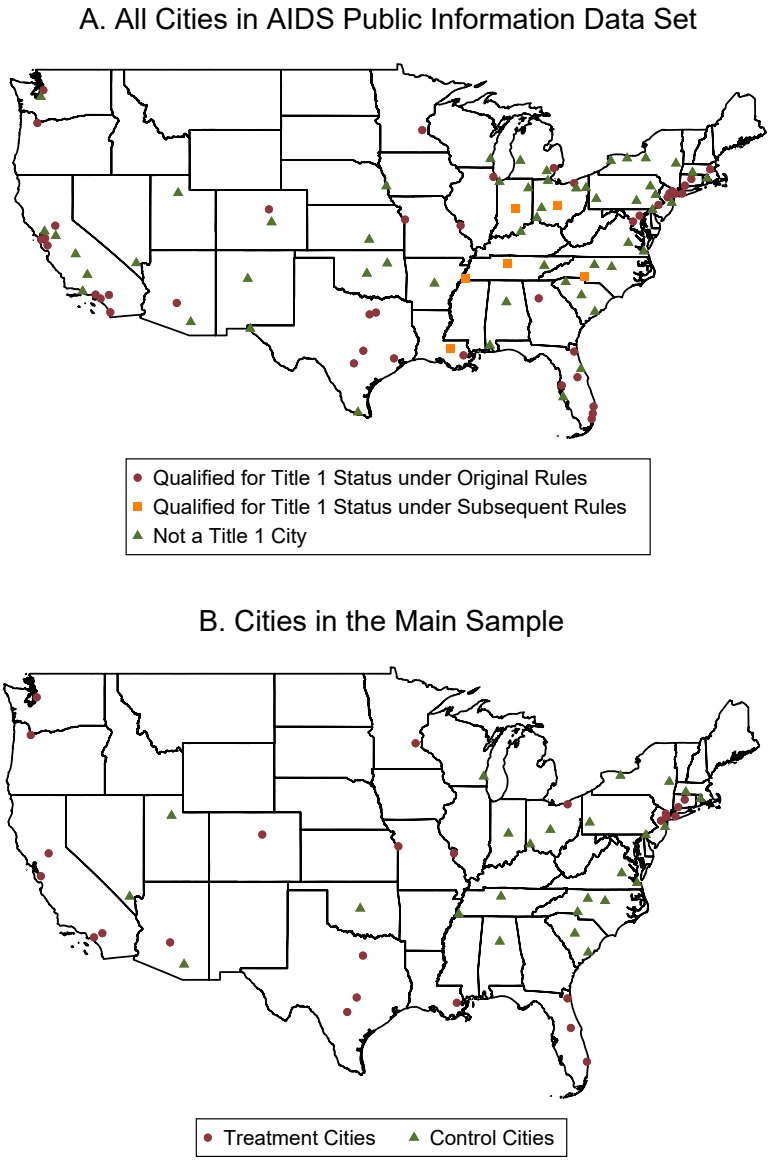
Online Appendix for "Evidence and Lessons on the Health Impacts of Public Health Funding from the Fight against HIV/AIDS" by Marcus Dillender

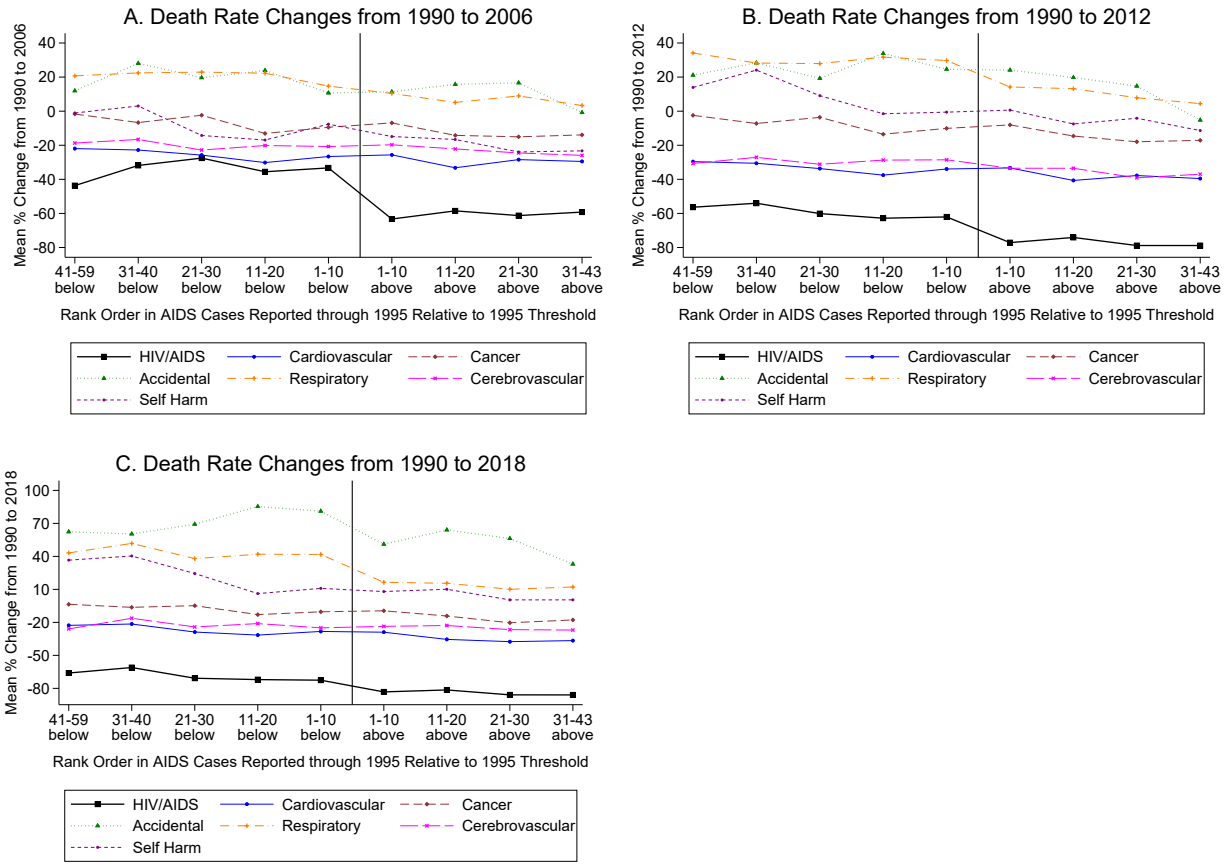
A Appendix Tables and Figures

Figure A.1: Cities in the AIDS Public Information Data Set



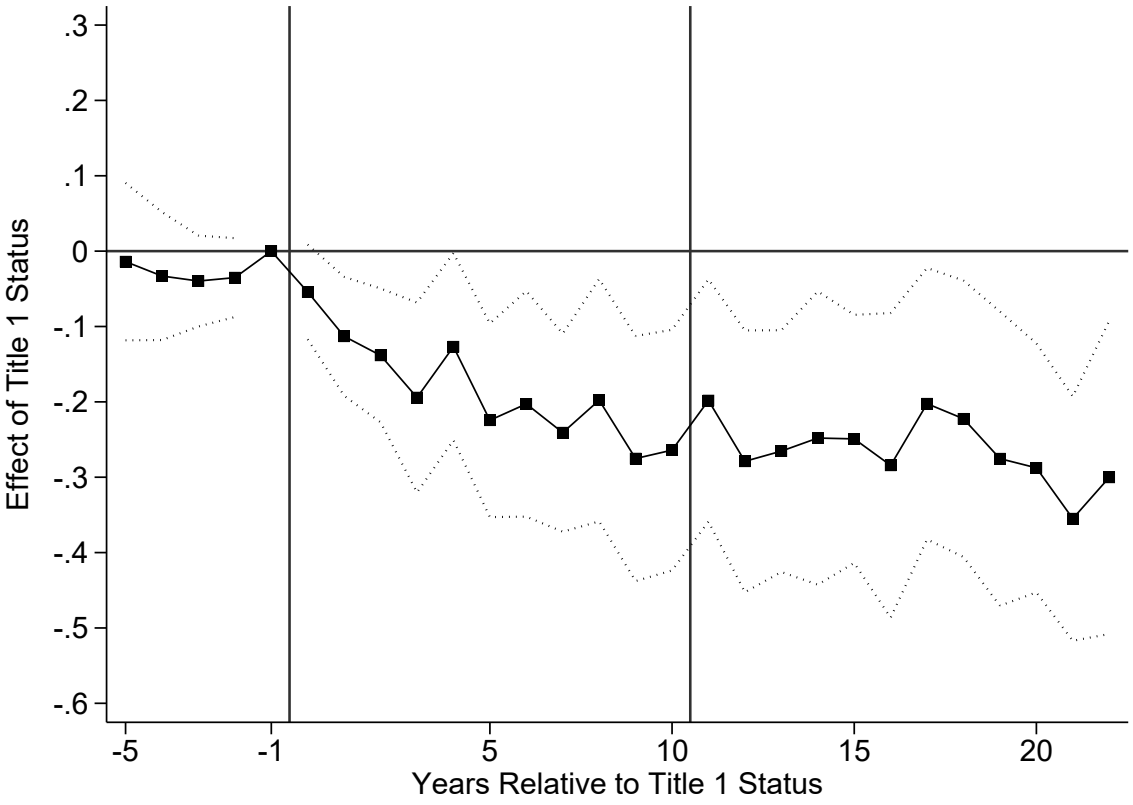
Notes: Graph A shows Title 1 status as of 2018 for cities in the AIDS Public Information Data Set. Graph B shows the treatment and control cities in the baseline sample.

