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## Online Appendix: The Returns to Public Library Investment

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### A Data Appendix

This appendix contains additional information on the datasets that we use in this project.

#### A.A Stanford Educational Data Archive

We use version 4.00 of the Stanford Educational Data Archive (SEDA) to track test scores for youth across time, as well as the characteristics of nearby local communities.

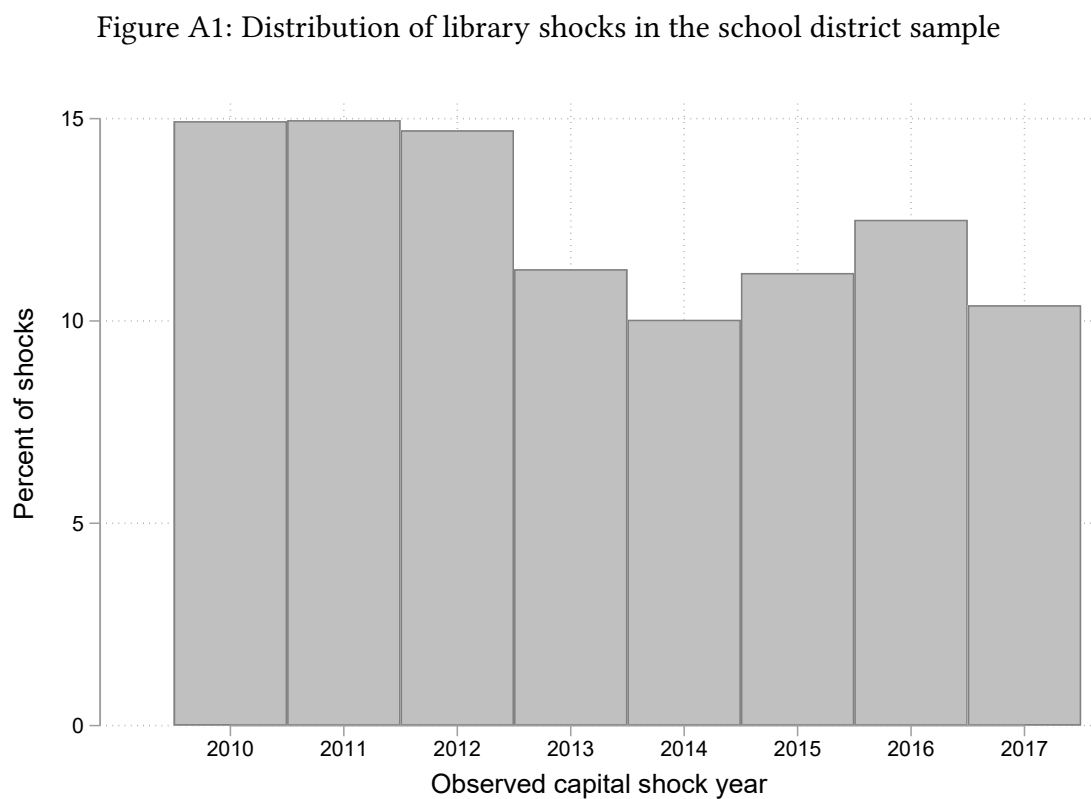
SEDA reflects an effort to standardize data reported by the states about the 3-8th graders and their performance on mandated language arts and math exams. In particular, Federal law requires these annual tests, but does not prescribe the exact form that they must take. States choose the format of their test and report the results as the number of students in each school who score above performance-based thresholds. The number of thresholds can vary by states and ranges from 2 to 5 cutoffs in our sample.

The staff that constructed SEDA have access to restricted data with full information of the number of students who scored above each threshold and their characteristics from 2008-2018. This is an improvement relative to publicly released data on *EDFacts* which suppresses information for small schools and student subgroups. SEDA staff clean these test scores and then estimate Heteroskedastic Ordered Probits to estimate the state-grade-subject specific test score cutoffs. They then standardize these cutoffs by linking them to information from the Nation's Report Card (NAEP). Since the NAEP is a common test across states, this process creates test scores that can be compared across states. More information on the construction of the test score data is given in Fahle et al (2021). SEDA standardizes test scores at the district-grade-subject-level; we do not observe individual-level school information in the SEDA data.

In addition to test scores, SEDA provides estimates of socio-demographic and economic characteristics of school districts drawn from the American Community Survey (ACS). We use

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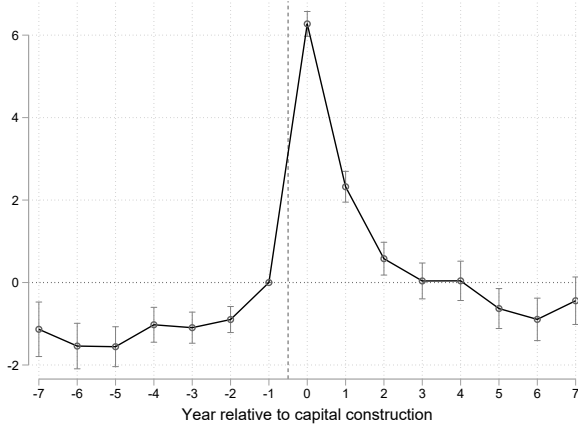
these ACS covariates in some of our analysis and robustness checks. The construction of these covariates and how they are mapped to school districts is described in greater detail in Fahle et al (2021).



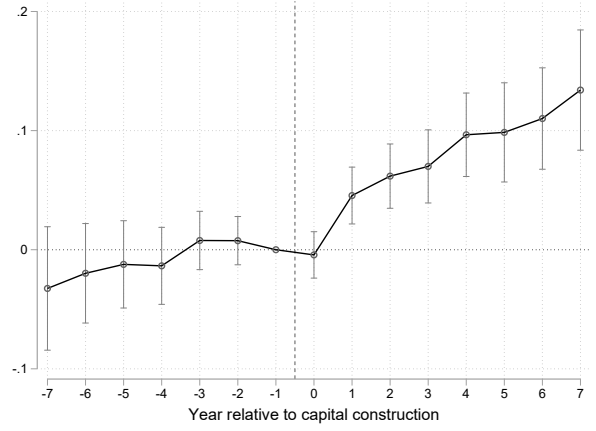
This figure shows the distribution of capital shock years in the school district sample for the sub-sample of districts with observed shocks. Approximately 7 percent of all districts have a shock between 2010 and 2017.

