The purpose of this appendix is to provide more details of the methods used in these analyses and a more complete description of the results. Specifically, in this appendix, we provide the following information:

1. Additional details of the STI funding data
2. Our examination of the optimal lag length to include in the model
3. Coefficient interpretation and methods for calculating SEs for cumulative effects
4. Full results from the main regression models
5. Additional results stratified by age
6. Results when applying alternate model specifications

1. DATA

STI prevention funding allocations were obtained from unpublished records of the Division of STD Prevention (DSTDP), Centers for Disease Control and Prevention (CDC). The STI prevention funding allocations applied in this study included financial support to all 50 states and the District of Columbia for STI prevention but excluded direct assistance (e.g., the provision of federal staff to serve as Disease Intervention Specialists). Support for research activities, such as evaluation activities and the Gonococcal Isolate Surveillance Project (GISP), was not included.

Funding allocations from 1975 to 1999 were as described in Chesson et al (2005), except that direct assistance was excluded. Briefly, the funding allocations for 1975 to 1999 included the base award, awards for the Infertility Prevention Project (IPP, beginning in 1994) and syphilis elimination awards (beginning in 1998). Data from 2000 to 2016 were compiled from DSTDP records in a manner similar to the compilation of the funding data in the Chesson et al (2005) study. Owing to data limitations, funding allocations in some years were based on records of proposed allocations, under the assumption that the available preliminary budget records are a close match to the actual funding allocated in those years. Funding allocations for 2000 and 2001 were extrapolated as follows. Given that base funding was quite stable from 1999 to 2001, and owing to a lack of data on IPP awards in 2000 and 2001, funding allocations in 2000 and 2001 were calculated assuming that base funding and IPP allocations were constant from 1999 to 2001. Specifically, the total funding allocation for each project area was calculated for 2000 based on the 1999 allocation, plus the change in syphilis elimination funding from 1999 to 2000. The allocation for 2001 was calculated in an analogous manner. For 2002 to 2013, the funding allocation was obtained from historical records, and included the “Comprehensive STD Prevention Services (CSPS)” base award, plus the following (if applicable): CSPS supplements, IPP awards, syphilis elimination awards (and supplements), and supplemental awards for enhanced prevention among men who have sex with men (MSM). From 2014 to 2016, the allocations were obtained from records of funding for STD AAPPS (Improving Sexually Transmitted Disease Programs through Assessment, Assurance, Policy Development, and Prevention Strategies) Part A. We focused on Part A allocations to be consistent with our approach of excluding supplemental funding for research activities, such as evaluation activities and GISP.

2. CHOICE OF LAG LENGTH

A number of technical and practical considerations led to the preferred choice of 2 lags of the funding variable in the distributed lag models. First, funding data was available starting from 1975, while reported gonorrhea case data began in 1981. Given the availability of funding data 6 years prior to the start of national gonorrhea case reporting, we initially decided to evaluate up to 6 years of lagged STI prevention funding. Including lags beyond 6 years would have required cutting additional years from the full panel, and funding from more than 6 years prior is unlikely to explain variation in contemporaneous STI rates beyond that which is explained by more recent funding, so 6 was the maximum lag length considered. Still, it was possible that including fewer than 6 lags would be most appropriate in our setting. To investigate this, we estimated separate regressions with lag lengths ranging from 1–6 and compared the results. If the size and significance of the cumulative effect stops increasing as more lags are added, this is evidence that it is reasonable to exclude those lags from the analysis. Another, more technically sophisticated, method to choose the appropriate lag is to compare model performance via information criteria. Two commonly used criteria are Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (SBIC). Both criteria are functions of the model log-likelihood, and smaller values indicate better model fit. These criteria and estimated cumulative effects are presented in Appendix Table 1 for various lag lengths.

Appendix Table 1. Assessment of the Appropriate Lag Length for Evaluating the Impact of STI Prevention Funding on Overall Gonorrhea and Chlamydia Rates

Number of funding lags	Cumulative effect	SE	*p*-value	AIC	SBIC
Gonorrhea					
0	–0.21	0.09	0.02	605	826
1	–0.28	0.11	0.01	595	826
2	–0.33	0.13	0.01	589	826
3	–0.34	0.13	0.02	590	833
4	–0.36	0.15	0.02	591	839
5	–0.37	0.16	0.02	590	838
6	–0.40	0.17	0.02	591	850
Chlamydia					
0	–0.02	0.05	0.72	–1,929	–1,829
1	–0.09	0.08	0.26	–1,936	–1,831
2	–0.17	0.10	0.09	–1,944	–1,834
3	–0.19	0.12	0.12	–1,943	–1,828
4	–0.15	0.14	0.28	–1,944	–1,825
5	–0.15	0.15	0.32	–1,942	–1,818
6	–0.15	0.15	0.33	–1,940	–1,811

STI, sexually transmitted infection; AIC, Akaike's information criterion; SBIC, Schwarz's Bayesian information criterion.