Figure A.2: Changes in Death Rates since 1990 by Cities' Rank Order in AIDS Cases Reported by March 31, 1995



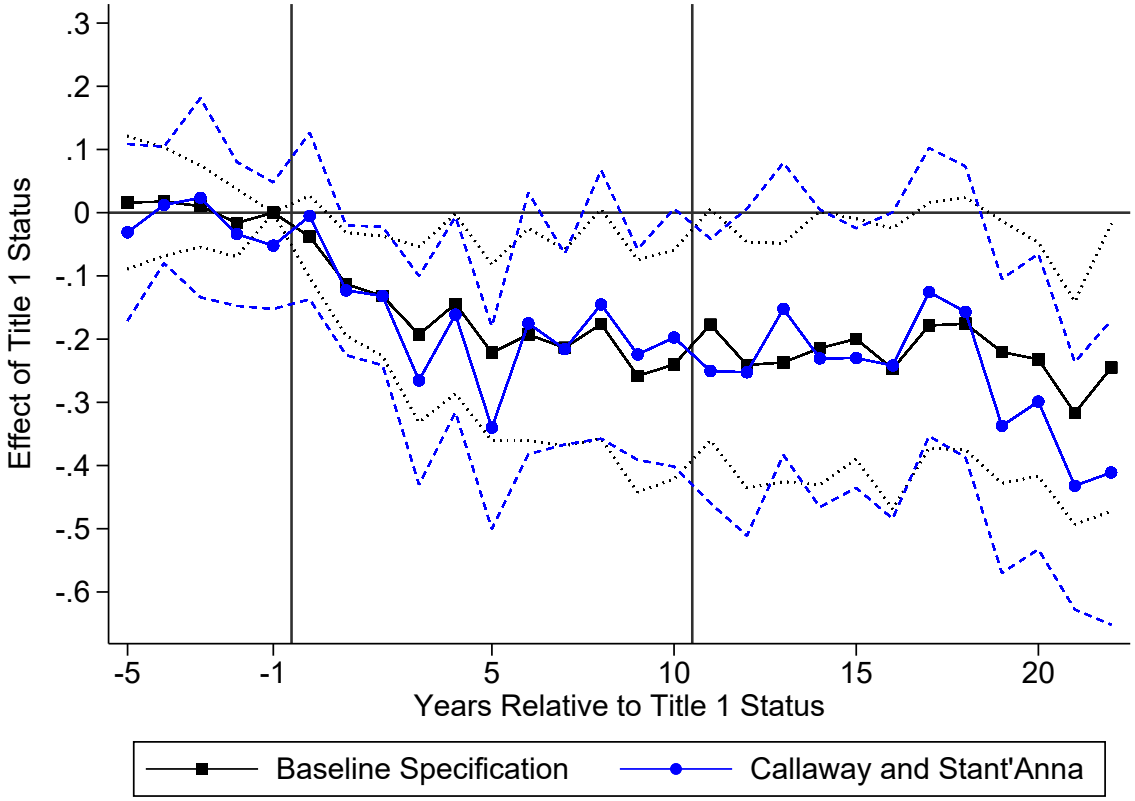
Notes: Each marker represents a set of cities grouped based on rank order in AIDS cases reported by March 31, 1995. The x-axes indicate cities' rank order in AIDS cases reported by March 31, 1995, relative to the original threshold for Title 1 eligibility. The y-axes indicate the mean percent change in death rates for the indicated cause in the indicated year relative to 1990.

Figure A.3: Relationship between Title 1 Status and HIV/AIDS Death Rates—Estimates Weighted by Population



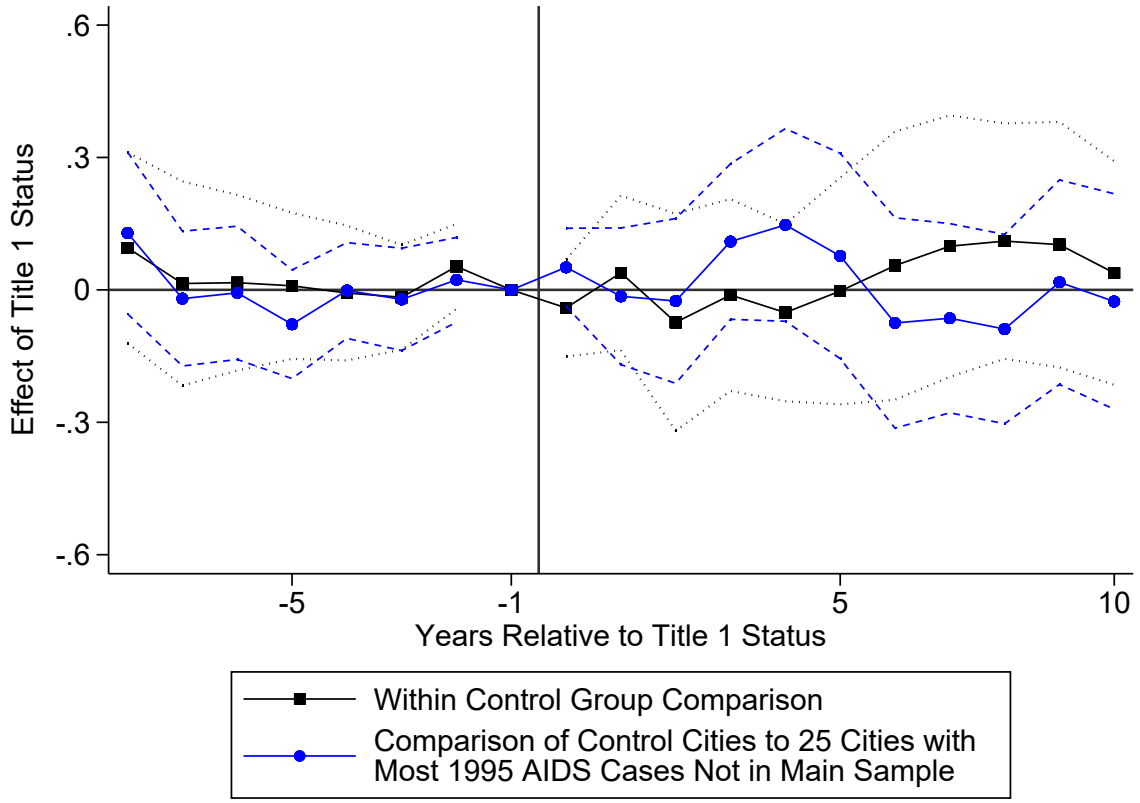
Notes: Each marker is a coefficient on Title 1 status interacted with number of years from initial Title 1 status eligibility from a single regression weighted by city populations with the log of HIV/AIDS death rates as the dependent variable. The year before cities obtained Title 1 status is the omitted category. The x-axis indicates the number of years from Title 1 status. The y-axis indicates the coefficient estimate. The sample contains 1,550 observations from 50 cities from 1988 to 2018. The regression includes city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. The sample does not contain observations with event times of more than 5 years before or more than 22 years after initial eligibility for all treated cities in the sample. Bins for event times outside of this range are included in the regression as separate indicator variables for each year but are not reported. The dashed lines indicate 95% confidence intervals calculated using standard errors clustered by city. The first vertical line indicates the start of Title 1 status. The second vertical line indicates when in event time all treated observations are beyond 2006. Numbers of HIV/AIDS deaths come from the Vital Statistics Mortality data.

Figure A.4: Comparison of Baseline Event-Study Estimates to Callaway and Sant'Anna Event-Study Estimates