Figure A2: Impact of capital expenditure shock on library use, TWFE

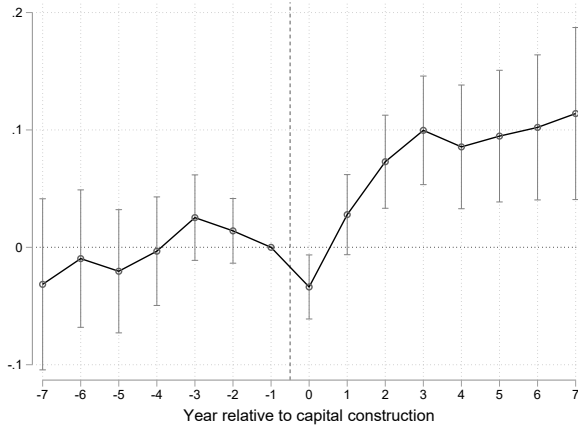
(A) Log capital spending



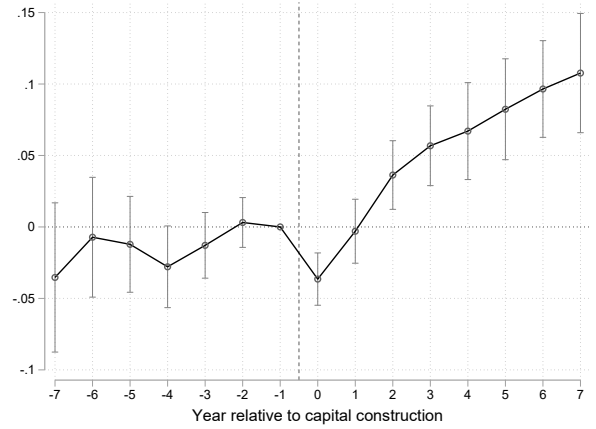
(B) Log children's circulation



(C) Log children event attendance



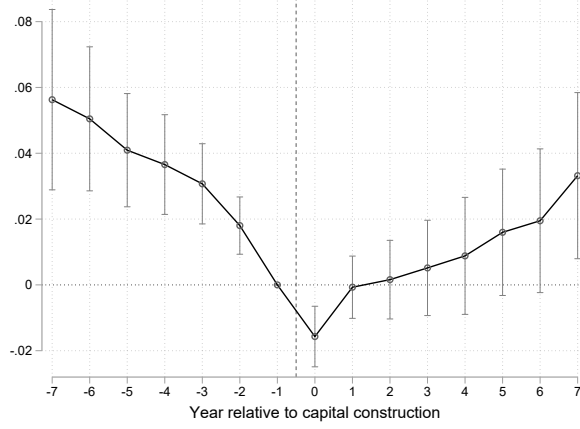
(D) Log visits



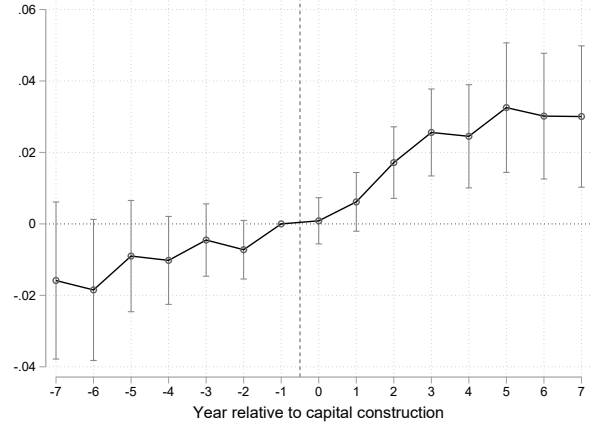
Event study estimates generated using the estimation procedure described in Section III with a standard two-way fixed effect approach instead of the Gardner approach used in our main figures. Outcomes are aggregated to the school district-level. The outcome variables are (A) Log capital spending, (B) log children's circulation, (D) log children's event attendance, and (D) log visits. All figures show 95 percent confidence intervals that account for within-school district clustering. Results are conditional on state-year fixed effects.

Figure A3: Impact of capital expenditure shock on library resources, TWFE

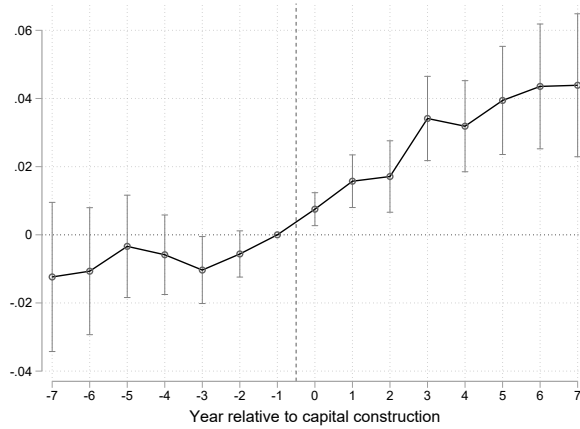
(A) Log book stock



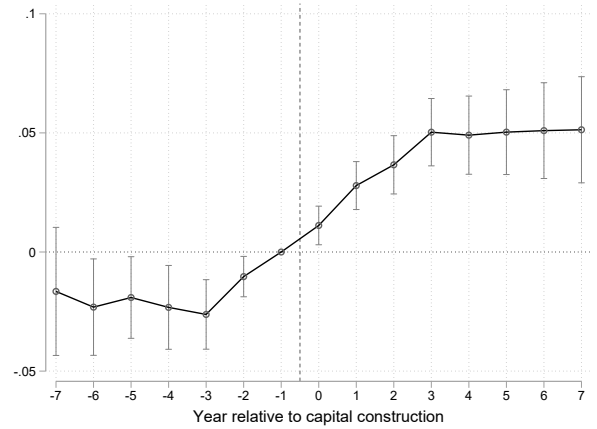
(B) Log number employees



(C) Log salary spending



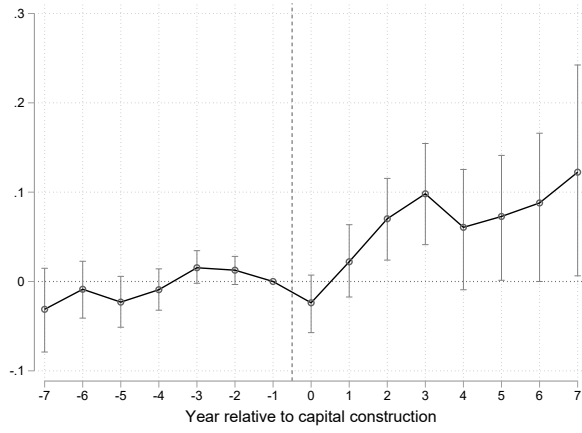
(D) Log operating spending



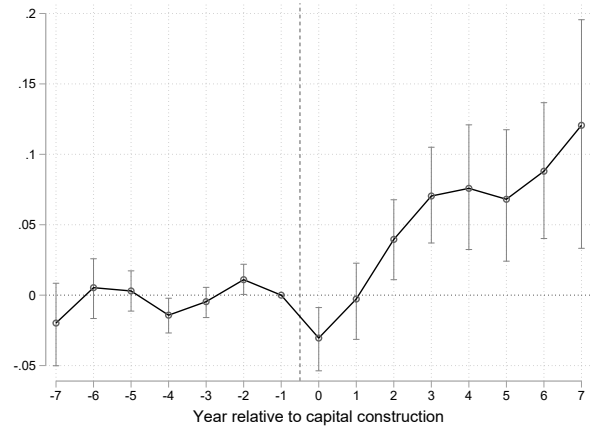
Event study estimates generated using the estimation procedure described in Section III with a standard two-way fixed effect approach instead of the Gardner approach used in our main figures. Outcomes are aggregated to the school district-level. The outcome variables are (A) log books, (B) log number employees, (C) log expenditures on salaries, and (D) log operating expenditures. All figures show 95 percent confidence intervals that account for within-school district clustering. Results are conditional on state-year fixed effects.

Figure A4: Impact of capital expenditure shock on library resources, intensive margin

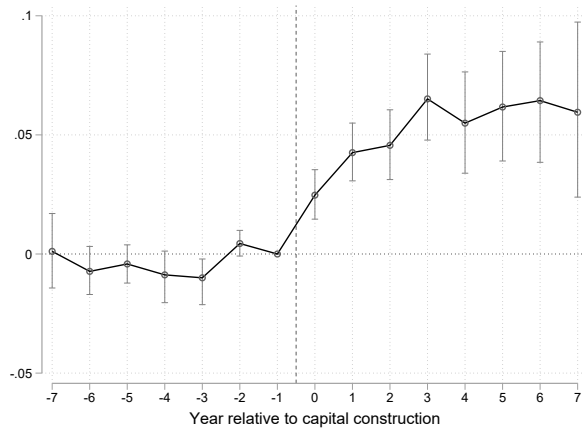
(A) Log children event attendance



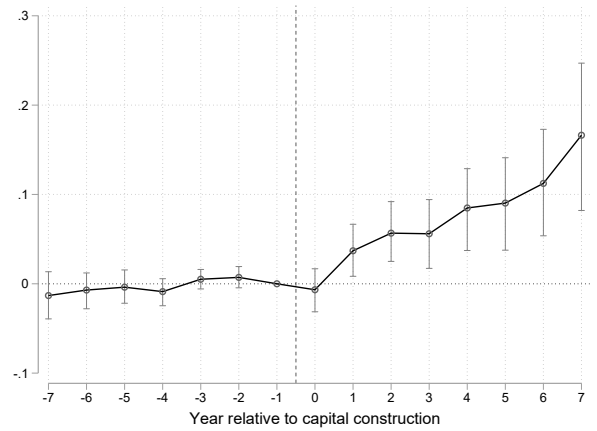
(B) Log visits



(C) Log operating spending



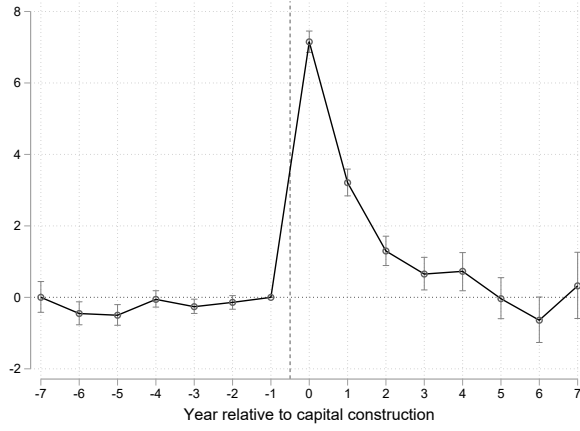
(D) Log children's circulation



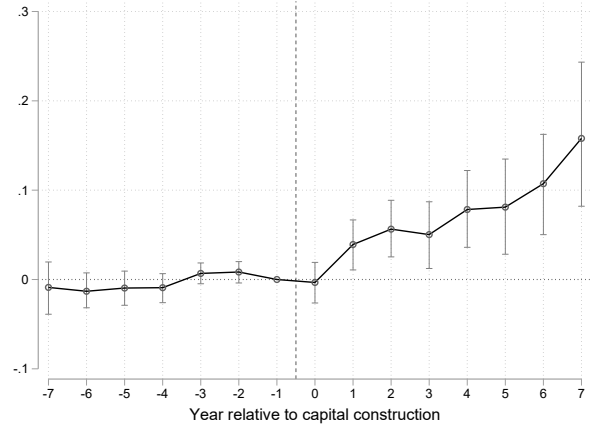
Event study estimates generated using the Gardner estimation procedure described in Section III. Outcomes are aggregated to the school district-level. The outcome variables are (A) log books, (B) log number employees, (C) log expenditures on salaries, and (D) log operating expenditures. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Results are conditional on state-year and district-grade fixed effects. Panel excludes observations where the outcome is zero (in levels).

