Crime and Inequality in Academic Achievement Across School Districts in the United States

Appendix A: The COPS Instrument

Hiring of Officers Outside of the COPS Program

Figure A1 shows the number of police officers per 100,000 residents in the school district that were on active duty in a given year in the sample of 813 school districts. The dashed line and the right y-axis show officers that had been added to the police force through the COPS program. The solid line and the left y-axis show officers that had been added through a hiring process different than the COPS program. The number of police officers per 100,000 residents that were hired through the COPS program increased from 12 in 1996 to 25 in 2008, whereas the number of police officers per 100,000 residents that were hired outside of the COPS program increased from 179 in 1996 to 199 in 2008. In absolute terms, fewer officers were added through the COPS program, but in relative terms, the growth in COPS officers was more rapid during this period. The size of the COPS police force grew by 108 %, whereas the size of the non-COPS police force grew by 11 %.

Changes in Crime Rates By Changes in COPS Grants

Table A1 splits the sample of school districts into three groups based on the change from the 1996 to 2002 birth cohorts in the rate of officers hired through the COPS program at ages 0-6. The first column are districts with no change in COPS officers from 1996 to 2002, the second column are districts with above zero but below-median change in COPS officers from 1996 to 2002, and the third group are districts with above-median change in COPS officers from 1996 to 2002. Each column shows the mean and standard deviation of the change in the violent crime rate at ages 0-6 from the 1996 to the 2002 birth cohort (in %). Comparing rates of change in the violent crime rate across columns, we can see that the decline in violence was larger in districts where the hiring of COPS officers was also higher.

Trends in Crime and Achievement Before and After the COPS Grants

Figures A2 to A7 are a series of event studies examining how different district-level outcomes changed before and after the receipt of the COPS grants. The coefficient plots are meant to represent trends in the corresponding outcome three years before the COPS grants were received and up to three years after. In practice, this is accomplished by adding lags and leads to the COPS measure relative to the measure of the outcome in the district and estimating the difference-in-differences model. For example, the point estimate on the far left in Figure A2a shows the effect of the COPS instrument on violent crime when the instrument leads the crime measure by 3 years. The point estimate on the far right shows the effect of the instrument on violent crime when the instrument lags the measurement of crime by three years. Before the officers were hired, districts followed similar crime and achievement trends (estimates -3 to -1 in the x-axis), which supports the common trends assumption needed to recover a causal effect from the difference-in-differences estimate. After the hires took place, we see a reduction in crime and an increase in achievement that lasted up to 3 years after the hires (estimates 0 to $+3$ in the x-axis). Each police officer hired through the grants led to a 1.3 % reduction in violent crime and to a .005 standard deviation increase in ELA achievement in the district. Figure A2b follows the same logic and shows trends in achievement before and after the receipt of the COPS grants. As it can be seen, districts that were set to receive a COPS grant followed a similar trend in ELA achievement in the three years prior to the receipt of the grant than districts that did not receive any grants. After the grants were received, ELA achievement increased relatively more in districts that hired more police officers through the COPS program. For an average increase in the number of police officers hired through the COPS grants per 100,000 residents at ages 0-6 of 12, ELA achievement at the end of eighth grade increased by .05 standard deviations.

In the next section, Figures A3 to A7 show changes before and after the COPS grants were received for a number of district characteristics. As before, these figures are event studies showing coefficient plots from separate regressions in which lags and leads have been

added to the COPS measure. These lags and leads span from three years prior to the receipt of the grants up to three years after.

Trends in School Resources Before and After the COPS Grants

In Figure A3, I use data at the school district level from the Local Education Agency Finance Surveys of 1994 to 2008 from the National Center for Education Statistics to examine trends in revenue that school districts collected through local property taxes and income taxes before and after the COPS officers were hired through the grants. The coefficient plots suggest that the COPS grants were not correlated with prior and posterior trends in revenue collection.[1] This indicates that high-income and affluent families were not moving at higher rates into districts that were expected to receive more COPS grants. It also suggests that these families did not move at higher rates into districts that had received more COPS grants. This evidence suggests that the improvement in achievement in districts that experienced declines in violence after the COPS grants were received was not driven by more affluent families moving into these districts.