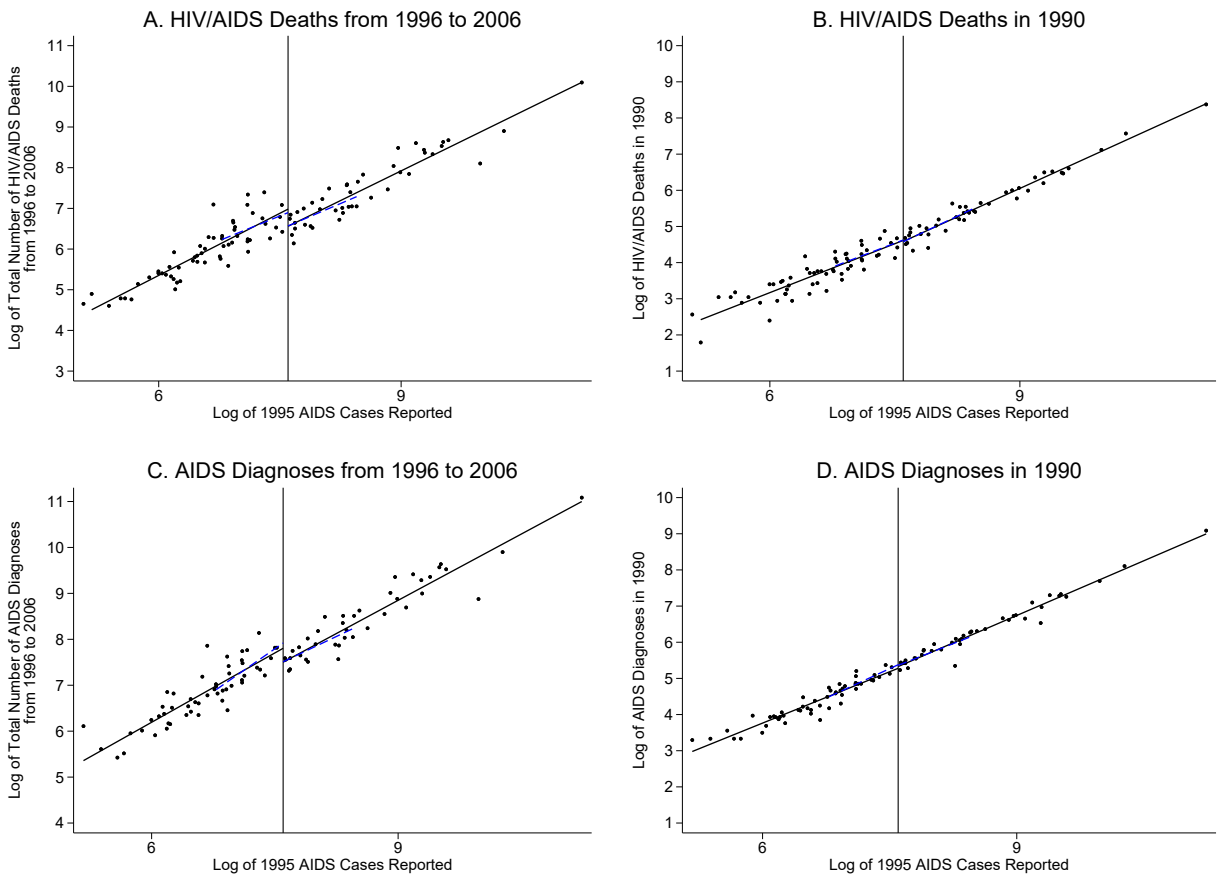
Notes: Each marker is a coefficient on Title 1 status interacted with number of years from initial Title 1 status eligibility from a single regression with the log of HIV/AIDS death rates as the dependent variable. The x-axis indicates the number of years from Title 1 status. The y-axis indicates the coefficient estimate. The black squares are the baseline estimates from Figure 3. The blue circles are estimates from using the methods described in Callaway and Sant'Anna (2021). The sample contains 1,550 observations from 50 cities from 1988 to 2018. Each regression includes city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. The sample does not contain observations with event times of more than 5 years before or more than 22 years after initial eligibility for all treated cities in the sample. Bins for event times outside of this range are included in the regression as separate indicator variables for each year but are not reported. The dashed lines indicate 95% confidence intervals calculated using standard errors clustered by city. The first vertical line indicates the start of Title 1 status. The second vertical line indicates when in event time all treated observations are beyond 2006. Numbers of HIV/AIDS deaths come from the Vital Statistics Mortality data.

Figure A.5: Placebo Analysis of Differential Trends among Cities with Fewer than 2,000 AIDS Cases Reported through March 31, 1995



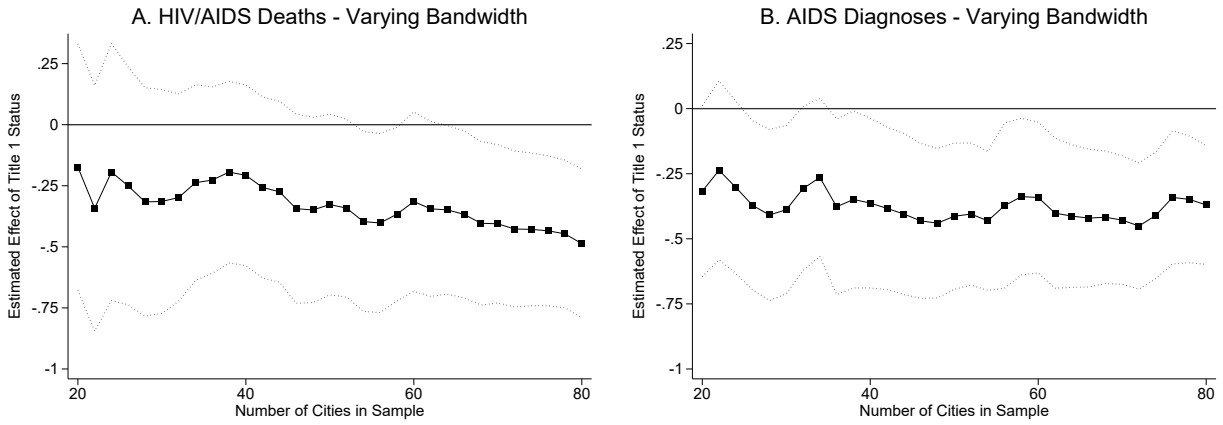
Notes: Each marker is a coefficient on a placebo treatment indicator variable interacted with number of years from 1995 from a regression with the log of HIV/AIDS death rates as the dependent variable. The interaction with the year 1995 is the omitted category. The x-axis indicates the number of years from 1995. The y-axis indicates the coefficient estimate. The black squares are from a single regression that includes the 475 observations from 1988 to 2006 from the main analysis sample's 25 control cities. The coefficients plotted are time indicator variables interacted with an indicator variable equal to one for the 12 cities in the sample with the most AIDS cases by March 31, 1995. The blue circles are from a single regression that includes the 950 observations from 1988 to 2006 from the 50 cities with the most AIDS cases by March 31, 1995, that did not qualify for Title 1 under the original Ryan White rules. The coefficients shown are time indicator variables interacted with an indicator variable equal to one for the 25 cities in the sample with the most March 31, 1995, AIDS cases. The regressions include city fixed effects and year fixed effects. The dashed lines indicate 95% confidence intervals calculated using standard errors clustered by city.

Figure A.6: HIV/AIDS Deaths and AIDS Diagnoses by AIDS Cases Reported by March 31, 1995



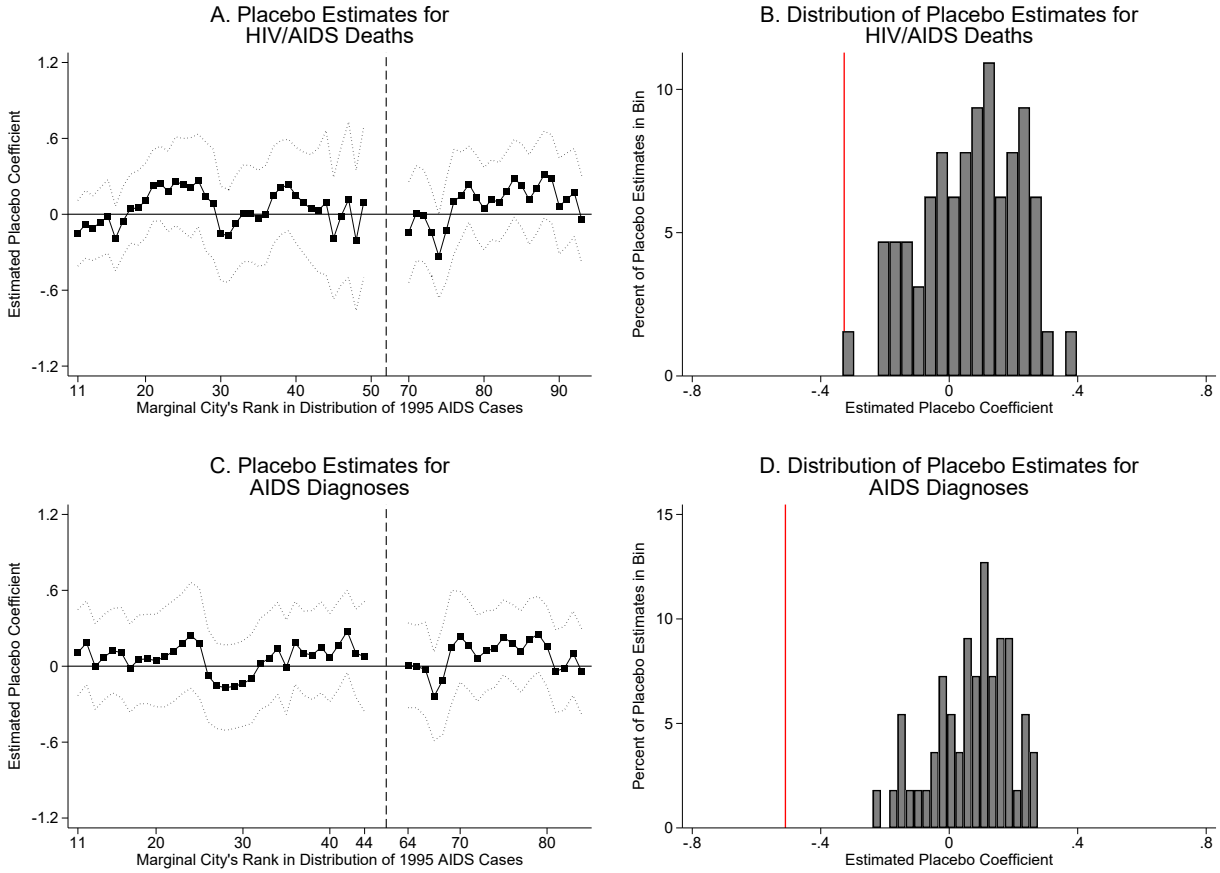
Notes: Each marker represents a separate city. The x-axes indicate the log of cities' AIDS cases reported by March 31, 1995. The y-axis of Graph A indicates the log of cities' HIV/AIDS deaths from 1996 to 2006. The y-axis of Graph B indicates the log of cities' HIV/AIDS deaths in 1990. The y-axis of Graph C indicates the log of cities' new AIDS diagnoses from 1996 to 2006. The y-axis of Graph D indicates the log of cities' new AIDS diagnoses in 1990. The vertical lines indicate the log of 2,000 AIDS cases reported by March 31, 1995. The solid black lines are fitted separately on either side of the threshold using data from all cities, while the dashed blue lines are fitted separately on either side of the threshold using data from the cities in the main sample.