Figure A5: Impact of capital expenditure shock on per user library use

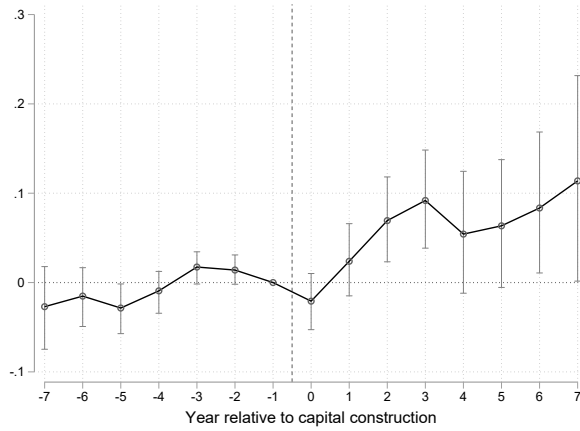
(A) Log capital spending



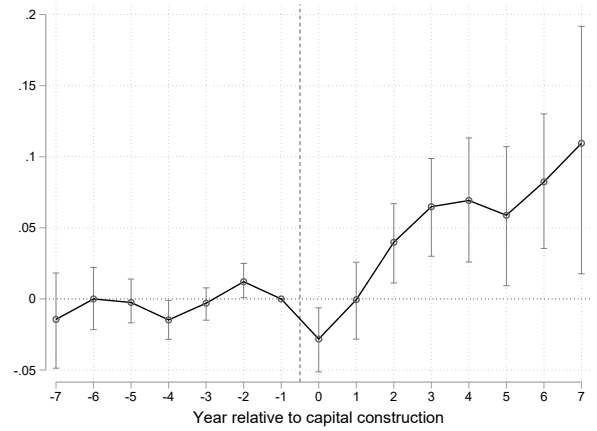
(B) Log children's circulation



(C) Log children event attendance



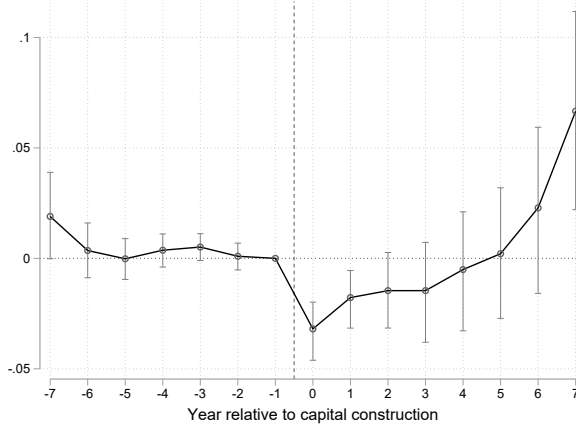
(D) Log visits



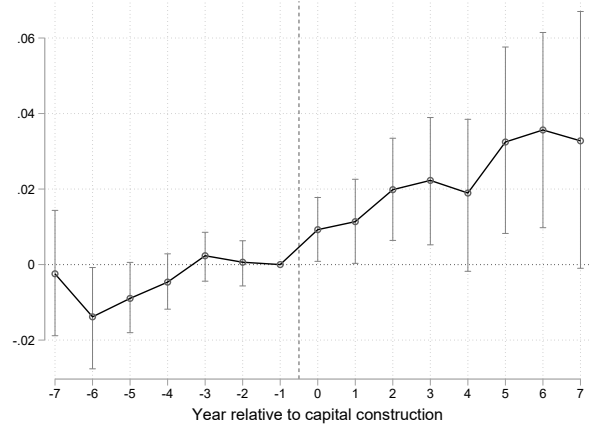
Event study estimates generated using the Gardner estimation procedure described in Section III. The outcome variables are (A) Log capital spending, (B) Log children's circulation, (D) log children's event attendance, and (D) log visits. All outcome variables are expressed as logged per-10,000-user figures. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