Another explanation for the findings on crime and achievement could be that public schools received more resources as cities received COPS funds to hire police officers. One could imagine a scenario in which a city had allocated certain funds at the beginning of the fiscal year to hire police officers, but when the city received the COPS grant, those funds were reallocated to the public school system in the city. That would represent a violation of the exclusion restriction in the 2SLS estimation because the instrument would have an effect on achievement through a channel other than the reduction in crime rates. To assess this possibility, in Figure A4, I use data from the Local Education Agency Finance Surveys of 1994 to 2008 from the National Center for Education Statistics to examine trends in

[1]The estimating equation corresponding to Figure A3 has the following form: $Y_{st} = \beta\, COPS_{st} + \boldsymbol{S'_s} + \boldsymbol{C'_t} + \epsilon_{st}$, where Y_{st} is the log revenue (in 2015 USD) per 100,000 residents in school district s in year t; $COPS_{st}$ is the number of police officers per 100,000 residents hired through the COPS grants in school district s in year t; and $\boldsymbol{S'_s}$ and $\boldsymbol{C'_t}$ are school district and year fixed effects. The sample includes the same 813 school districts used in the previous analyses. Changes in COPS grants and outcomes are measured year-to-year from 1994 to 2008.

school district expenditures and teacher salaries before and after the COPS grants. None of the point estimates reported in Figure A4 suggests that school districts increased their expenditures or teacher salaries in a way that was correlated with the COPS grants.[2]

Trends in Enrollment and Composition of Schools Before and After the COPS Grants

One limitation of the SEDA data is that they represent repeated cross-sections of districts over several school years. As such, it is impossible to determine, for example, whether the children who started third grade in school year 2009-2010 were the same ones that were in eighth grade by school year 2014-2015. Students moving to other school districts or being retained in a grade will change the pool of students between third and eighth grade. Changes in the composition of the student body would not be problematic if they occurred at random. However, if the composition of birth cohorts changed with crime rates or the COPS grants, that would undermine the validity of the estimates. For example, if high-income families moved in greater numbers into school districts that became safer, that would increase the mean achievement in the district. Similarly, if low-income families stayed in school districts where violent crime had declined the least, the mean achievement in those districts would remain low.

To assess the extent to which the decline in crime induced by the COPS grants changed the composition school districts over time, in Figures A5 and A6, I use data at the school-level from the Public Elementary/Secondary School Universe Survey Data from the National Center for Education Statistics for years 1994 to 2008 to examine how enrollment and the socio-economic composition of schools in the district changed before and after the COPS officers were hired through the grants.[3] Among other demographics, these data include

[2]The estimating equation corresponding to Figure A4 is analogous to that used in Figure A3 with Y_{st} representing the log of expenditures or salaries (in 2015 USD) per 100,000 residents in school district s in year t.

[3]Enrollment and demographic measures in the Public Elementary/Secondary School Universe Survey Data are at the school level. To be consistent with the rest of model specifications, I average these school-level measures across all schools in the district and estimate school district-level models. The estimating equation has the following form: $Y_{st} = \beta\, COPS_{st} + \boldsymbol{S'_s} + \boldsymbol{C'_t} + \epsilon_{st}$, where Y_{st} is the log of number of students in third grade, the log of number of students in eighth grade, the share of FRL-eligible students, the share

counts of students enrolled in each grade in the district, the total number of students enrolled in the district, the number of students with free and reduced-price lunch (FRL) eligibility,[4] and the number of students of each racial/ethnic group. Figures A5 and A6 show that the COPS grants were not correlated with prior and posterior trends in third-grade enrollment, eighth-grade enrollment, share of students that were eligible for free and reduced-price lunch, share of black students, share of Hispanic students, and share of white students.