Figure A.7: Sensitivity to Bandwidth of Regression Discontinuity Estimates of Impact of Title 1 on 1996 to 2006 AIDS Outcomes



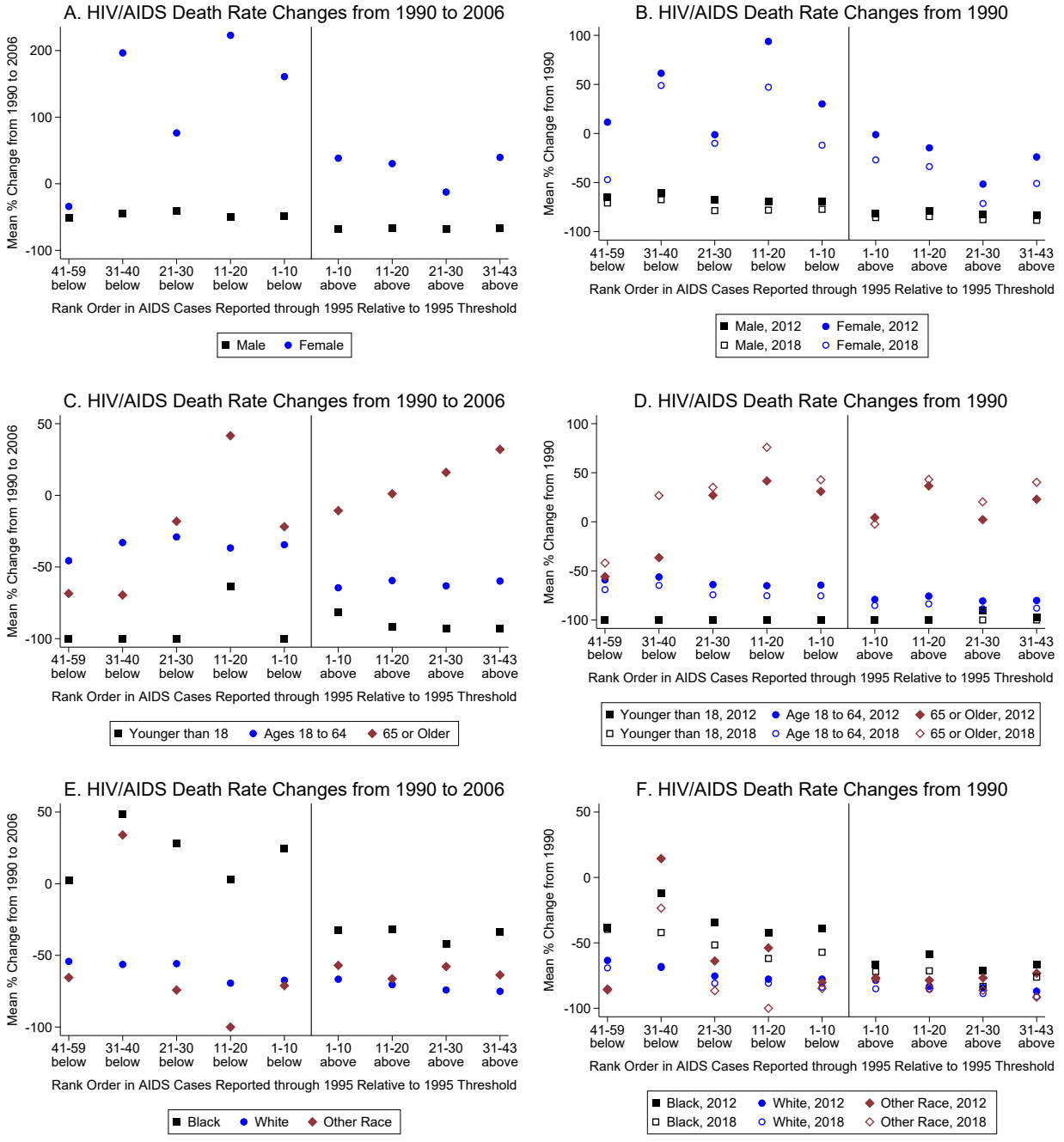
Notes: Each marker represents a separate estimate of the impact of Title 1 status on 1996 to 2006 HIV/AIDS deaths and AIDS diagnoses from a single regression of Equation (5). The x-axes indicate the number of cities included in the regression from a symmetric bandwidth on either side of the threshold. Each regression controls for the log of AIDS cases reported by March 31, 1995, and the log of AIDS cases reported by March 31, 1995, interacted with an indicator variable for having reported at least 2,000 AIDS cases by March 31, 1995. The dashed lines indicate 95% confidence intervals calculated using robust standard errors.

Figure A.8: Placebo Regression Discontinuity Estimates of Impact of Title 1 on 1996 to 2006 AIDS Outcomes



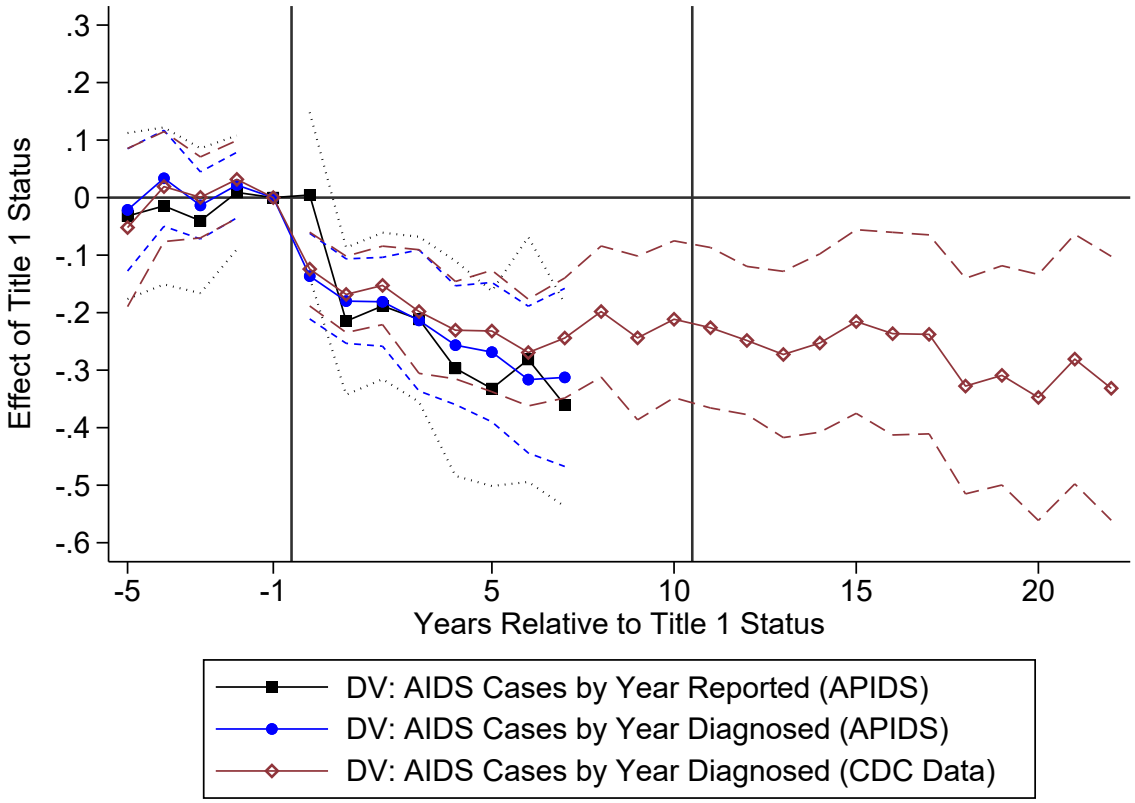
Notes: Each marker in Graphs A and C represents a separate estimate of a placebo effect on 1996 to 2006 HIV/AIDS deaths and AIDS diagnoses outcomes from a single regression of Equation (5). The x-axes indicate the rank order of the first city to the right of the placebo cutoff in the distribution of AIDS cases reported by 1995. The y-axes indicate the placebo estimates for the indicated dependent variable. Regressions include up to 25 observations on either side of the cutoff. For placebo cutoffs with fewer than 25 cities on one side of the cutoff, Graphs A and C show estimates with an asymmetric bandwidth as long as the placebo cutoff has at least ten observations on either side of the bandwidth. Each regression controls for the log of AIDS cases reported by March 31, 1995, and the log of AIDS cases reported by March 31, 1995, interacted with an indicator variable for cities being above the placebo cutoff. The dashed lines indicate 95% confidence intervals calculated using robust standard errors. Graphs B and D plot histograms of the placebo estimates. The red vertical lines indicate the baseline estimates of the effect of Title 1 status displayed in Column 1 of Table A.7.

