0166	0.0198	0.000937	0.0180	0.0216
Post	0.00829	0.00163	0.0051	0.0114	-0.00262	0.00844	-0.0191	0.0135	0.0071	0.00225	0.0027	0.0114
Colorado*Post	0.00329	0.00163	0.0001	0.0064	0.0142	0.00844	-0.0023	0.0303	0.00448	0.00225	0.0001	0.0088
Constant	0.913	0.000683	0.9117	0.9143	0.949	0.00343	0.9423	0.9555	0.939	0.000937	0.9372	0.9408
State fixed effects	Yes				Yes				Yes			
N	230000				20000				46500			
R-squared	0.0054				0.0028				0.0024			
Panel B: Hispanics alone												
	Model B1: Whole US				Model B2: Adjacent States				Model B3: Parallel Trends States			
	Beta	Robust SE	95% CI		Beta	Robust SE	95% CI		Beta	Robust SE	95% CI	
Colorado	-0.102	0.00278	-0.1074	-0.0967	0.00121	0.00502	-0.0086	0.0108	-0.0038	0.00773	-0.0188	0.0110
Post	0.0455	0.00573	0.0343	0.0564	0.0422	0.0106	0.0215	0.0624	0.038	0.0129	0.0128	0.0626
Colorado*Post	0.0233	0.00573	0.0121	0.0342	0.0266	0.0106	0.0059	0.0468	0.0308	0.0129	0.0056	0.0554
Constant	0.936	0.00278	0.9306	0.9413	0.833	0.00502	0.8232	0.8426	0.838	0.00773	0.8229	0.8527
State fixed effects	Yes				Yes				Yes			
N	55500				5500				6500			
R-squared	0.0109				0.0075				0.0063			

Table 4. Age-standardized OLS models stratified by race/ethnicity

Notes:
Ages are ages at last birthday.
All estimates weighted.
All estimates are age-standardized when more than a single birth year is included.
All counts (Ns) are rounded according to Census Bureau rules.