Trends in State-Level Incarceration Rates Before and After the COPS Grants

Lastly, in Figure A7, I use data at the state-level from Bureau of Justice Statistics to examine trends in incarceration rates before and after the COPS officers were hired through the grants. The coefficient plots show that the COPS grants were not correlated with prior and posterior trends in incarceration in the state, ruling out the possibility that the effects of the COPS grants on achievement runs through this channel.

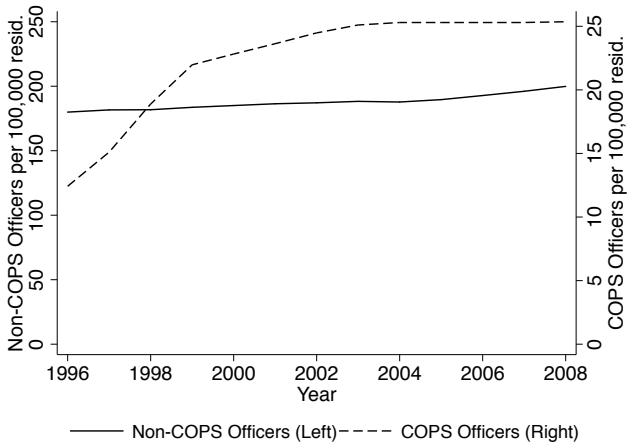
The conclusion that emerges from Figures A2 to A7 is that the COPS grants increased achievement levels in the district through their impact on crime rates, but they did not change other attributes of the district that are directly or indirectly linked to achievement. While not definitive, this circumstantial evidence provides compelling support for the exclusion restriction assumption needed in the 2SLS estimation.

---

of black students, the share of Hispanic students, or the share of white students in school district s in year t. $COPS_{st}$ is the number of police officers per 100,000 residents hired through the COPS grants in school district s in year t; and $\boldsymbol{S'_s}$ and $\boldsymbol{C'_t}$ are school district and year fixed effects. The sample includes the same 813 school districts used in the previous analyses. Changes in COPS grants, enrollment, and composition are measured year-to-year from 1994 to 2008. Measures of economic an racial composition are estimated for the entire district (i.e., pooling all students in grades K-12)

[4] Using FRL eligibility status to measure the extent to which the economic composition in the district changed is an imperfect way of doing so, but given data limitations, it is the most common approach in the education literature.

Figure A1: Police Officers per 100,000 Residents, 1996-2008



Notes: The dashed line and the right y-axis show officers that had been added to the police force through the COPS program. The solid line and the left y-axis show officers that had been added through a hiring process different than the COPS program.

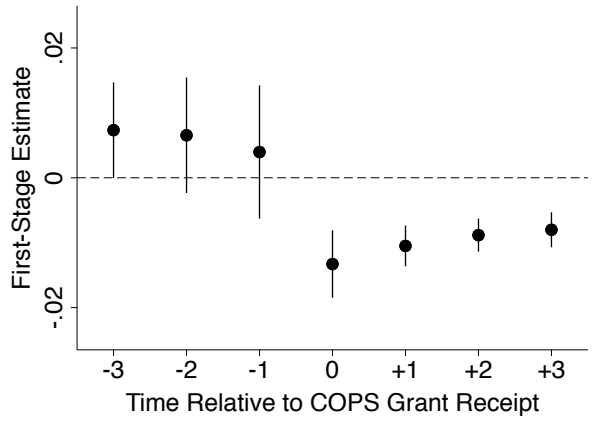
Table A1: Change in Violent Crime (in %), By Change in COPS Officers, 1996-2002

	Change in COPS Officers (1996-2002)		
	$\delta = 0$	$0 < \delta <$ median	$\delta \geq$ median
% Change Violent	-2.05	-1.76	-10.03
	(16.35)	(19.00)	(28.40)