Figure A.9: Changes in HIV/AIDS Death Rates since 1990 by Cities' Rank Order in AIDS Cases Reported by March 31, 1995—for Demographics Groups



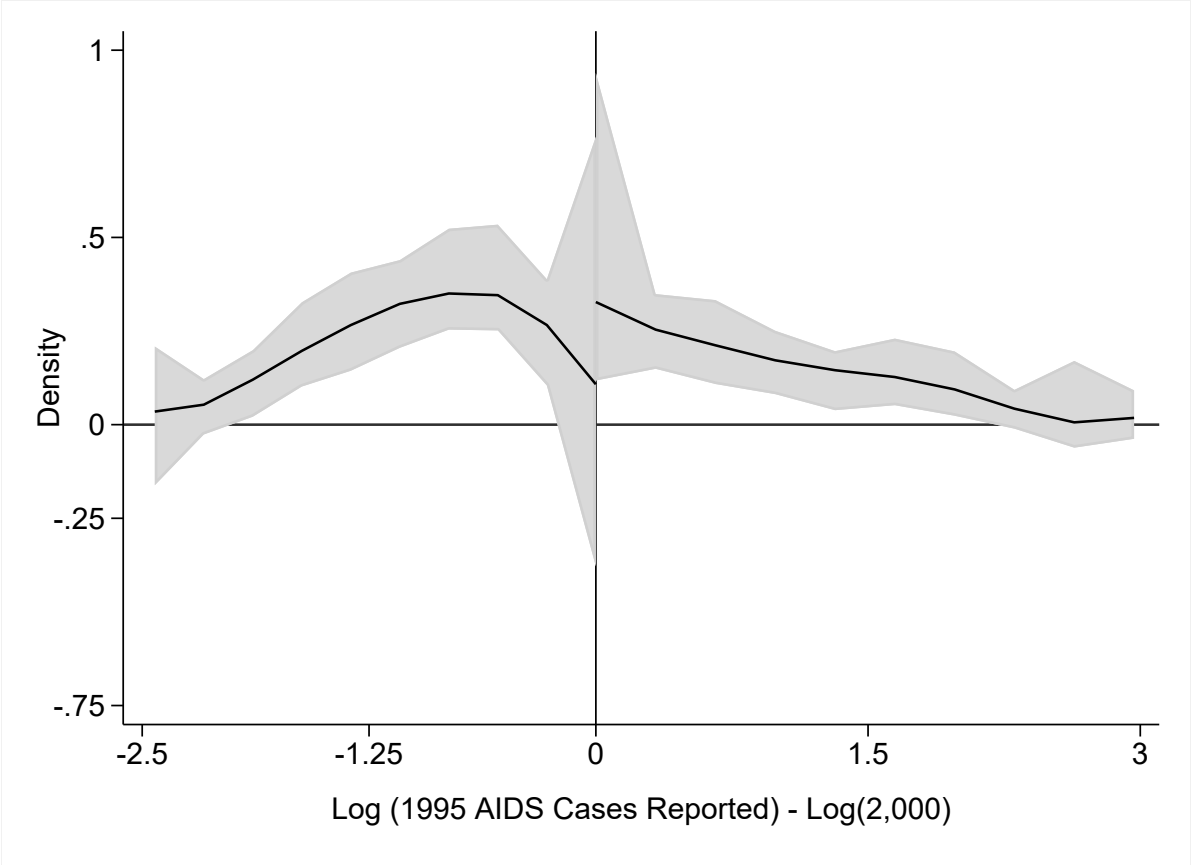
Notes: Each marker represents a demographic group for a set of cities grouped based on rank order in AIDS cases reported by March 31, 1995. The x-axes indicate cities' rank order in AIDS cases reported by March 31, 1995, relative to the original threshold for Title 1 eligibility. The y-axes indicate the mean percent change in HIV/AIDS death rates for the indicated demographic group in the indicated year relative to 1990.

Figure A.10: Relationship between Title 1 Status and Rates of New AIDS Cases—Estimates Weighted by Population



Notes: Each marker is a coefficient on Title 1 status interacted with number of years from initial Title 1 status eligibility. The year before cities obtained Title 1 status is the omitted category. The x-axis indicates the number of years from Title 1 status. The y-axis indicates the coefficient estimate. The black squares are from a single regression with the log of rates of new AIDS cases by year reported from the AIDS Public Information Data Set as the dependent variable. The blue circles are from a single regression with the log of rates of annual AIDS cases by year diagnosed from the AIDS Public Information Data Set as the dependent variable. The sample for these regressions contains 750 observations from 50 cities from 1988 to 2002. The maroon diamonds are from a single regression with the log of annual AIDS diagnosis rates from the CDC as the dependent variable. The sample contains 1,426 observations from 46 cities from 1988 to 2018. Each regression is weighted by city populations and includes city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. The sample does not contain observations with event times outside of the ranges shown for all treatment cities. Bins for event times outside of those shown are included in the regression as separate indicator variables for each year but are not reported. The dashed lines indicate 95% confidence intervals calculated using standard errors clustered by city. The first vertical line indicates the start of Title 1 status. The second vertical line indicates when in event time all treated observations are beyond 2006.

Figure A.11: McCrary Density Plot



Notes: The graph displays estimates of the density along with 95% confidence intervals constructed using local regression distribution estimation.

Table A.1: Percent of Title 1 Spending by Category in Fiscal Year 2010

Type of Care	Percentage
Outpatient Care and Pharmacy	35.2%
Case Management and Treatment Adherence	18.3%
Mental Health	5.8%
Substance Abuse Services	4.9%
Nutrition and Food Services	4.4%
Early Intervention and Outreach Services	4.2%
Other Medical Services	9.3%
Support Services	5.7%
Clinical Quality Management	3.2%
Administration Costs	9.1%

Notes: The data come from the Health Resources and Services Administration's 2010 Ryan White expenditure report.

Table A.2: Cities in the AIDS Public Information Data Set

City	AIDS Cases by Original Cutoff	Ranking	Main Sample	Year Title 1 Status Achieved
Akron, OH	312	7	no	
Albany-Schenectady, NY	1,001	39	yes	
Albuquerque, NM	651	24	no	
Allentown, PA	461	13	no	
Ann Arbor, MI	252	4	no	
Atlanta, GA	9,729	93	no	1991
Austin, TX	2,466	68	yes	1995
Bakersfield, CA	527	20	no	
Baltimore, MD	7,811	90	no	1992
Baton Rouge, LA	794	30	no	2007
Bergen-Passaic, NJ	3,602	75	yes	1994
Birmingham, AL	1,038	43	yes	
Boston, MA	8,938	92	no	1991
Buffalo, NY	883	34	no	
Charleston, SC	885	35	yes	
Charlotte, NC	1,216	48	yes	2007
Chicago, IL	13,385	97	no	1991
Cincinnati, OH	1,211	46	yes	
Cleveland, OH	2,044	60	yes	1996
Colorado Springs, CO	288	6	no	
Columbia, SC	1,012	40	yes	
Columbus, OH	1,512	54	yes	2013
Dallas, TX	8,020	91	no	1991
Dayton, OH	616	21	no	
Daytona Beach, FL	649	23	no	
Denver, CO	3,945	78	yes	1994
Detroit, MI	4,742	85	no	1993
El Paso, TX	488	16	no	
Fort Lauderdale, FL	7,380	89	no	1991
Fort Wayne, IN	159	1	no	
Fort Worth, TX	2,063	61	yes	1996
Fresno, CA	715	28	no	
Gary, IN	402	10	no	
Grand Rapids, MI	485	15	no	
Greensboro, NC	1,016	41	yes	
Greenville, SC	796	31	no	
Harrisburg, PA	517	19	no	
Hartford, CT	2,244	66	yes	1996
Houston, TX	11,965	96	no	1991
Indianapolis, IN	1,725	56	yes	2007
Jacksonville, FL	2,697	70	yes	1995
Jersey City, NJ	4,406	83	yes	1991
Kansas City, MO	2,705	71	yes	1994
Knoxville, TN	402	9	no	
Las Vegas, NV	1,810	57	yes	1999
Little Rock, AR	630	22	no	
Los Angeles, CA	28,912	101	no	1991
Louisville, KY	748	29	no	