For gonorrhea outcomes, the AIC and SBIC were both minimized when including 2 funding lags. For chlamydia, the AIC and SBIC were minimized at 1 and 2 lags, respectively. The cumulative effect had a slight increase from 2 to 6 lags for gonorrhea rates, but peaks for chlamydia at 3 lags. However, for chlamydia the cumulative effect term was only significant at the 10% level when including 2 lags. Consequently, 2 years of lagged funding was chosen as the preferred specification for consistency.

3. SE CALCULATION FOR CUMULATIVE EFFECTS AND COEFFICIENT INTERPRETATION

To derive formal SEs for the cumulative effect, we estimated the following model:

$$Ln\left(Rate_{i,t}\right) = \theta_1 Ln\left(Funding_{i,t}\right) + \sum_{1}^{K} \theta_{1+k}\left[Ln\left(Funding_{i,t-k}\right) - Ln\left(Funding_{i,t}\right)\right] + State_i + Year_t + State_i \times Trend + \varepsilon_{i,t}$$

(for K=2 in our main models). The coefficient θ_1 will equal $\beta_1 + \beta_2 + \cdots + \beta_K$ from equation (1) in the main paper, and standard statistical inference can be made on θ_1 .[2]

There are multiple ways to conceptualize the cumulative effect, θ_1. First, consider a permanent 1% increase in funding starting in year t-k. In this case, funding increases by 1% in the starting year and is maintained at that same, higher level in the following years. The cumulative effect is the percent change in Rate in year t associated with this permanent increase. In other words, it is the effect in the current year of the additional funding this year, the additional funding last year, and the additional funding every previous year up to the start of the permanent increase. Alternatively, consider a one-time 1% increase in year k. In this case, funding increases in year k but reverts to the previous base level in the following years. The cumulative effect of this funding change will equal its effect on Rate in year t-k (β_K), plus its effect on Rate in each of the following years until the one time change no longer has any influence on Rate.

For equation (1) in the main paper, the exact percent change in *Rate* for coefficient β_1 is given by $\left\{e^{\beta_1 \Delta Ln(Funding)} - 1\right\}$. For small changes in funding, the coefficient β_1 is approximately equal to this percent change. For larger changes, the exact equation can be used, but the resulting calculation differs depending on the direction (positive or negative) of the funding change. Directly interpreting β_1 as the percent change is common practice in economics research.[2]

4. MAIN REGRESSION MODEL: FULL RESULTS

Appendix Table 2. Full Results From Main Regression Model. Estimated Percent Change in Rates of Reported Chlamydia and Gonorrhea Cases Associated With a One Unit Change in the Covariate

Variables	**Gonorrhea % change (SE)**			**Chlamydia % change (SE)**		
	Male	**Female**	**Overall**	**Male**	**Female**	**Overall**
Funding						
Log($Funding_{t}$)	–0.0842 (0.0646)	–0.110 (0.0697)	–0.0960 (0.0657)	–0.0179 (0.0839)	0.0250 (0.0425)	0.0172 (0.0470)
Log($Funding_{t-1}$)	**–0.130**** (0.0565)	**–0.103*** (0.0548)	**–0.115**** (0.0547)	–0.0982 (0.0764)	–0.0411 (0.0713)	–0.0510 (0.0678)
Log($Funding_{t-2}$)	**–0.126**** (0.0523)	**–0.104**** (0.0517)	**–0.114**** (0.0508)	**–0.209**** (0.0835)	–0.102 (0.0614)	**–0.137**** (0.0616)
Cumulative effect	**–0.341**** (0.131)	**–0.317**** (0.123)	**–0.325**** (0.126)	**–0.325**** (0.127)	–0.118 (0.100)	**–0.171*** (0.0990)
Covariates						
Poverty	**–2.603***** (0.743)	**–1.499**** (0.670)	**–2.116***** (0.680)	–0.543 (0.676)	–0.233 (0.406)	–0.343 (0.437)
Violent crime	**0.0907***** (0.0339)	**0.0901***** (0.0301)	**0.0891***** (0.0320)	–0.0231 (0.0269)	0.00299 (0.0150)	–0.00244 (0.0159)
Percent white	–1.702 (3.764)	–0.653 (4.104)	–0.938 (3.741)	3.245 (2.083)	0.344 (1.426)	0.750 (1.406)
Percent ages 15–24 years	7.231 (4.530)	–0.994 (4.802)	3.616 (4.584)	2.160 (2.543)	1.787 (1.544)	1.678 (1.586)
Percent ages 25–44 years	**15.14***** (5.162)	**10.90*** (5.773)	**13.24**** (5.276)	–4.041 (3.025)	–0.766 (1.143)	–1.778 (1.385)
Constant	**–428.6***** (38.00)	**–280.7***** (63.07)	**–367.0***** (40.35)	**–170.5***** (19.14)	**–63.20***** (20.72)	**–97.49***** (19.28)
Observations	1,830	1,830	1,830	867	867	867
R-squared	0.820	0.739	0.794	0.912	0.869	0.899
Number of states	51	51	51	51	51	51