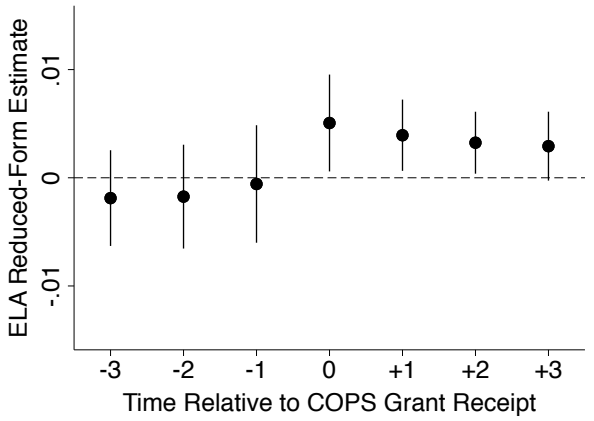
Notes: This table splits the sample of school districts into three groups based on the change from the 1996 to the 2002 birth cohorts in the rate of officers hired through the COPS program at ages 0-6. The first column are districts with no change in COPS officers from 1996 to 2002, the second column are districts with above zero but below-median change in COPS officers from 1996 to 2002, and the third group are districts with above-median change in COPS officers from 1996 to 2002. Each column shows the mean and standard deviation of the change in the violent crime rate at ages 0-6 from the 1996 to the 2002 birth cohort (in %). The sample includes the same 813 school districts used in the analyses.

Figure A2: Changes in Violent Crime and ELA Achievement Before and After the COPS Grants

(a) Violent Crime



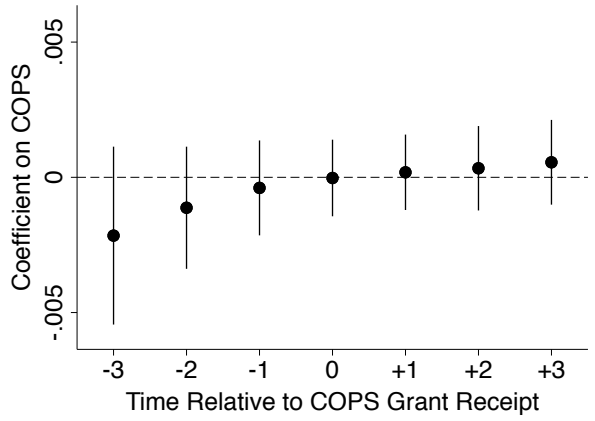
(b) ELA Achievement



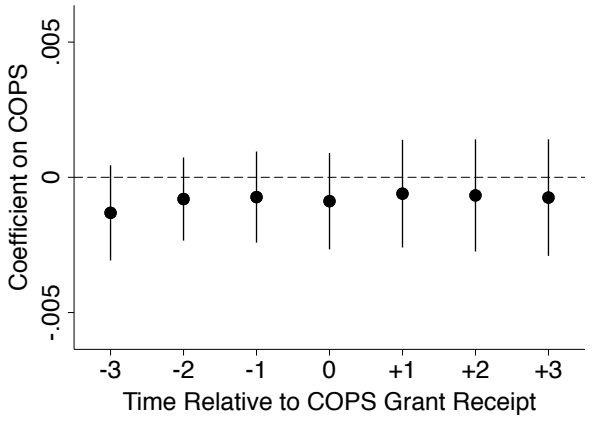
Notes: Each point estimate and 95 % confidence interval is obtained from a separate regression of the corresponding outcome on the COPS instrument. Each regression adds a lag or a lead to the COPS instrument (from -3 years to + 3y years) relative to the outcome. COPS are in number of officers per 100,000 residents at ages 0-6. Violent crime rates are in number of crimes per 100,000 residents (log-transformed) at ages 0-6. ELA achievement is computed at the end of 8th grade and measured in standard deviations of the national distribution. The sample includes the same 813 school districts and 7 birth cohorts used in previous analyses. All models include school district fixed effects, cohort fixed effects, and precision weights.