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Table A.2 — continued

City	AIDS Cases Original Cutoff	Ranking	Baseline Sample	Year Title 1 Status Achieved
McAllen-Edinburg-Mission, TX	176	2	no	
Memphis, TN	1,490	53	yes	2007
Miami, FL	14,545	99	no	1991
New Brunswick, NJ	2,098	62	yes	1996
Milwaukee, WI	1,214	47	yes	
Minneapolis-St Paul, MN	2,180	65	yes	1996
Mobile, Al	674	25	no	
Ocean City, NJ	1,862	59	yes	
Nashville, TN	1,291	51	yes	2007
Nassau-Suffolk, NY	4,230	81	yes	1993
New Haven, CT	3,913	77	yes	1994
New Orleans, LA	4,132	79	yes	1993
New York, NY	75,781	102	no	1991
Newark, NJ	10,861	95	no	1991
Norfolk, VA	1,852	58	yes	1999
Oakland, CA	5,588	87	no	1992
Oklahoma City, OK	1,067	44	yes	
Omaha, NE	441	12	no	
Orange County, CA	3,773	76	yes	1993
Orlando, FL	3,324	74	yes	1994
Philadelphia, PA	10,750	94	no	1991
Phoenix, AZ	3,057	73	yes	1994
Pittsburgh, PA	1,600	55	yes	
Portland, OR	2,644	69	yes	1995
Providence, RI	1,220	49	yes	
Raleigh-Durham, NC	1,209	45	yes	
Richmond, VA	1,456	52	yes	
Riverside-San Bernardino, CA	4,322	82	yes	1994
Rochester, NY	1,247	50	yes	
Sacramento, CA	2,177	64	yes	1996
Saint Louis, MO	2,968	72	yes	1994
Salt Lake City, UT	954	37	yes	
San Antonio, TX	2,427	67	yes	1995
San Diego, CA	6,868	88	no	1991
San Francisco, CA	21,560	100	no	1991
San Jose, CA	2,145	63	yes	1996
Sarasota, FL	867	33	no	
Scranton, PA	266	5	no	
Seattle, WA	4,672	84	yes	1993
Springfield, MA	958	38	yes	
Stockton, CA	470	14	no	
Syracuse, NY	714	27	no	
Tacoma, WA	506	18	no	
Tampa-Saint Petersburg, FL	5,060	86	no	1993
Toledo, OH	359	8	no	
Tucson, AZ	900	36	yes	
Tulsa, OK	686	26	no	
Vallejo-Fairfield-Napa, CA	859	32	no	
Ventura, CA	495	17	no	

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Table A.2 — continued

City	AIDS Cases Original Cutoff	Ranking	Baseline Sample	Year Title 1 Status Achieved
Washington, DC	13,635	98	no	1991
West Palm Beach, FL	4,151	80	yes	1994
Wichita, KS	421	11	no	
Wilmington, DE	1,030	42	yes	
Youngstown, OH	218	3	no	

Table A.3: Characteristics of HIV/AIDS and Non-HIV/AIDS Deaths from 1988 to 2018

	HIV/AIDS Deaths	Non-HIV/AIDS Deaths
Fraction Male	0.81	0.50
Fraction Female	0.19	0.50
Fraction Younger than 18	0.01	0.02
Fraction Ages 18 to 64	0.95	0.24
Fraction 65 or Older	0.04	0.73
Mean Age	42.1	72.2
Fraction Black	0.44	0.12
Fraction White	0.55	0.86
Fraction Other Race	0.01	0.02
Fraction in City in APIDS	0.84	0.61
Total	514,430	74,648,275

Notes: The data come from the Vital Statistics Mortality data from 1988 to 2018.

Table A.4: Differences in Medicaid Rules and Coverage and Uninsured Rates

	Mean for Control Cities	Mean for Title 1 Cities	Difference	S.E.	p-value
% with Separate SSI and Medicaid Applications in 1996	30.7	27.2	3.5	12.8	0.787
Medicaid Eligibility Income Limit as % of FPL in 1996	38.8	41.2	-2.4	4.6	0.605
% with Childless Adults Eligible for Medicaid	13.6	12.4	1.2	1.7	0.471
% of State on Medicaid in 1996	10.7	11.2	-0.4	0.9	0.637
% of State Uninsured in 1996	12.7	15.3	-2.6	1.1	0.016
% of Prime-Aged Males in State on Medicaid in 1996	5.4	4.9	0.5	0.6	0.405
% of Prime-Aged Males in State Uninsured in 1996	16.6	20.0	-3.4	1.2	0.009
% of State on Medicaid in 1990	8.6	8.8	-0.2	0.7	0.787
% of State Uninsured in 1990	11.5	13.3	-1.8	1.1	0.107
% of Prime-Aged Males in State on Medicaid in 1990	3.2	3.0	0.1	0.4	0.724
% of Prime-Aged Males in State Uninsured in 1990	15.3	17.8	-2.5	1.3	0.074

Notes: The data on health insurance coverage come from the Current Population Survey's Annual Social and Economic Supplement. For cities that span multiple states, the values shown are means weighted by the share of cities' population in each state.

Table A.5: The Effect of Title 1 Status on HIV/AIDS Death Rates from Alternative Samples

	Number of Cities	(1)	(2)
Baseline	50	-0.185	-0.163
		(0.069)	(0.075)
		[0.010]	[0.036]
n		950	1,550
All Cities in AIDS Public Information Data Set	102	-0.184	-0.196
		(0.052)	(0.056)
		[0.001]	[0.001]
n		1,938	3,162
30 Cities Closest to Original Threshold on Both Sides of Threshold	60	-0.165	-0.152
		(0.065)	(0.069)
		[0.014]	[0.032]
n		1,140	1,860
20 Cities Closest to Original Threshold on Both Sides of Threshold	40	-0.163	-0.164
		(0.089)	(0.092)
		[0.076]	[0.083]
n		760	1,240
Excluding 5 Cities Closest to Original Threshold on Both Sides of Threshold	40	-0.220	-0.167
		(0.089)	(0.098)
		[0.018]	[0.096]
n		760	1,240
Replacing Subsequent Title 1 Cities in Sample	50	-0.191	-0.161
		(0.063)	(0.071)
		[0.004]	[0.028]
n		950	1,550
Excluding 1994–1996 and Cities Obtaining Title 1 Status before 1994	47	-0.199	-0.160
		(0.088)	(0.093)
		[0.029]	[0.092]
n		765	1,305
Years		1988-2006	1988-2018

Notes: Each cell displays the effect of Title 1 status from separate regressions of Equation (1). The unit of observation is a city and year combination. The dependent variable is the log of HIV/AIDS deaths per 100,000 people. Numbers of HIV/AIDS deaths each year come from the Vital Statistics Mortality data. All regressions include city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. Standard errors are clustered by city and are shown in parentheses. P-values are shown in brackets.

Table A.6: Callaway and Sant'Anna and Effects over Time

	D.V.: Log(HIV/AIDS Deaths per 100,000 People)			D.V.: Log(AIDS Diagnoses per 100,000 People)		
	Baseline	Callaway and Sant'Anna		Baseline	Callaway and Sant'Anna	
	(1)	(2)	(3)	(4)	(5)	(6)
Average Treatment Effect, All Years	-0.163	-0.231		-0.248	-0.312	
	(0.075)	(0.078)		(0.055)	(0.075)	
	[0.036]	[0.003]		[0.000]	[0.000]	
Average Treatment Effect, before 1996			-0.078			-0.153
			(0.062)			(0.071)
			[0.205]			[0.030]
Average Treatment Effect, 1996-2006			-0.203			-0.308
			(0.071)			(0.062)
			[0.004]			[0.000]
Average Treatment Effect, 2007-2018			-0.276			-0.347
			(0.099)			(0.110)
			[0.005]			[0.002]
Number of Cities	50	50	50	46	46	46
Mean of D.V. in Levels	6.3	6.3	6.3	13.4	13.4	13.4
n	1,550	1,550	1,550	1,426	1,426	1,426

Notes: Each column displays the effect of Title 1 status on the indicated dependent variable from separate regressions of Equation (1). The unit of observation is a city and year combination. Columns 1 and 4 report the baseline estimates. Column 2, 3, 5, and 6 report estimates using the methods described in Callaway and Sant'Anna (2021), with average estimates calculated as the weighted mean of group-specific estimates, where weights equal to the groups' share of the treatment observations. All regressions include city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. Numbers of HIV/AIDS deaths each year come from the Vital Statistics Mortality data. Numbers of new AIDS diagnoses come from the CDC. Standard errors are clustered by city and are shown in parentheses. P-values are shown in brackets.

Table A.7: Regression Discontinuity Estimates of the Effect of Title 1 Status on HIV/AIDS Deaths and AIDS Diagnoses

	(1)	(2)	(3)
Panel A. Log(HIV/AIDS Deaths from 1996 to 2006)			
	-0.327	-0.246	-0.344
	(0.189)	(0.205)	(0.198)
	[0.090]	[0.231]	[0.089]
n	50	46	46
Panel B. Log(HIV/AIDS Deaths in 1990)			
	-0.049	0.004	-0.090
	(0.141)	(0.146)	(0.151)
	[0.730]	[0.980]	[0.552]
n	50	45	45
Panel C. Log(AIDS Diagnoses from 1996 to 2006)			
	-0.408	-0.374	-0.430
	(0.147)	(0.168)	(0.153)
	[0.008]	[0.026]	[0.008]
n	46	44	44
Panel D. Log(AIDS Diagnoses in 1990)			
	-0.017	-0.031	0.015
	(0.078)	(0.101)	(0.095)
	[0.827]	[0.757]	[0.874]
n	46	28	28
Approach	Linear Polynomial	Local Linear Regression	Linear Polynomial
Sample	Baseline	Optimal Bandwidth	Optimal Bandwidth

Notes: Each cell displays the effect of Title 1 status on the indicated dependent variable from separate regressions. The unit of observation is a city. The regressions in columns 1 and 3 control for the log of AIDS cases reported by March 31, 1995, and the log of AIDS cases reported by March 31, 1995, interacted with an indicator variable for having reported at least 2,000 AIDS cases by March 31, 1995. Column 2 displays estimates of the effect of Title 1 status from using local linear regression with a triangular kernel. The sample for column 1 is the cities in the main sample with non-missing information. The samples for columns 2 and 3 are the cities within the mean squared error optimal bandwidth. Numbers of HIV/AIDS deaths each year come from the Vital Statistics Mortality data. Numbers of new AIDS diagnoses come from the CDC and are non-missing for 93 of the cities in the AIDS Public Information Data Set. Robust standard errors are shown in parentheses. P-values are shown in brackets.