Figure A6: Impact of capital expenditure shock on per user library resources

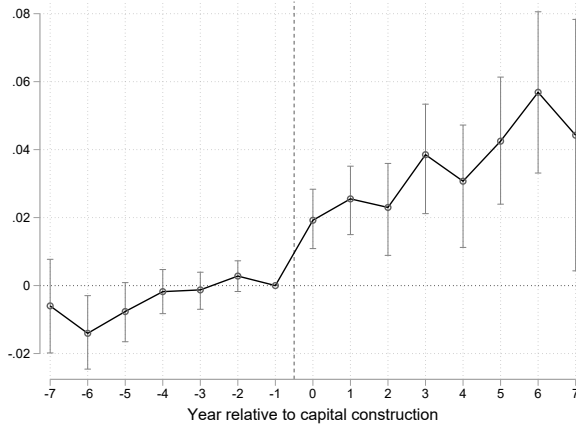
(A) Log book stock



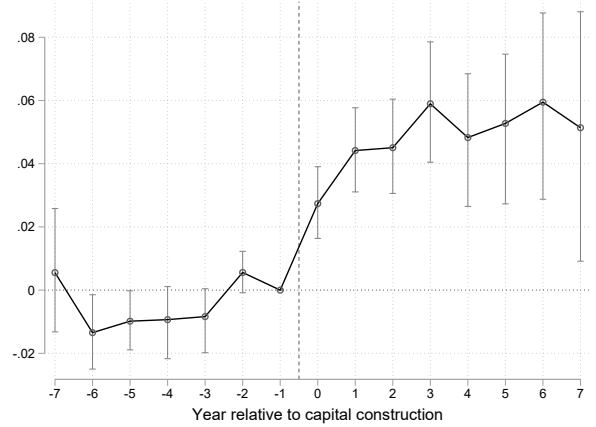
(B) Log number employees



(C) Log salary spending



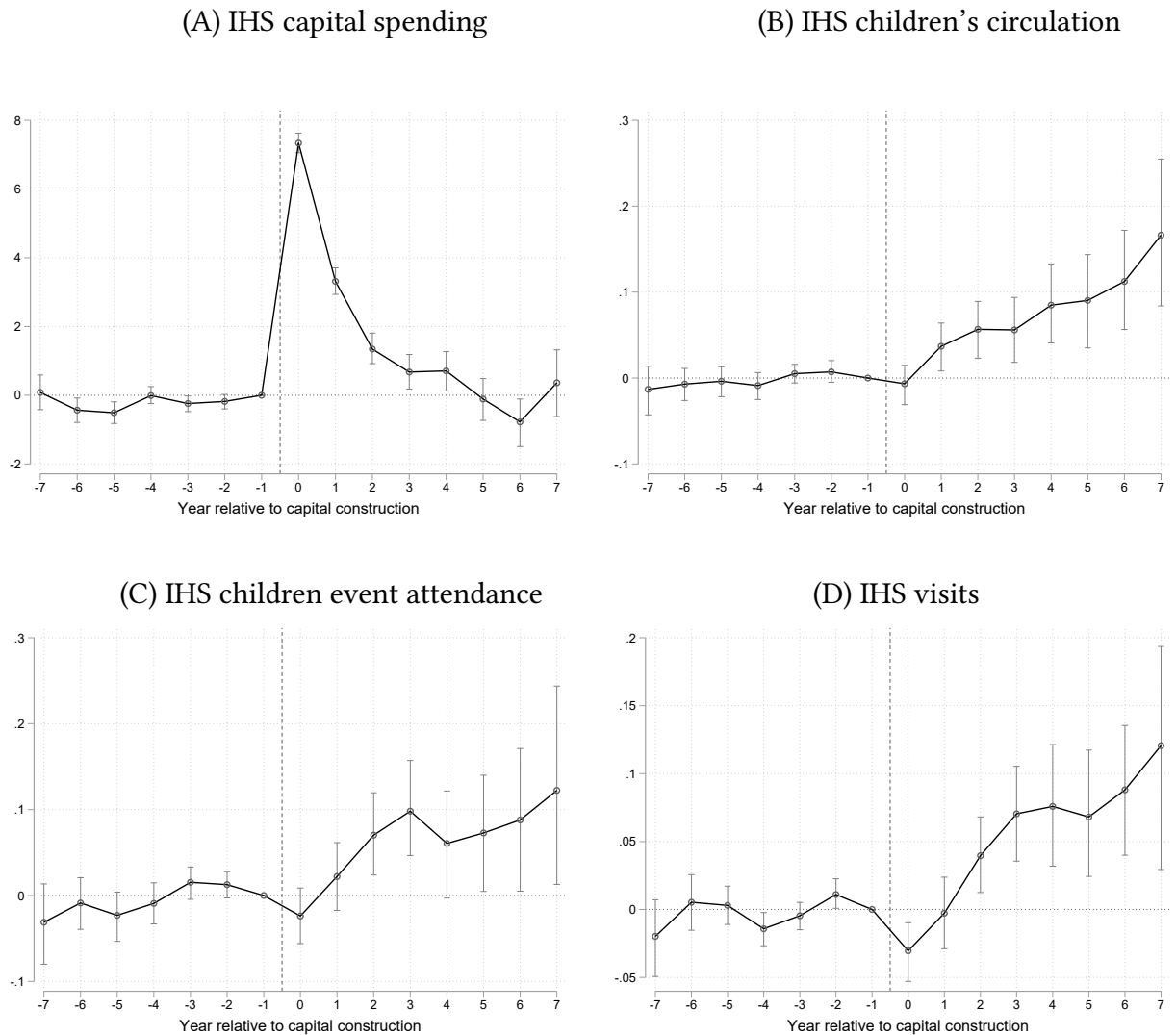
(D) Log operating spending



Event study estimates generated using the Gardner estimation procedure described in Section III. The outcome variables are (A) Log books, (B) Log number employees, (C) log expenditures on salaries, and (D) log operating expenditures. All outcome variables are expressed as logged per-10,000-user figures. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.



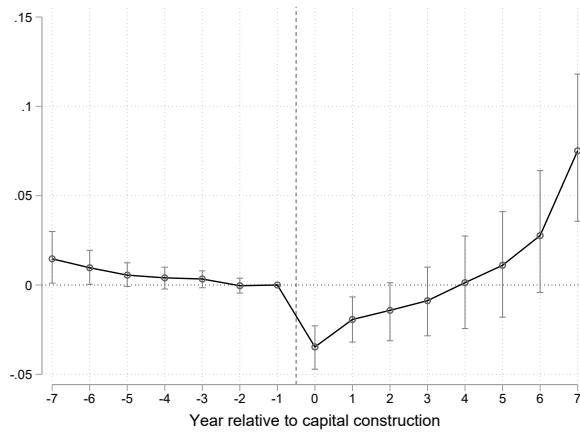
Figure A7: Impact of capital expenditure shock on library use, inverse hyperbolic sine transformed outcomes



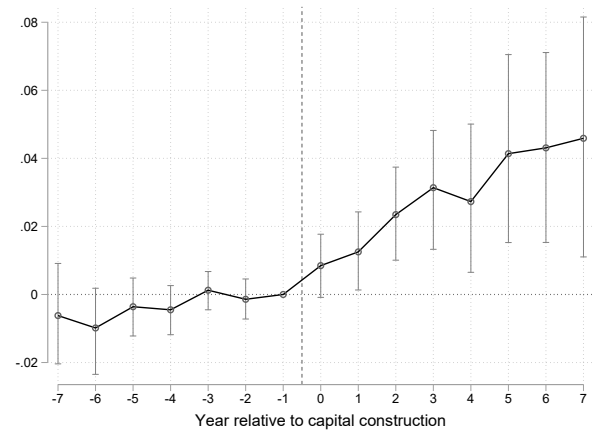
Event study estimates generated using the Gardner estimation procedure described in Section III. All outcome variables are transformed using the inverse hyperbolic sine method. The outcome variables are (A) IHS capital spending, (B) IHS children's circulation, (D) IHS children's event attendance, and (D) IHS visits. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

Figure A8: Impact of capital expenditure shock on library resources, inverse hyperbolic sine transformed outcomes