Figure A3: Changes in School District Revenue Before and After the COPS Grants

(a) Revenue from Property Taxes

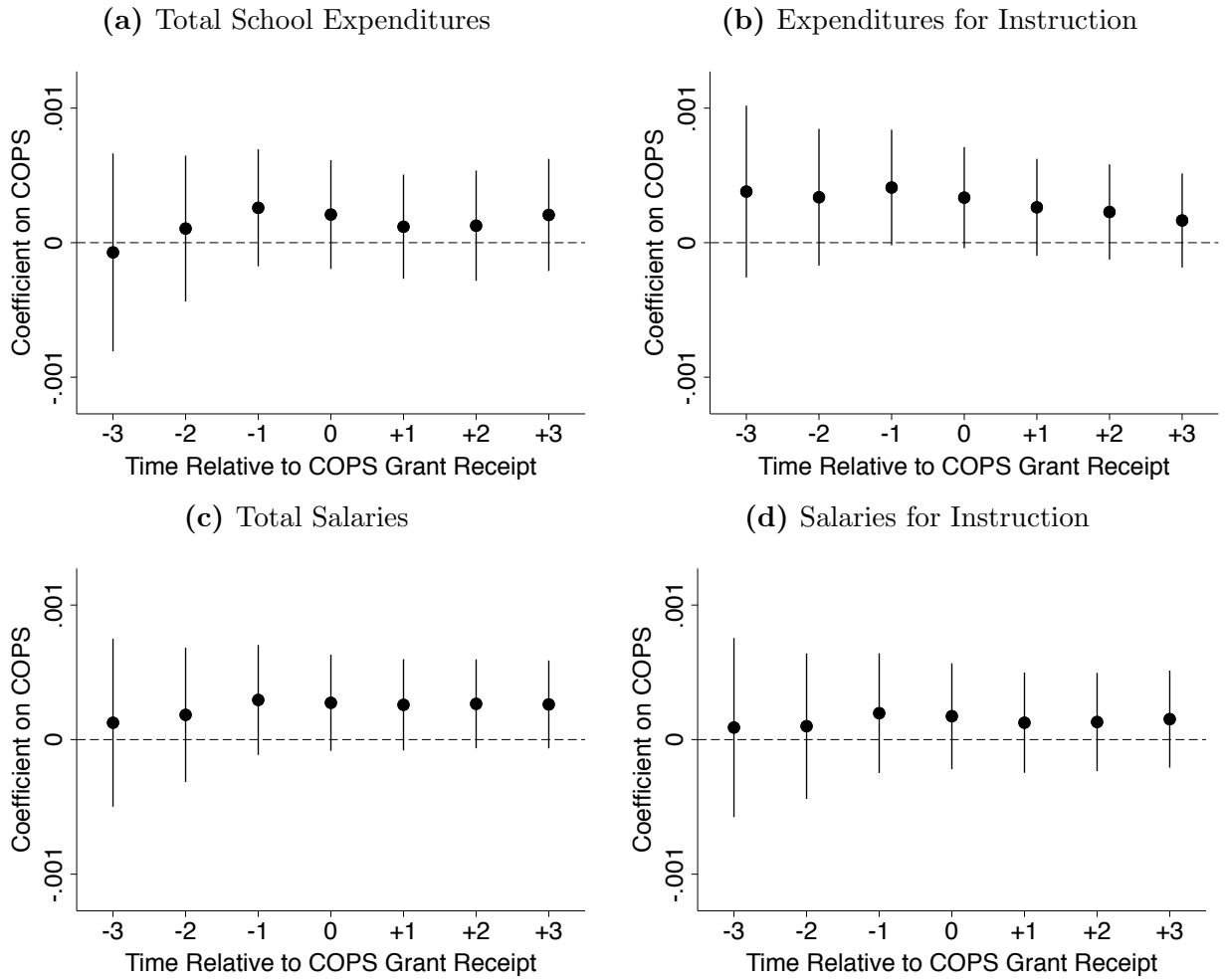


(b) Revenue from Income Taxes



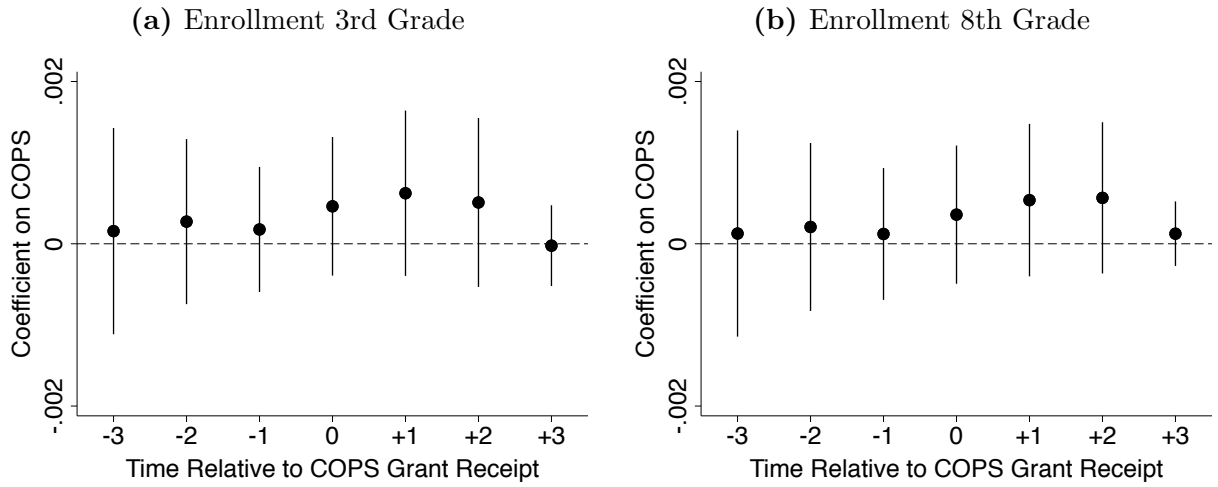
Notes: Each point estimate and 95 % confidence interval is obtained from a separate regression of the corresponding outcome on the COPS instrument. Each regression adds a lag or a lead to the COPS instrument (from -3 years to + 3y years) relative to the outcome. COPS are in number of officers per 100,000 residents in the district. Revenue from property taxes and income taxes are in 2015 USD per 100,000 residents in school district (log transformed). COPS officers and school district revenue are measured year-to-year from 1994 to 2008. The sample includes the same 813 school districts used in previous analyses. All models include school district fixed effects and year fixed effects.

Figure A4: Changes in School Expenditures and Teacher Salaries Before and After the COPS Grants