B Estimating the Effect of Title 1 Status Using Variation in Title 1 Status from the 2006 Ryan White CARE Act Reauthorization

As described in the main text, the primary analysis defines the Title 1 status treatment variable as an indicator variable equal to one for cities obtaining Title 1 status under the original rules for Title 1 eligibility. The 2006 Ryan White CARE Act reauthorization changed the eligibility rules to allow some cities on the worst HIV/AIDS trajectories to obtain Title 1 status. In this appendix, I first show that estimating a naive difference-in-differences model that uses variation in Title 1 status from the 2006 reauthorization to identify the impact of Title 1 status without accounting for pre-existing trends would wrongly attribute the worsening HIV/AIDS outcomes associated with these cities qualifying for Title 1 status in 2007 as being part of the effect of Title 1 status. I then show that estimating a specification that accounts for city-specific time trends provides further evidence that Title 1 status reduces HIV/AIDS deaths.

For this analysis, I focus on the five cities obtaining Title 1 status in 2007 after the eligibility rules were changed. These cities are Baton Rouge, Charlotte, Indianapolis, Memphis, and Nashville. I include as the control cities the 25 cities with the most AIDS cases reported by 1995 that did not achieve Title 1 status before the 2006 Ryan White reauthorization and focus on years 1998 to 2018.[1]

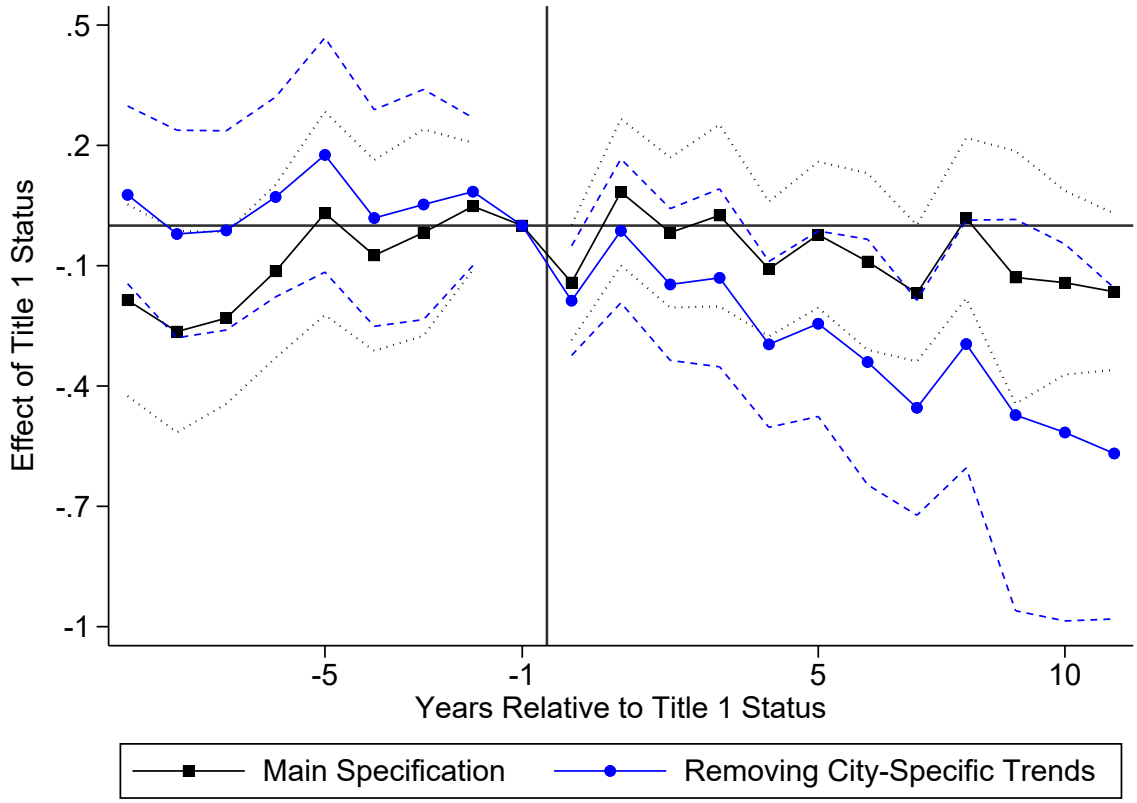
The black squares in Figure B.1 show estimates of duration-specific effects of Title 1 status from a single regression of Equation (1). The estimates indicate HIV/AIDS death rates for the cities that obtained Title 1 status in 2007 were increasing in the early 2000s relative to other cities. Within a few years of these cities obtaining Title 1 status in 2007, HIV/AIDS death rates begin to fall relative to non-Title-1 cities. This profile of estimates is consistent with the evidence in the main text that Title 1 status reduces HIV/AIDS deaths. However, the pre-existing trend towards more HIV/AIDS deaths for the 2007 Title 1 cities means that the parallel trends assumption required for difference-in-differences models is violated and that the baseline estimating equation will not yield valid estimates of the impact of Title 1 status. Table B.1 displays the estimated effect of Title 1 status from Equation (1). The point estimate is positive and statistically insignificant.

To account for the differential pre-trends, I remove the trends from the dependent variable and then estimate Equation (1) using the measure with the trends removed as the dependent variable. To remove the trends, I first estimate Equation (1) supplemented with 30 city-specific linear time trends using data from years 1998 to 2006. I then calculate the residuals for years 1998 to 2018, which is equivalent to removing the time trend from the logged HIV/AIDS death rates. Finally, I re-estimate Equation (1) with the residuals as the dependent variable.

[1] I exclude Columbus, which obtained Title 1 status in 2013, though a similar analysis could also be done to estimate the impact of Title 1 status on Columbus.

The blue series in Figure B.1 displays the coefficients on years relative to Title 1 status with the de-trended measure as the dependent variable. Column 2 of Table B.1 displays the estimate of the average impact of Title 1 on this de-trended variable. Once the differential trends that led to certain cities obtaining Title 1 status are accounted for, the estimates follow a similar pattern as the estimates of Title 1 status presented in the main text. The estimate in Table B.1 indicates that Title 1 status leads to a reduction in HIV/AIDS death rates of 0.318 log points, or approximately 27 percent.

Figure B.1: Relationship between Title 1 Status and HIV/AIDS Death Rates for Cities Obtaining Title 1 Status in 2007



Notes: Each marker is a coefficient on Title 1 status interacted with number of years from initial Title 1 status eligibility with the log of HIV/AIDS death rates as the dependent variable. The x-axis indicates the number of years from Title 1 status. The y-axis indicates the coefficient estimate. The sample contains 630 observations from 30 cities from 1998 to 2018. The regression for the blue circles accounts for city-specific linear time trends, while the regression for the black squares does not. Each regression includes city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. The dashed lines indicate 95% confidence intervals calculated using standard errors clustered by city.

Table B.1: Estimated Effect of Title 1 Status Using Variation in Title 1 Status from 2006 Ryan White CARE Act Reauthorization

	(1)	(2)
	0.019	-0.318
	(0.093)	(0.135)
	[0.841]	[0.025]
Years	1998-2018	1998-2018
Accounts for City-Specific Linear Trend		x
Number of Cities	30	30
n	630	630
Mean of D.V. in Levels	4.0	4.0

Notes: Each column displays the effect of Title 1 status from separate regressions of Equation (1). The unit of observation is a city and year combination. The dependent variable is the log of HIV/AIDS deaths per 100,000 people. Numbers of HIV/AIDS deaths each year come from the Vital Statistics Mortality data. All regressions include city fixed effects, year fixed effects, and controls for the share of cities' residents who are Black, Hispanic, younger than 18, 65 and older, and male. Standard errors are clustered by city and are shown in parentheses. P-values are shown in brackets.

C Additional Details on Relationship between Title 1 and Title 2 Funding

Title 1 and Title 2 of the Ryan White CARE Act jointly account for nearly 90% of all Ryan White funds. Ever since the Ryan White program began in 1991, Title 1 funding has been allocated independently of funding from the other titles. In the original Ryan White CARE Act, Title 2 funds were also allocated completely independently of other sources of funds. Title 1 and Title 2 both being based on AIDS cases and both being determined independently of each other led to each AIDS case in a Title 1 city being counted twice, once for Title 1 funding and once for Title 2 funding. While subsequent Ryan White reauthorizations have implemented provisions to offset this double counting, the offset has always been partial. This double counting is relevant for this study because differences in Title 1 funding would not have led to health differences if other sources of HIV/AIDS funding fully compensated for the differences in Title 1 funding. The main manuscript focused on understanding the effect of eligibility for Title 1 funds and then discussed the implied cost in Title 1 funds per life saved. The rules that partially offset the double counting of AIDS cases for Titles 1 and 2 mean that the cost to save a life through the Ryan White CARE Act could be lower than the cost implied by only focusing on Title 1 funding. In this appendix, I provide an expanded discussion of the relationship between Title 1 funding and Title 2 funding. I first describe the primary, direct ways that Title 1 funding can affect Title 2 funding.[2] I then describe an empirical approach that assesses the impact of a Title 1 dollar going to a city on a state's Title 2 funding.[3]

For all of Ryan White's history, an AIDS case has increased Title 1 funding only if the AIDS case has occurred in a Title 1 city. Under the original Ryan White CARE Act rules, an AIDS case in a Title 1 city would generate the same amount of additional Title 2 funding for a state as an AIDS case outside of a Title 1 city. Thus, an additional AIDS case in a Title 1 city under the original rules increased total Title 1 and Title 2 money going to the city and state by the amount of the extra Title 1 money the Title 1 city received. The 1996 reauthorization that largely froze Title 1 status at 1995 levels also changed the Title 2 allocation rules to account for Title 1. Unlike in the original Ryan White CARE Act, the 1996 reauthorization set aside

[2] I use the term "direct" to be clear that this discussion focuses on the statutory channels that were first put in place in the 1996 reauthorization. Title 1 funding can also have indirect effects on Title 2 funding as well as on subsequent Title 1 funding through improving HIV/AIDS outcomes, which could reduce subsequent funding based on contemporaneous HIV/AIDS outcomes.