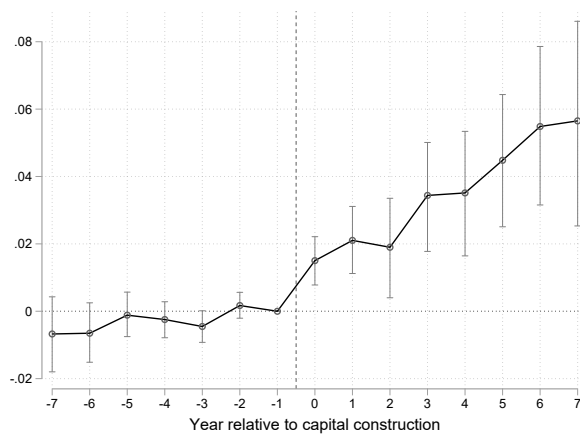
(A) IHS book stock



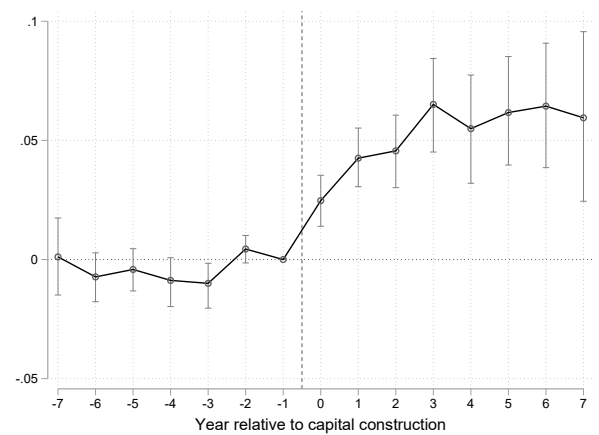
(B) IHS number employees



(C) IHS salary spending



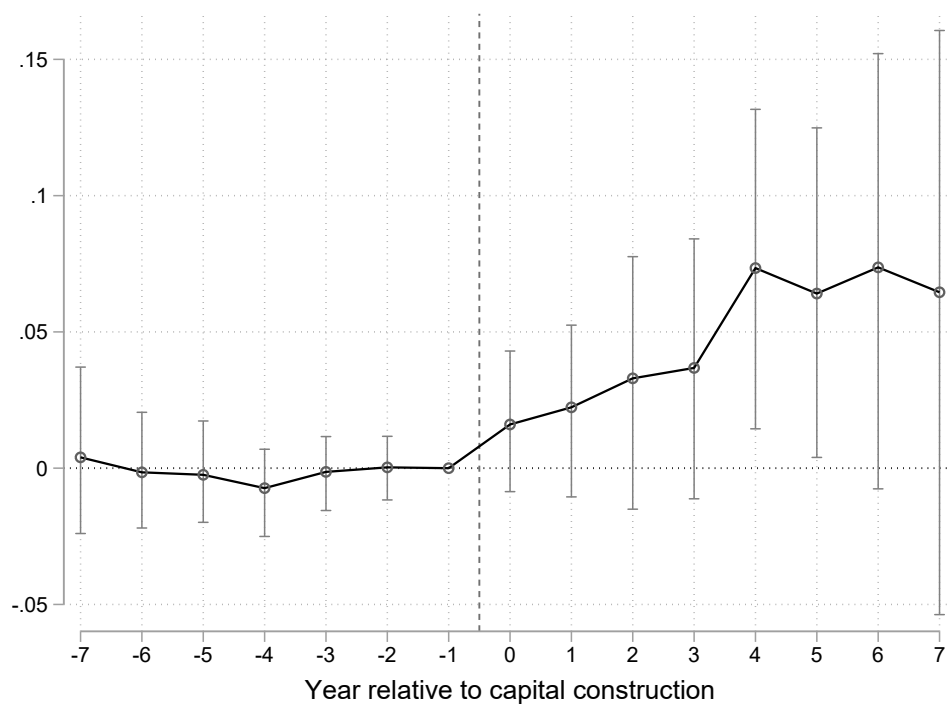
(D) IHS operating spending



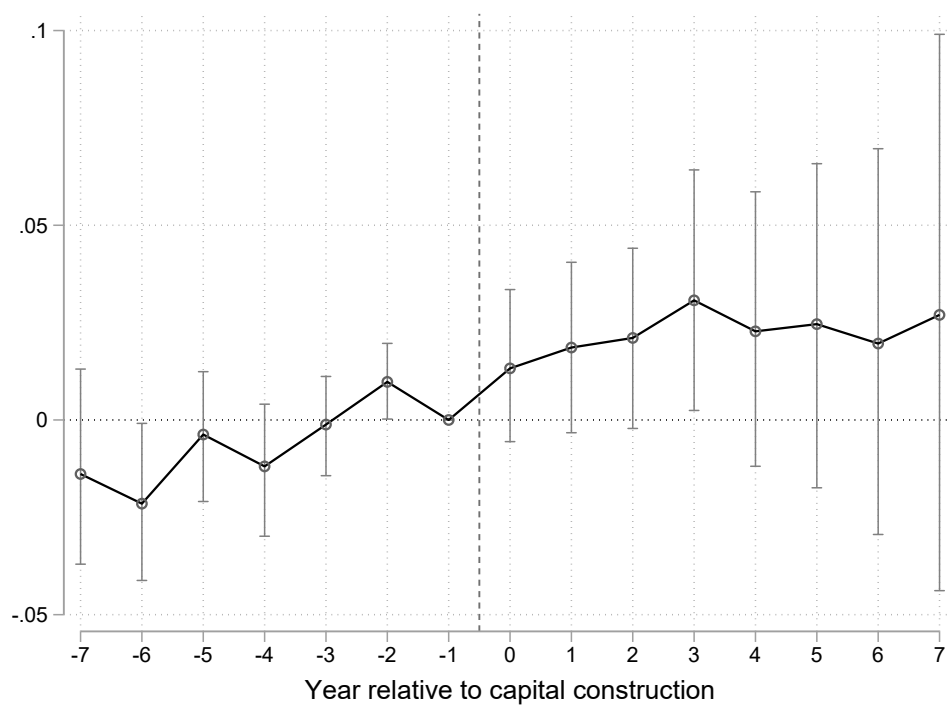
Event study estimates generated using the Gardner estimation procedure described in Section III. All outcome variables are transformed using the inverse hyperbolic sine method. The outcome variables are (A) IHS books, (B) IHS number employees, (C) IHS expenditures on salaries, and (D) IHS operating expenditures. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

Figure A9: Impact of capital expenditure shock on library resources, alternative quality variables

(a) Log library media subscriptions

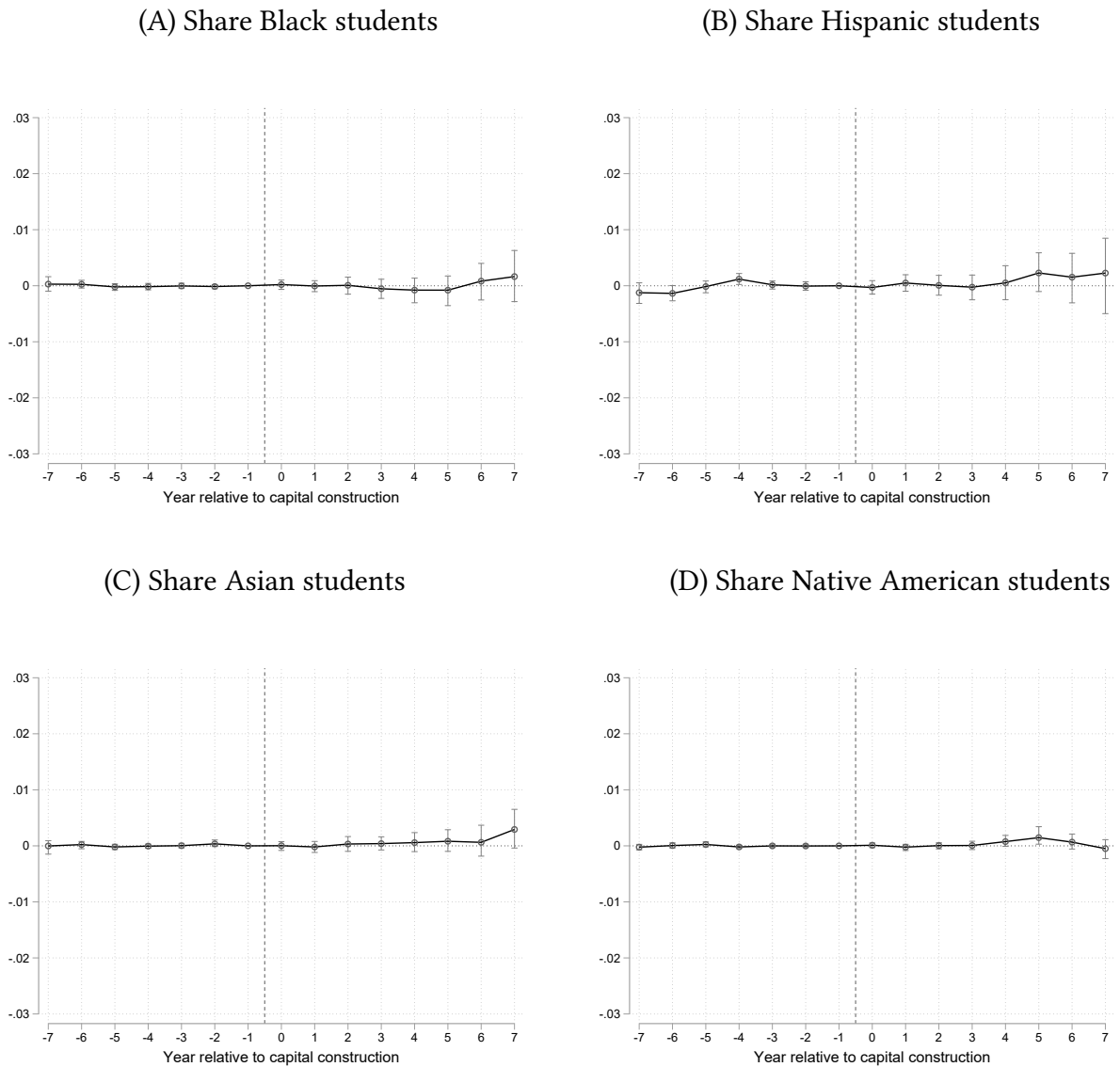


(b) Log spending on collections



Event study estimates generated using the Gardner estimation procedure described in Section III. The outcome variables are (A) Log media subscriptions and (B) Log expenditures on collections. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

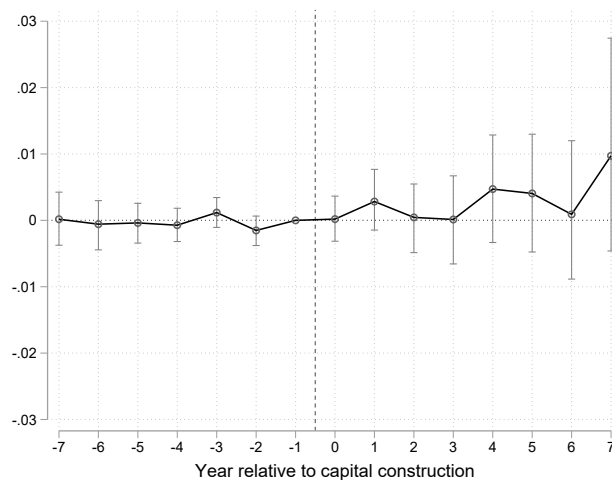
Figure A10: Dynamic correlation between capital expenditure shocks and school district characteristics



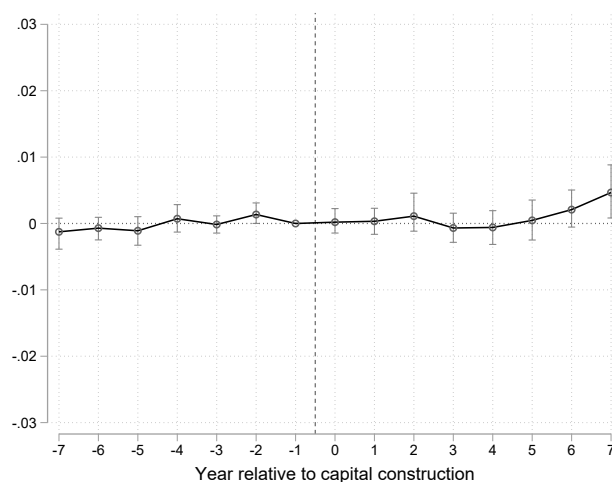
Event study estimates generated using the Gardner estimation procedure described in Section III. The outcome variables are (A) Share Black students, (B) Share Hispanic students, (C) Share Asian students, and (D) Share Native American students. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