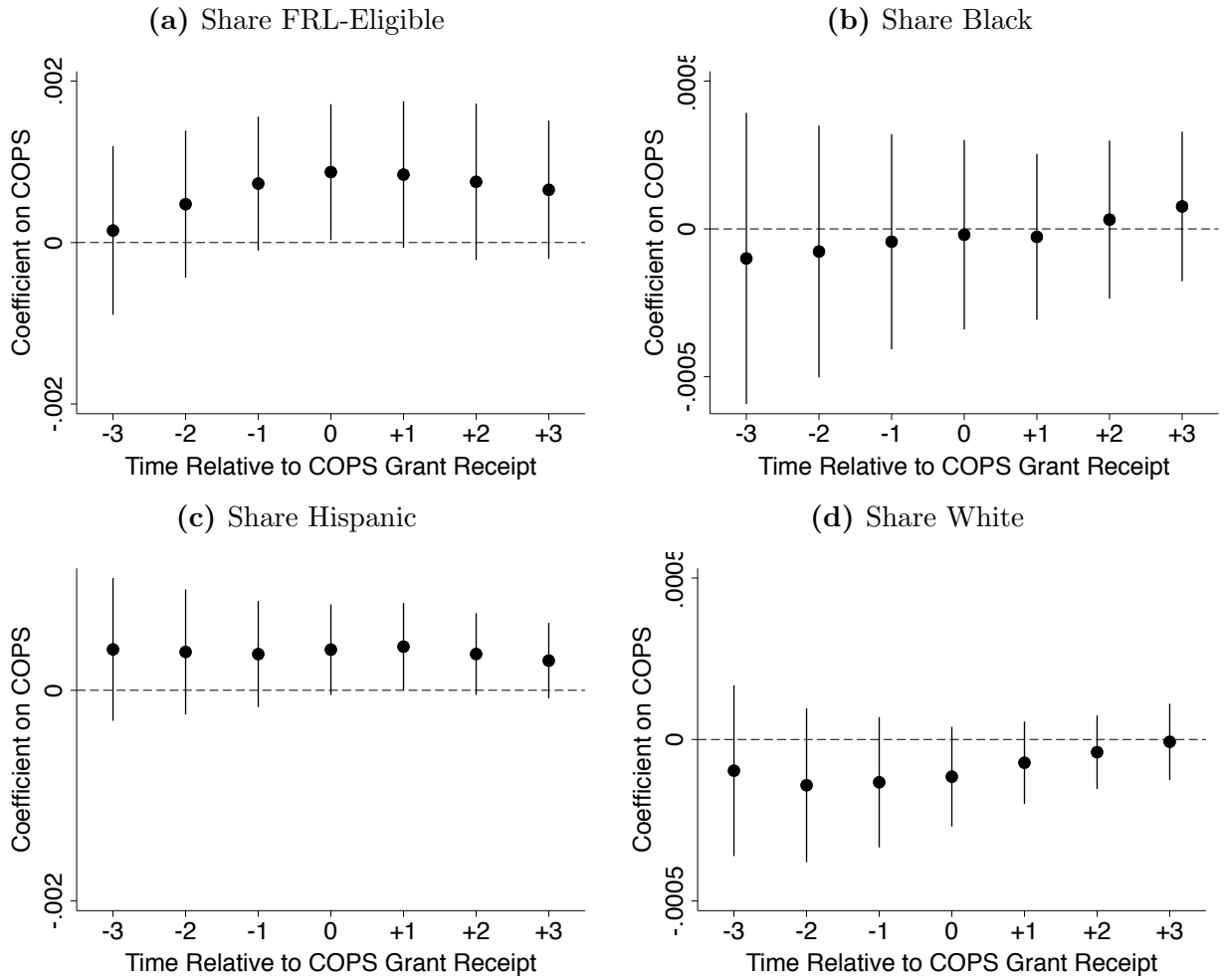
Notes: Each point estimate and 95 % confidence interval is obtained from a separate regression of the corresponding outcome on the COPS instrument. Each regression adds a lag or a lead to the COPS instrument (from -3 years to + 3y years) relative to the outcome. COPS are in number of officers per 100,000 residents in the district. Expenditures and teacher salaries are in 2015 USD per 100,000 residents in school district (log transformed). COPS officers, expenditures and teacher salaries are measured year-to-year from 1994 to 2008. The sample includes the same 813 school districts used in previous analyses. All models include school district fixed effects and year fixed effects.

Figure A5: Changes in School District Enrollment Before and After the COPS Grants



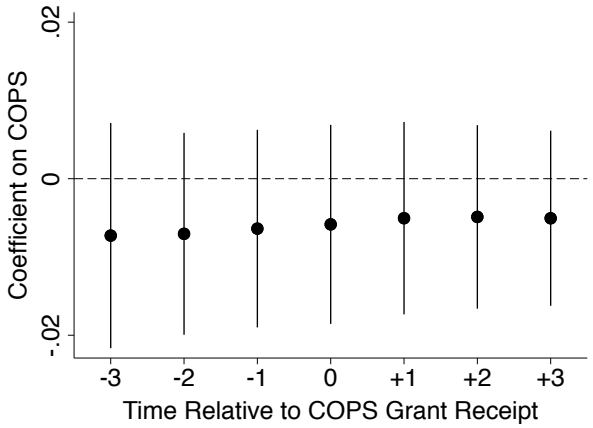
Notes: Each point estimate and 95 % confidence interval is obtained from a separate regression of the corresponding outcome on the COPS instrument. Each regression adds a lag or a lead to the COPS instrument (from -3 years to + 3y years) relative to the outcome. COPS are in number of officers per 100,000 residents in the district. Enrollment is the log number of students enrolled in the corresponding grade in all public schools in the district. COPS officers and enrollment are measured year-to-year from 1994 to 2008. The sample includes the same 813 school districts used in the previous analyses. All models include school district fixed effects and year fixed effects.