[3] In principle, if one had complete information on all parameters used to determine Title 2 allocations, it would be possible to calculate the impact of Title 1 funds on Title 2 funds using the Title 2 allocation rules. However, because Title 2 has minimum per-state funding amounts, different categories of funds, numerous inputs, a mixture of formula and discretionary funding, and changes to both formula structures and input definitions over time, the allocation of Title 2 funds is complex, and assessing the impact of an additional dollar of Title 1 funding on Title 2 funds through the allocation rules is challenging. For this reason, I opt to produce an empirical estimate of the offset rather than to attempt to calculate the offset from the allocation rules. For a discussion of how Title 2's complex allocation rules complicate efforts to determine the exact impact of Title 1 funding on Title 2 funds using the allocation rules, refer to HRSA administrator Elizabeth Duke's 2006 Congressional testimony about double counting in the Ryan White CARE Act (U.S. Congress Senate Committee on Health, Education, Labor, and Pensions 2006).

5% of Title 2 funding to be allocated to states proportionally based on their share of AIDS cases occurring outside of Title 1 cities, which led to an AIDS case in Title 1 cities generating less additional Title 2 funding than an AIDS case outside of Title 1 cities. As a rough example, if Ryan White allocations were based solely on AIDS prevalence, in 1997 an additional AIDS case in a Title 1 city under the original rules would have generated an additional $4,157 in Title 1 funding for the city and an additional $2,635 in Title 2 funding for the state. An additional AIDS case in a non-Title-1 city, meanwhile, would have generated no Title 1 money but would have still generated $2,635 in Title 2 funding for the state—the same amount of Title 2 funding generated by the AIDS case in the Title 1 city. The new rule in the 1996 reauthorization that set aside 5% of Title 2 funding for AIDS cases outside of Title 1 cities would not alter Title 1 funding, but it would mean that an additional AIDS case in a Title 1 city would have generated only $2,503 in Title 2 funding for the state while an additional AIDS case outside a Title 1 city would have generated an additional $2,919 for the state in Title 2 funding.

The 2000 reauthorization further adjusted Title 2 funding rules to set aside an additional $10 million of Title 2 funds to be allocated to non-Title-1 cities with at least 500 AIDS cases reported in the past five years. Of this $10 million, half is allocated proportionally based on AIDS cases for all cities with 500 to 999 AIDS cases reported in the past five years, while the other half is allocated proportionally for non-Title-1 cities with at least 1,000 AIDS cases reported in the last five years. Beginning in 2007, the funding formulas for both Title 1 and Title 2 funding began to be based on estimates of the number of people living with HIV rather than on AIDS measures.

Although these changes have preserved large disparities in Ryan White funding, if states fully offset the effect of Title 1 funds on Title 2 funds through directing less Title 2 funding to Title 1 cities, then the amount of federal spending required to avoid an HIV/AIDS death would be less than $334,000. To consider the potential offset amount, I assess the relationship between Title 1 funding and Title 2 funding from 1996 to 2018 empirically by estimating models of the following form:

$$Title2\_Dollars_{jt} = share\_AIDS_{jt}\alpha_t + Title1\_Dollars_{jt}\beta + \epsilon_{jt}, \tag{7}$$

where j indexes the state, t indexes the year, $Title2\_Dollars$ is the total Title 2 dollars the state receives in a year, $share\_AIDS$ is the state's share of all AIDS cases in the United States in a year (Centers for Disease Control and Prevention 2020*b*, 2021*b*), and $Title1\_Dollars$ is the total number of Title 1 dollars received by cities in the state in a year. A state's share of AIDS cases approximates the information used for Title 2 funding but without accounting for cities in the state receiving Title 1 funding. Thus, the coefficient on Title

1 dollars from Equation (7) is an estimate of how much less additional Title 2 money a Title 1 city generates for each dollar of Title 1 money it receives.

The coefficient on $Title1\_Dollars$ from estimating Equation (7) is -0.122 (SE: 0.042; p-value: 0.004). While AIDS cases in Title 1 cities generate additional Title 2 dollars for the state, this estimate implies that each dollar of Title 1 funding in years 1996 to 2018 is associated with $\$0.122$ less in additional Title 2 funding after accounting for states' AIDS burdens. Under the assumption that states direct Title 2 funds entirely based on where they were generated, this impact translates to an additional dollar of Title 1 funding generating $\$0.878$ of additional Ryan White funding for the city.[4] When the sample is restricted to the 34 states with cities in the main sample, the estimated coefficient on Title 1 is similar at -0.124 (SE: 0.050; p-value: 0.013), which implies each additional dollar of Title 1 funding generates an additional $\$0.876$ of Ryan White funding for the city.

The main text described a back-of-the-envelope calculation that indicated that an HIV/AIDS death was avoided for every $334,000 of Title 1 funding allocated. Next, I recalculate the implied cost per life saved assuming that Title 1 funds from 1996 to 2018 increased cities' Ryan White funding by 87.6%—the amount implied from estimating Equation (7) with the sample of states with cities in the baseline sample. Under this assumption, the estimated impact of Title 1 eligibility from the main text implies that one HIV/AIDS death was avoided by Title 1 for every $295,179 of additional Ryan White funding it led to Title 1 cities receiving.

Interactions between Title 1 funding and Title 2 funding are natural to consider because they are both part of the Ryan White CARE Act and because an impact of Title 1 funding on Title 2 funding is explicitly written into the law. However, it should be emphasized that just as infectious diseases can have widespread effects, programs that treat infectious diseases can also have widespread effects. For example, by preventing people from developing HIV or AIDS, HIV/AIDS funding would be expected to reduce both Medicaid and Medicare spending on HIV/AIDS since these programs would likely eventually have to pay for at least part of the HIV/AIDS treatment. However, by causing people with HIV to stay alive until they are eligible for Medicare at age 65, HIV/AIDS funding can also eventually increase Medicare's costs. Note that while programs that target infectious diseases are particularly likely to have spillover implications for other sources of government spending, government health programs more broadly also have complex interactions with each other. Consider, for example, the impact that Medicaid can have on Medicare. By avoiding deaths before age 65, Medicaid will eventually lead to more people receiving Medicare, which

[4] That is, the estimate implies that the net change in a city's Ryan White funding from an additional dollar of Title 1 funding is $\$0.878$ under the following assumption: If an AIDS case in a Title 1 city generates $\$X$ of Title 2 funding and an AIDS case in a non-Title-1 city generates $\$Y$ of Title 2 funding, then the state directs $\$X$ of Title 2 funding to the Title 1 city and $\$Y$ of Title 2 funding to the non-Title-1 city.

will increase Medicare costs. But to the extent that prevention or early treatment can lower long-run costs, Medicaid also has the potential to decrease Medicare costs if it provides treatment that lowers long-run costs.

To summarize this appendix, for Title 1 funding to affect HIV/AIDS outcomes, additional Title 1 funding must not be completely offset by decreases in other types of HIV/AIDS funding. While the main analysis focused on estimating the impact of an indicator variable for a city being eligible for Title 1 funds, Section 4 also described a back-of-the-envelope calculation of the amount of Title 1 funding allocated per life saved. Ryan White reauthorizations have put rules in place to partially offset the double counting of an AIDS case for Title 1 and Title 2 funding. Thus, while an AIDS case in a Title 1 city has generated both Title 1 funding and Title 2 funding throughout the Ryan White CARE Act's history, it has generated less additional Title 2 funding than an AIDS case outside of a Title 1 city does for much of Ryan White's existence. This decrease in Title 2 funding to partially offset the increase in Title 1 funding means that the amount of Ryan White funding required to avoid an HIV/AIDS deaths is likely less than the amount of Title 1 funding allocated per life saved. This appendix discussed how Title 1 funding affects Title 2 funding and produced estimates of the impact of an additional dollar of Title 1 funding on total additional Ryan White funding. I then used this estimate to produce a back-of-the-envelope calculation of the amount of Ryan White funding required to avoid an HIV/AIDS death. This analysis indicates that Title 1 avoided an HIV/AIDS death for approximately every $295,000 additional Ryan White dollars received by Title 1 cities, which is less than the baseline calculation for Title 1 funds alone but not dramatically so.