Figure A11: Dynamic correlation between capital expenditure shocks and additional school district characteristics

(a) Share of students who qualify for free lunch



(b) Share of students who qualify for reduced price lunch



(c) Share of disadvantaged students

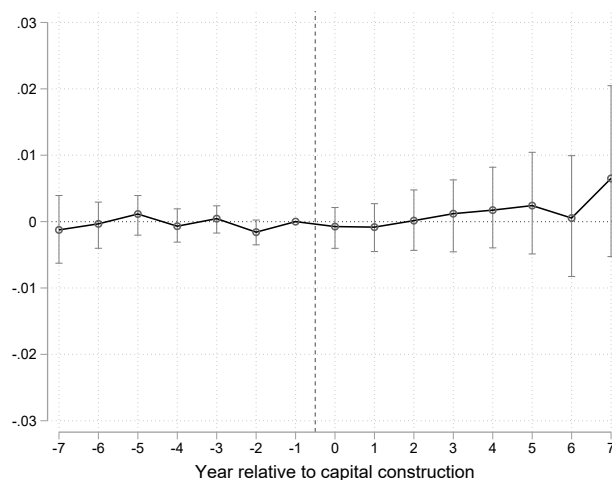
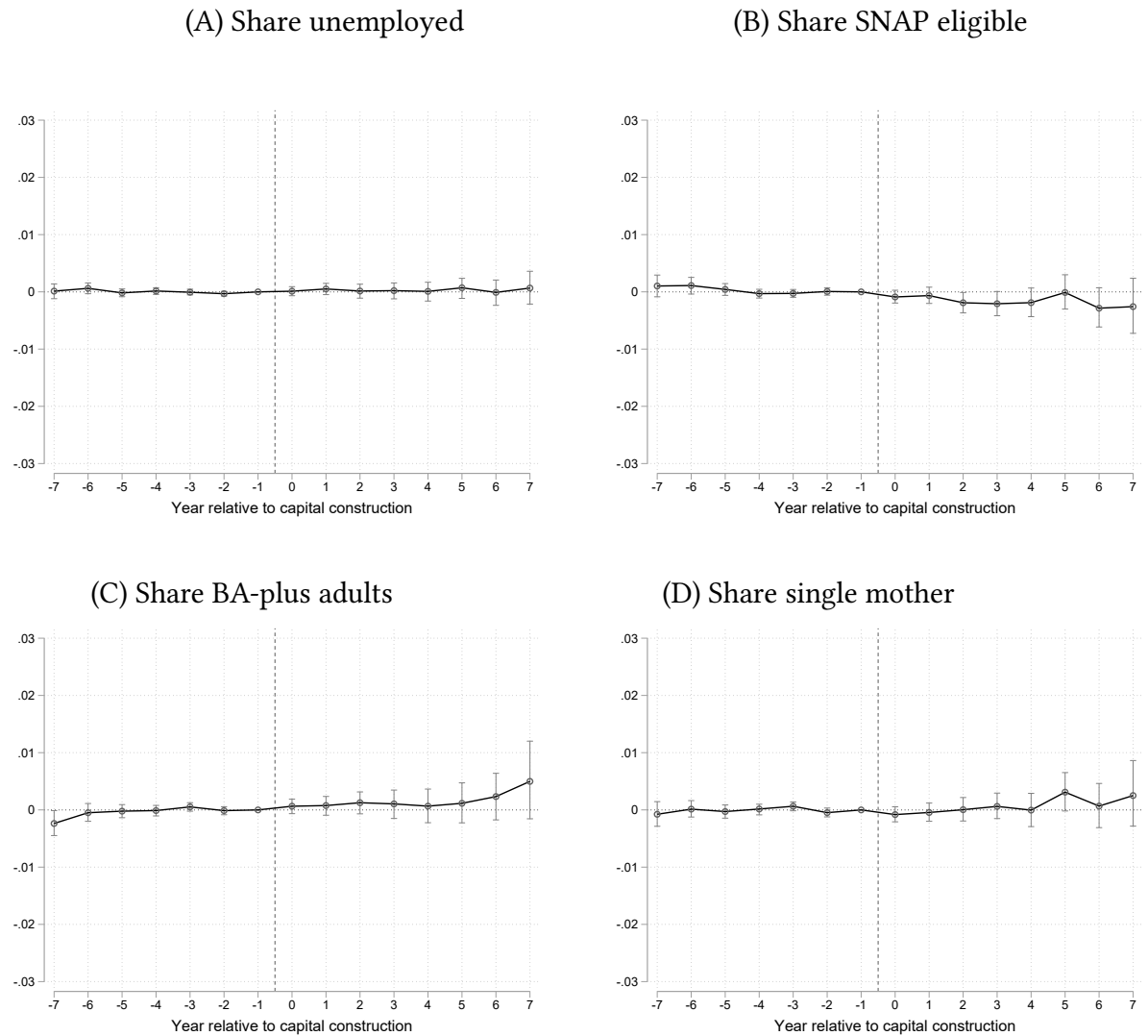
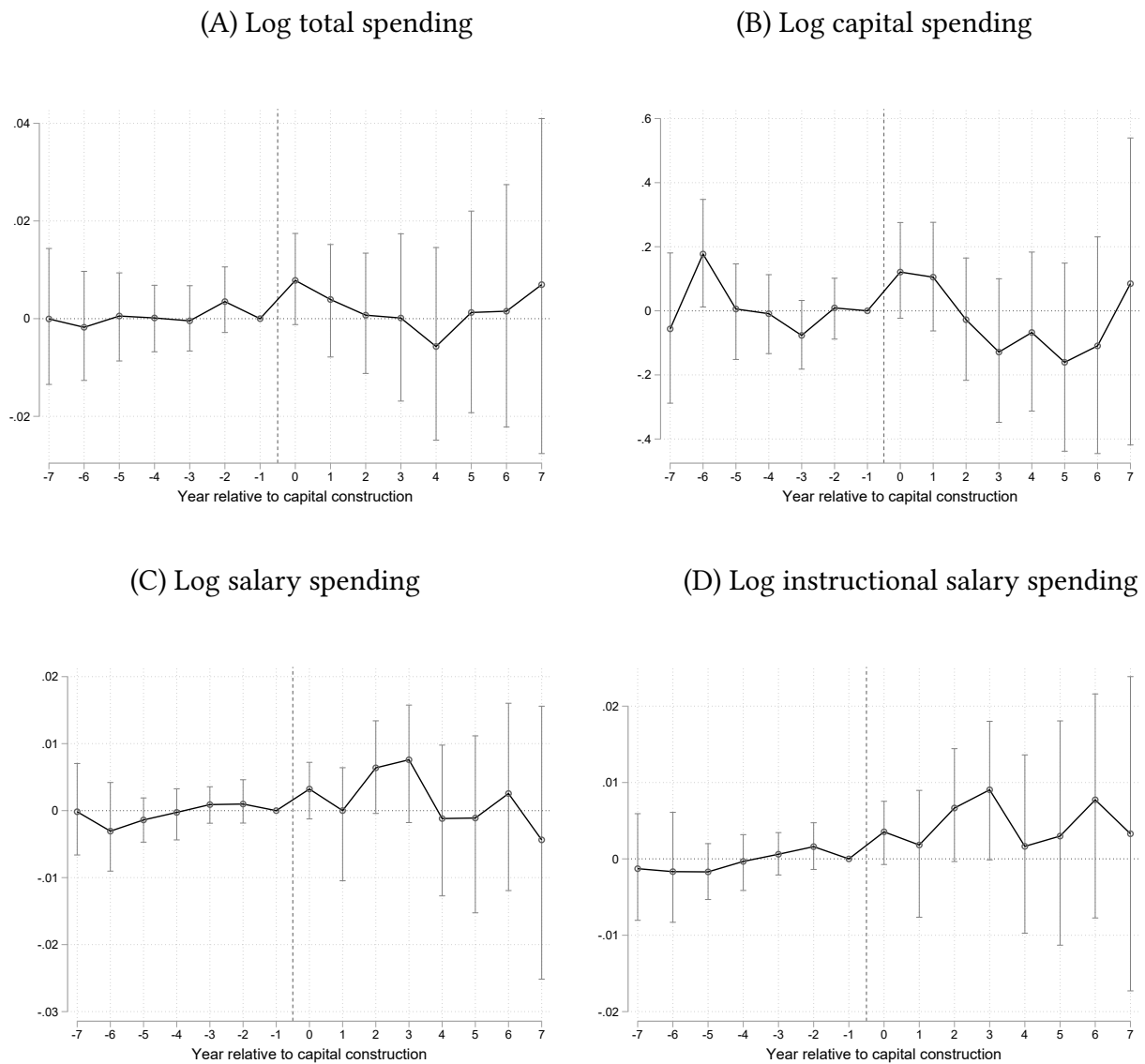