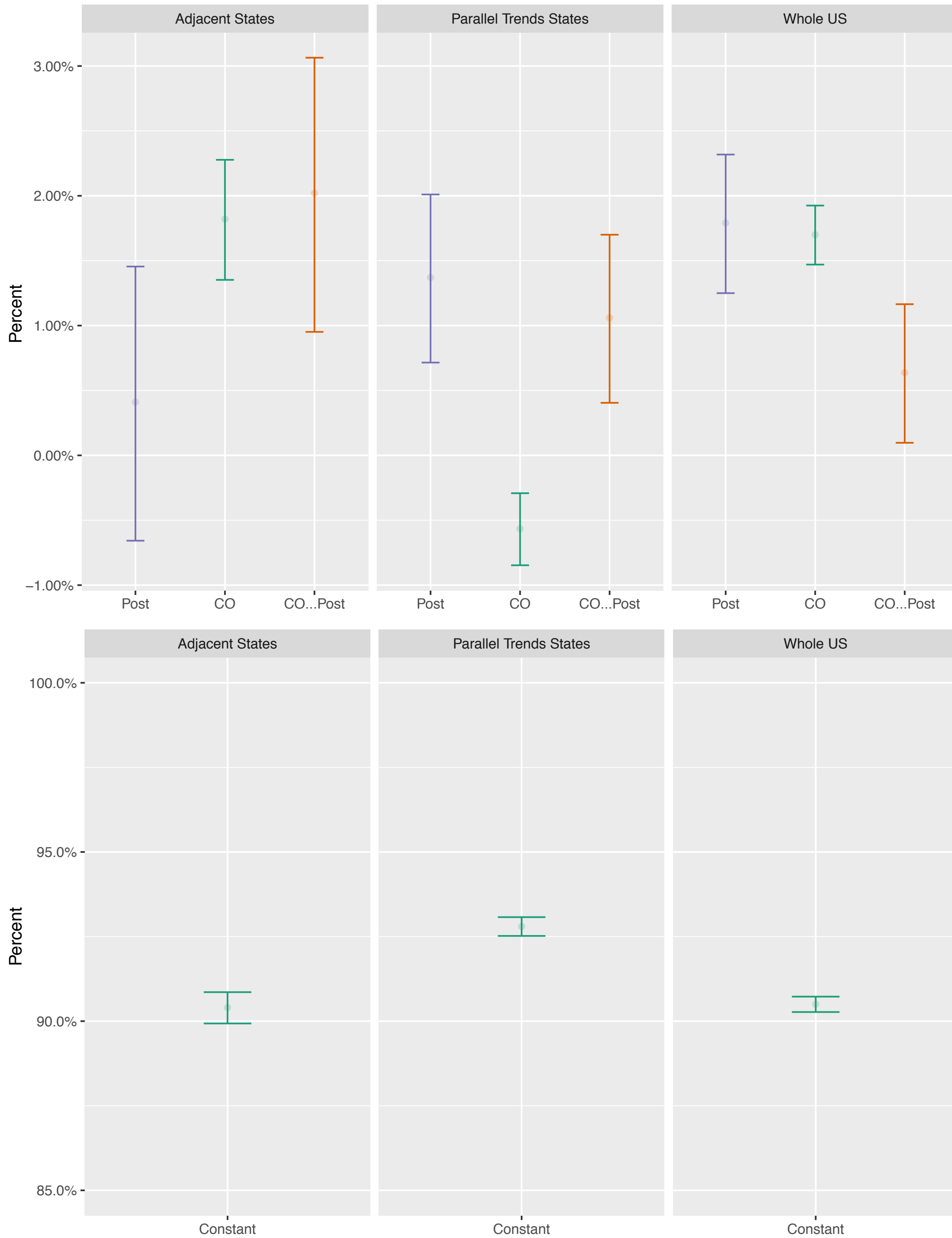

Figure 3. Coefficients from models S1, S2, and S3

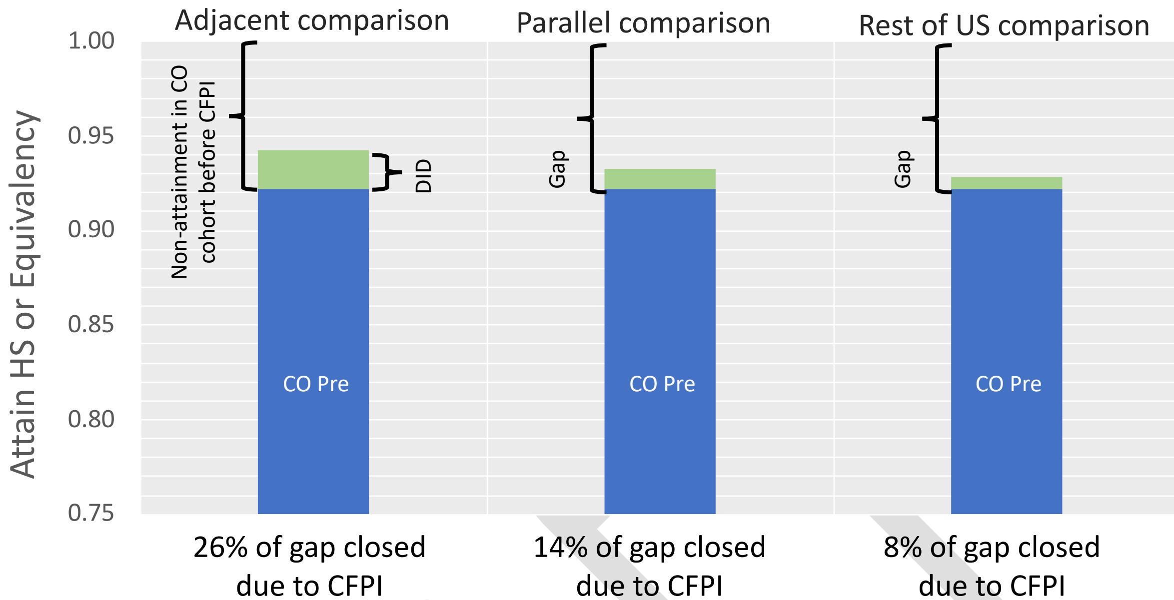

Figure 4a. CFPI's contribution to closing the gap to full high school completion

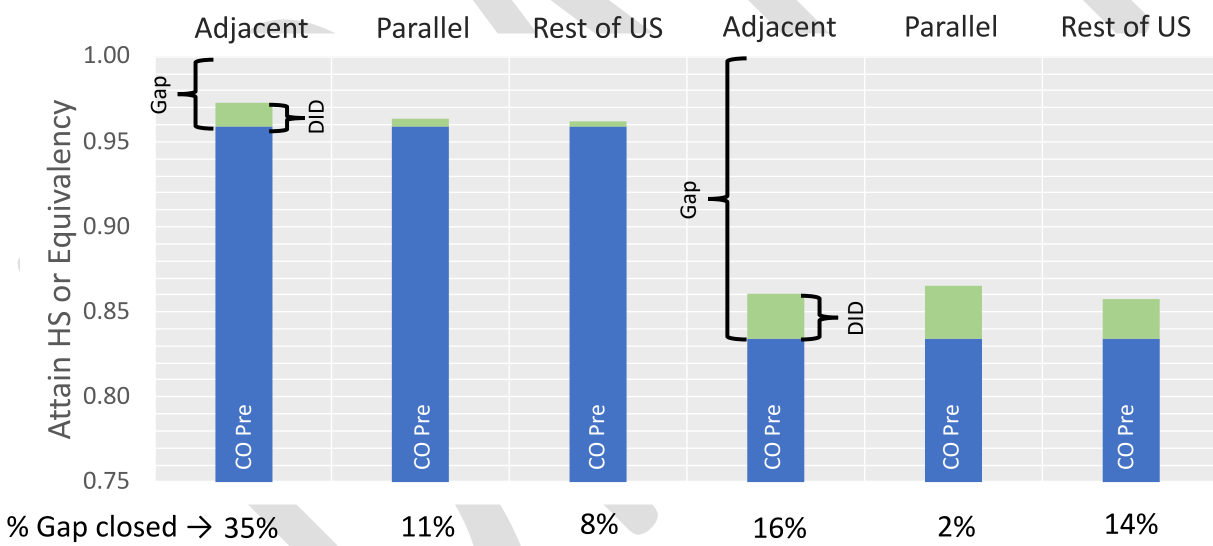

Figure 4b. CFPI's contribution to closing the gap to full high school completion for whites and Hispanics separately