Figure A6: Changes in School District Composition Before and After the COPS Grants



Notes: Each point estimate and 95 % confidence interval is obtained from a separate regression of the corresponding outcome on the COPS instrument. Each regression adds a lag or a lead to the COPS instrument (from -3 years to + 3y years) relative to the outcome. COPS are in number of officers per 100,000 residents in the district. Shares of FRL-eligible students, black students, Hispanic students, and white students are measured across K-12 grades. COPS officers and shares are measured year-to-year from 1994 to 2008. The sample includes the same 813 school districts used in previous analyses. All models include school district fixed effects and year fixed effects.

Figure A7: Changes in Incarceration Rates in the State Before and After the COPS Grants



Notes: Each point estimate and 95 % confidence interval is obtained from a separate regression of the corresponding outcome on the COPS instrument. Each regression adds a lag or a lead to the COPS instrument (from -3 years to + 3y years) relative to the outcome. COPS are in number of officers per 100,000 residents in the state. Incarceration rates are in number of persons in prison or jail per 100,000 residents in the state. COPS officers and incarceration rates are measured year-to-year from 1994 to 2008. The sample includes all US states except Alaska and Hawaii. All models include state fixed effects and year fixed effects.

Appendix B: Impact in Racial and Gender Gaps

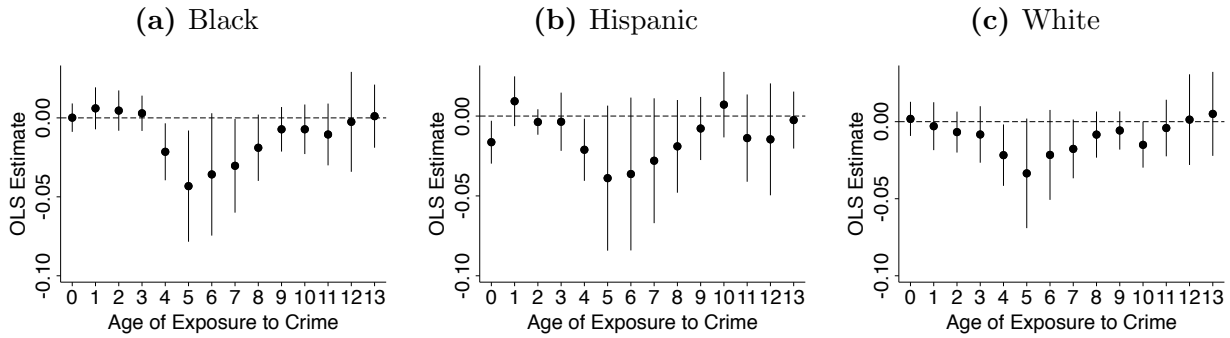
Table A2: 2SLS Estimates of Effect on Racial and Gender Gaps

	ELA			Math		
	(1) White-Black	(2) White-Hispanic	(3) Female-Male	(4) White-Black	(5) White-Hispanic	(6) Female-Male
Log All Violent	-0.078	-0.005	-0.159	-0.169	-0.146	-0.245**
	(0.161)	(0.206)	(0.098)	(0.185)	(0.173)	(0.097)
Observations	4,255	4,255	4,255	4,255	4,255	4,255

* 0.10 ** 0.05 *** 0.01. Standard errors clustered by school district in parentheses. All models include school district fixed effects, cohort fixed effects, and precision weights.

Appendix C: OLS Estimates With Different Age of Exposure to Crime

Figure A8: OLS Estimates, ELA, By Age of Exposure to Crime



Notes: Each point estimate and 95 % confidence interval is obtained from a separate OLS regression of eighth-grade ELA achievement on violent crime rate. Each regression varies the age when the violent crime rate is measured for a given cohort, from 0 to 13 years old. Violent crime rates are in number of crimes per 100,000 residents (log-transformed). ELA achievement is computed at the end of 8th grade and measured in standard deviations of the national distribution. The sample includes the same 813 school districts and 7 birth cohorts used in previous analyses. All models include school district fixed effects, cohort fixed effects, and precision weights.