Figure A12: Dynamic correlation between capital expenditure shocks and community characteristics



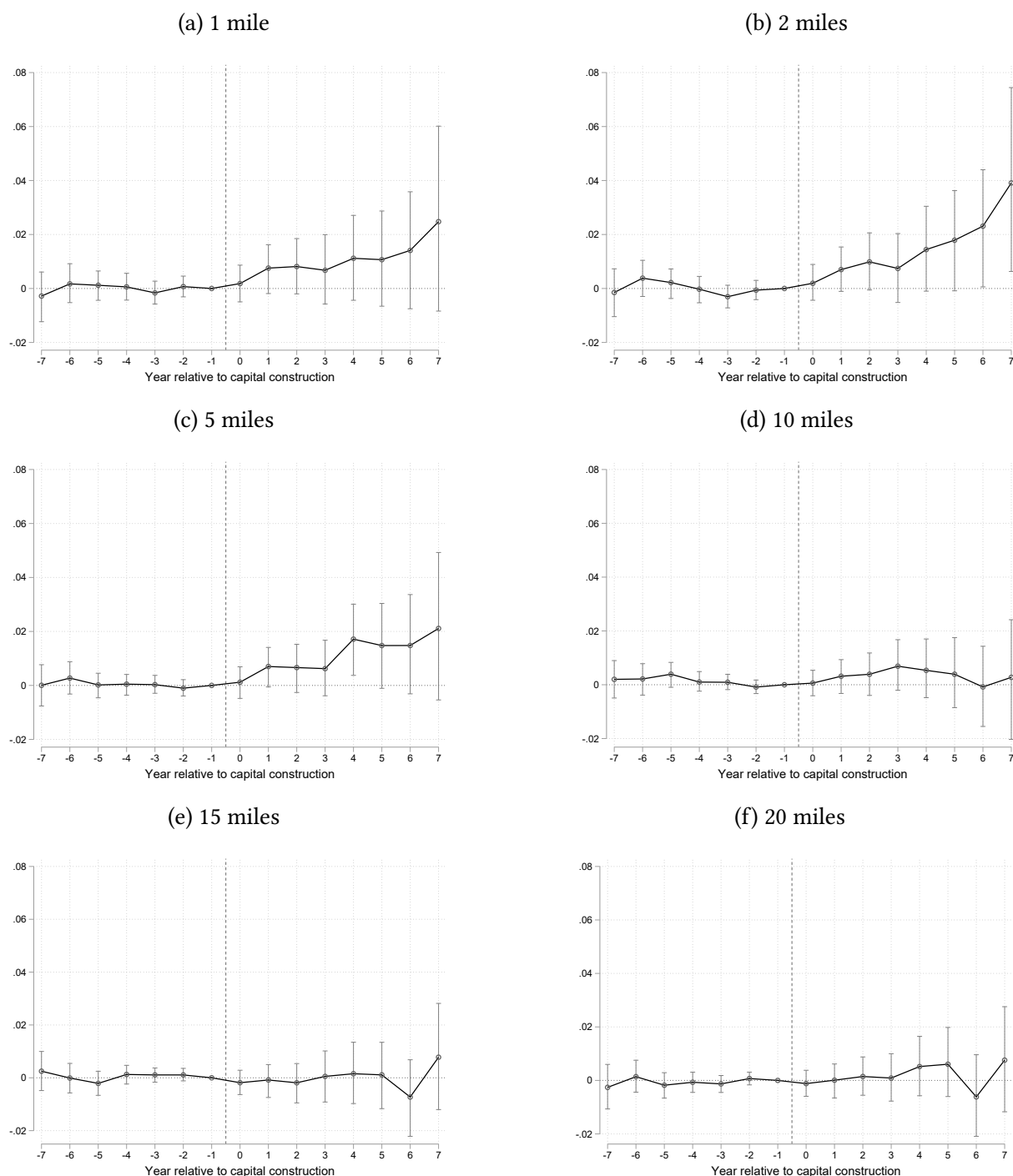
Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

Figure A13: Dynamic correlation between capital expenditure shocks and school district finances



Event study estimates generated using the Gardner estimation procedure described in Section III. The outcome variables are (A) Log total school spending, (B) Log capital school spending, (C) Log salary school spending, and (D) Log instructional salary school spending. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects.

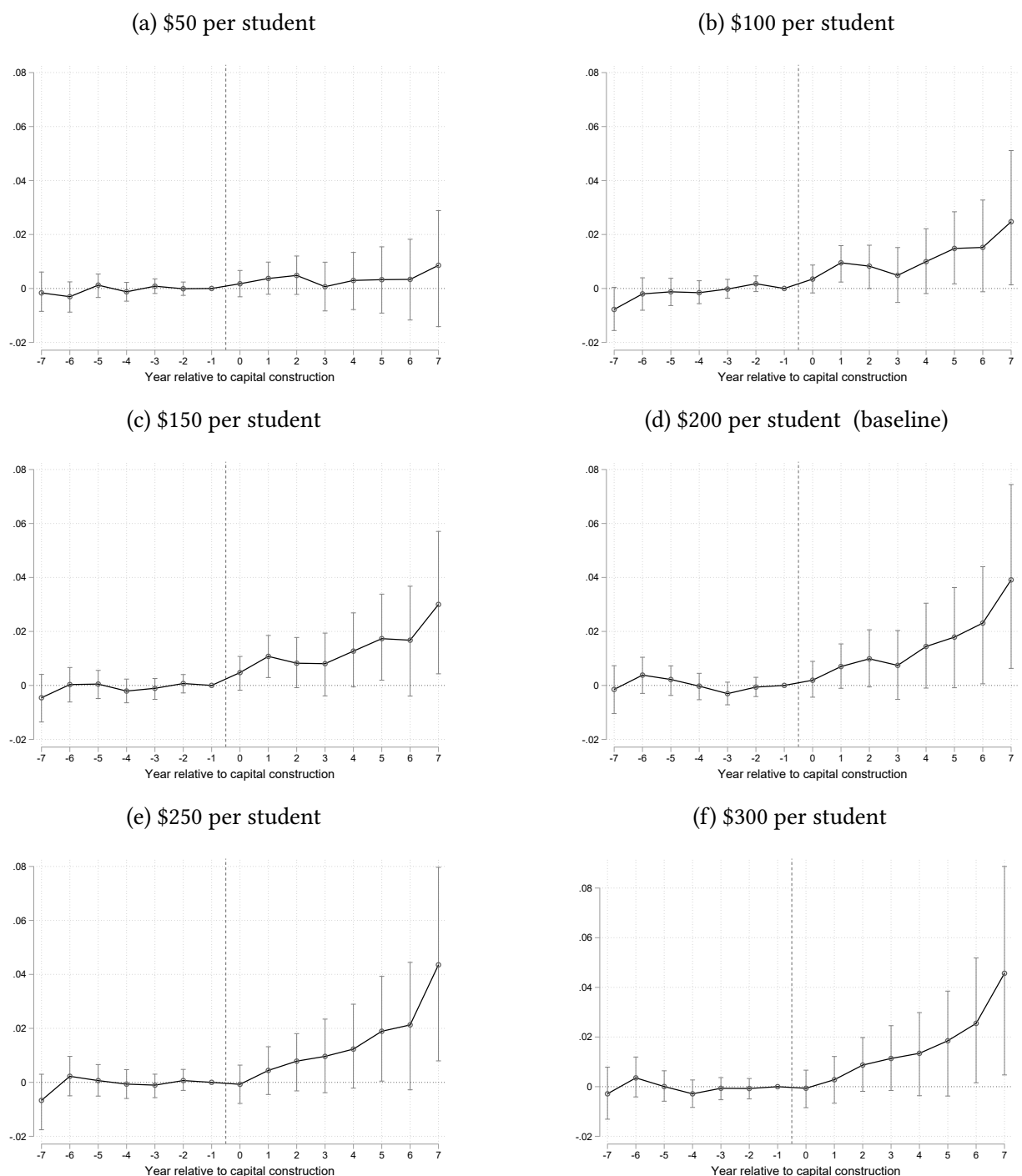
Figure A14: Impact of library capital spending shocks on reading test scores, alternative distance thresholds



Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects. Each figure shows results letting the capital spending events occurs within the indicated distance of a school district.