Notes: Models estimated using gonorrhea case report data during 1981–2016 and chlamydia case report data during 2000–2016, using the covariates in equation 1. We used distributed lag regression models to estimate the effect of STI prevention funding on reported STI case rates over time at the state level. The estimated cumulative effects of funding changes reflect the effects over current and 2 lagged years, as illustrated in Table 2 of the manuscript. Separate regressions were run for each outcome: reported rates of male gonorrhea, female gonorrhea, overall gonorrhea, male chlamydia, female chlamydia, and overall chlamydia. All models include State and Year fixed effects and a State-specific time trend. All funding variables are log-transformed. For the purposes of this study, Washington DC was considered a state. Robust SEs, clustered by state, are included in parentheses. Boldface indicates statistical significance (*p<0.1; **p<0.05; ***p<0.01).

STI, sexually transmitted infection.

The covariates in the model primarily serve as proxies for other unobserved determinants of STI rates, but their estimated coefficients are still worth mentioning. Finding that reported gonorrhea rates are more strongly associated with the percent of the population that is aged 25–44 years than the percent that is aged 15–24 years is unexpected, since the 15–24 year age group generally has higher reported STI rates. This finding likely arises in part because the 25–44 year age group has a larger population than the 15–24 year age group, and thus has a larger impact on overall gonorrhea rates than the 15–24 year age group. An alternate explanation is that relatively high growth in the population aged 15–24 years tends to occur in geographic areas that already have relatively high levels of reported STI rates, such as large urban areas. In this case, an increase in the population aged 15–24 years would have a larger absolute, but smaller relative, impact on reported STI rates than a similar increase in the population aged 25–44 years. To support this interpretation, we note that in an alternative model where reported gonorrhea rates are not log-transformed, the percent of the population in the 15–24 year age group is found to have a statistically significant effect that is larger than that of the 25–44 year group.

In the model evaluating gonorrhea, a positive association between crime and reported case rates is consistent with our expectations, but the negative coefficient on poverty is unintuitive. Although simple correlations between poverty and reported STI rates in the data are positive, the inclusion of state time trends and binary year variables in our empirical strategy results in a negative estimated relationship. The underlying causes of the negative coefficient are unclear, but omitting poverty from the regression has essentially no impact on the estimated cumulative effect of prevention funding on reported case rates.

As shown by the R-squared terms in Appendix Table 2, the models explained much of the state-level variation in reported STI rates. This is primarily due to the inclusion of binary state variables, binary year variables, and state time trends.

5. MAIN REGRESSION MODEL: STRATIFIED BY AGE

Appendix Table 3. Estimated Percentage Change in Rates of Reported Chlamydia and Gonorrhea Cases Associated With a 1% Change in STI Prevention Funding, by Age Group

Age group	**Gonorrhea**			**Chlamydia**		
	Male % change (SE)	**Female % change (SE)**	**Overall % change (SE)**	**Male % change (SE)**	**Female % change (SE)**	**Overall % change (SE)**
15–24 years	**–0.327**** (0.137)	**–0.296**** (0.121)	**–0.303**** (0.127)	**–0.288**** (0.137)	–0.122 (0.0968)	–0.153 (0.0972)
25–44 years	**–0.350***** (0.127)	**–0.356**** (0.133)	**–0.350***** (0.126)	**–0.342**** (0.133)	–0.112 (0.110)	**–0.194*** (0.108)

Notes: Models estimated using gonorrhea case report data during 1981–2016 and chlamydia case report data during 2000–2016, using the covariates in equation 1. We used distributed lag regression models to estimate the cumulative effect of STI prevention funding on reported STI case rates over time at the state level. Separate regressions were run for each infection and subpopulation. The estimated effects of funding changes reflect the cumulative effects over current and 2 lagged years, as illustrated in Table 3 of the manuscript. The two age groups were selected because ages 15 to 44 years account for the large majority of reported chlamydia and gonorrhea cases, and females under the age of 25 are targeted for screening. Rates for ages 15–24 were calculated as the number of cases among 15–24 year-olds divided by the 15–24 year-old population. Rates for ages 25–44 were calculated similarly. Boldface indicates statistical significance (*p<0.1; **p<0.05; ***p<0.01).

STI, sexually transmitted infection.

6. APPLICATION OF ALTERNATE MODEL SPECIFICATIONS

Results for alternative model specifications are included in Appendix Table 4. Each model uses reported male rates as the outcome variable since associations using reported male rates were strongest in the main regression models. First, a generalized linear model (GLM) using the Poisson family with a log-link function was estimated. Next, two additional OLS models were estimated: a linear model (without log-transformations of dependent variable and funding variables) and a log-log model without the State specific time trends ($State_i$ × Trend). All models control for state and year fixed effects. Some of the coefficient estimates are imprecise (p>0.1), but the results are broadly consistent with our preferred specification. For example, a 10 cent increase in per capita funding was associated with a 38.9 point decrease in reported male gonorrhea rates using the linear model. For chlamydia, the Poisson results indicate that a one percent increase in prevention funding is associated with a cumulative 0.23% decrease in reported male chlamydia rates.

In Appendix Table 5, the gonorrhea model was estimated first without including time-varying covariates and then with two additional covariates: male-to-female ratio and total population size. Since state geographic size is controlled for using state fixed effects, changes in total population serve as a proxy for changes in population density. This exercise shows that the choice of which covariates to include in the model does not have a substantial impact on the estimated results. The last four columns in Appendix Table 5 come from four separate regressions. The sample is divided in half based on the state having above or below state contributions to total state STI prevention funding, based on the analysis in Meyerson and Gilbert (2010). Two regressions, on the low and high state contribution samples, use gonorrhea as the outcome variable, and the other two use chlamydia as the outcome. Since we only used federal STI prevention funding in our analysis, this exercise allowed us to compare states that relatively high and low support from other funding sources. The results show that in states with high state funding, changes in federal funding have larger impacts on STIs. This could indicate that states with higher state contributions are using the federal funds more efficiently, or that state and federal funding complement each other and are both necessary for STI prevention. A limitation to this exercise is that the Meyerson and Gilbert (2010) paper only collected data for 2007 and relied on incomplete reporting of funding from states. Still, whether a state contributions are higher or lower than the national median is likely fairly consistent over time.

Appendix Table 4. Alternative Regression Specification Results: Coefficients Showing Estimated Cumulative Association Between STI Prevention Funding and Male Reported Gonorrhea and Chlamydia Rates

	Gonorrhea			Chlamydia			
Variable	**Poisson**	**Linear**	**Log–Log**	**Poisson**	**Linear**	**Log–Log**	**Log–Log 1996**
Funding		**–389.1****			–11.21		
		(162.8)			(36.25)		
Log (funding)	–0.0748		**–0.313*****	**–0.231***		0.0674	**–0.319*****
	(0.122)		(0.108)	(0.130)		(0.119)	(0.109)
State time trend	X	X		X	X		X
Observations	1,830	1,830	1,830	867	867	867	1,071
R-squared		0.886	0.785		0.868	0.861	0.929
Number of states	51	51	51	51	51	51	51

Notes: All models include State and Year fixed effects. For the purposes of this study, Washington, DC was considered a state. Separate regressions were run for gonorrhea and chlamydia. For the Log–Log models, exact percent change in rates from a one unit increase in STI prevention funding can be calculated as exp(coefficient)-1. Cluster-robust SEs in parentheses. Boldface indicates statistical significance (*p<0.1; **p<0.05; ***p<0.01).

Appendix Table 5. Alternative Regression Specification Results: Coefficients Showing Estimated Cumulative Association Between STI Prevention Funding and Male Reported Gonorrhea and Chlamydia Rates

	Gonorrhea				Chlamydia	
Variable	**No covariates**	**Additional covariates**	**High state contrib.**	**Low state contrib.**	**High state contrib.**	**Low state contrib.**
Log(funding)	–0.384**	–0.337**	–0.558***	–0.173	–0.344*	–0.300**
	(0.161)	(0.131)	(0.190)	(0.150)	(0.177)	(0.138)
Observations	1,830	1,830	933	897	546	525
R-squared	0.789	0.826	0.849	0.809	0.918	0.947
Number of states	51	51	26	25	26	25

Notes: All models include State and Year fixed effects and a state specific time trend. Separate regressions were run for gonorrhea and chlamydia. The "Additional covariates" column includes controls for male-to-female population ratio and total population. States are divided into high and low state contribution groups based on if their state contribution to the overall STD prevention budget is higher or lower than the median in Meyerson and Gilbert (2010). For the purposes of this study, Washington, DC was considered a state. Exact percent change in rates from a one unit increase in STI prevention funding can be calculated as exp(coefficient)-1. Cluster-robust SEs in parentheses. Boldface indicates statistical significance (**p*<0.1; ***p*<0.05; ****p*<0.01).

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