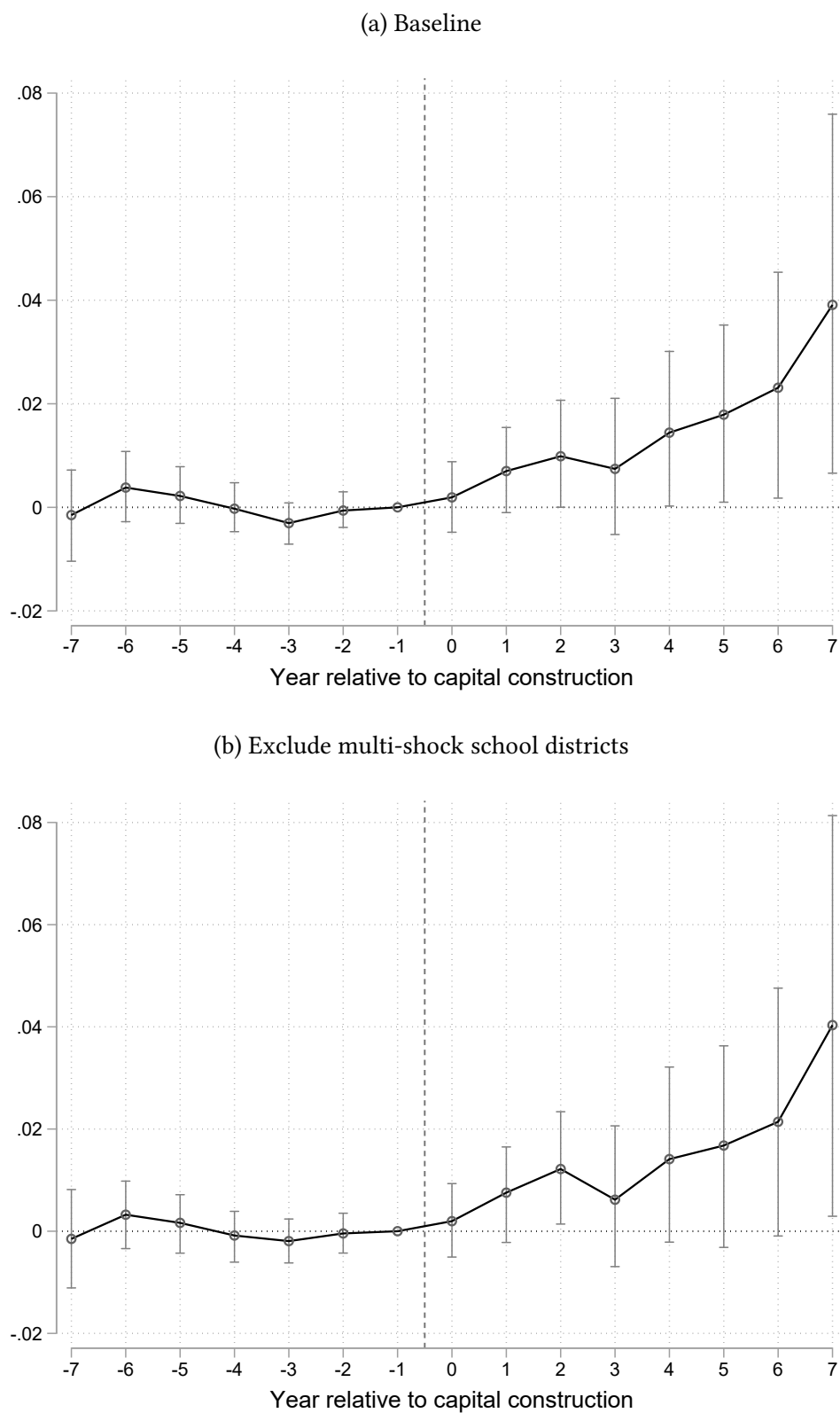


Figure A15: Impact of library capital spending shocks on reading test scores, alternative capital spending event thresholds



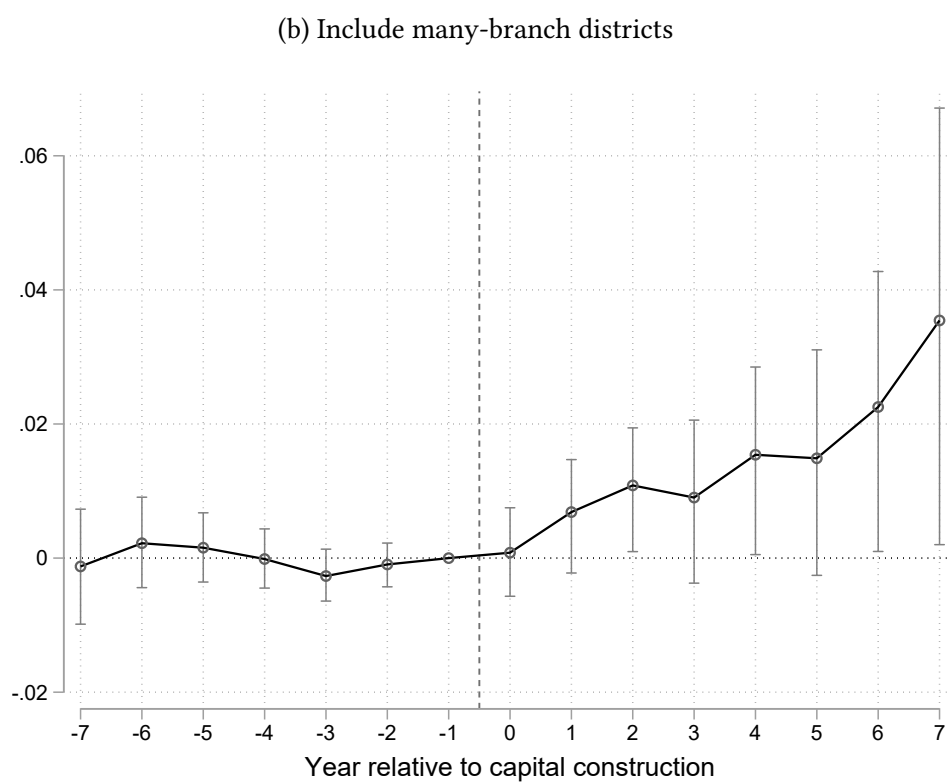
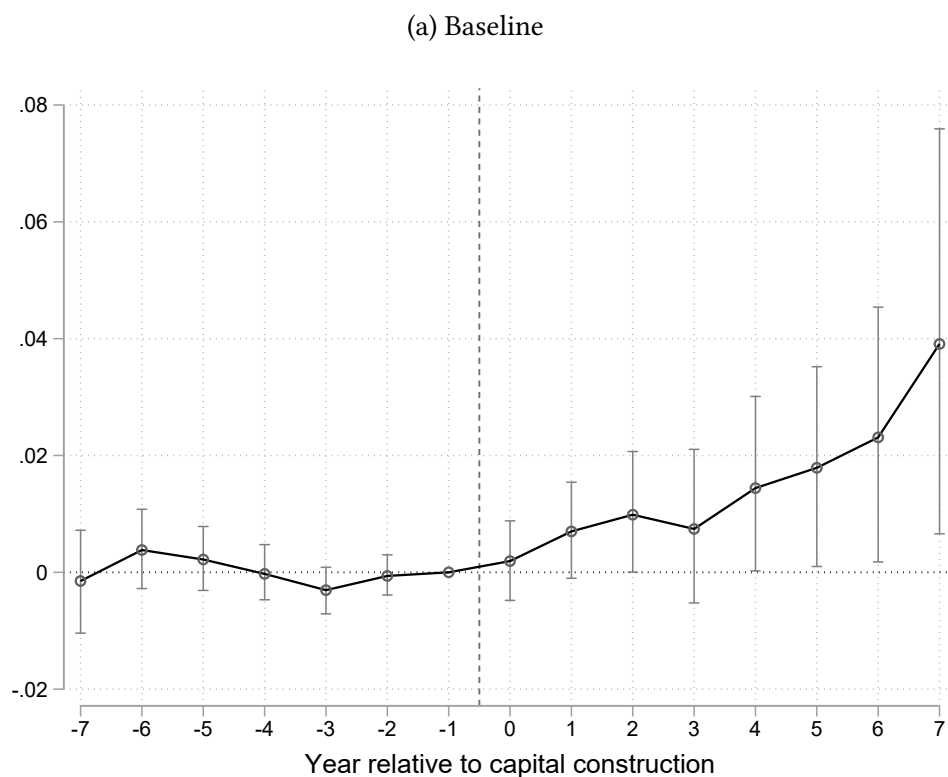
Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects. Each figure shows results letting capital spending events be defined by the indicated per student dollar threshold.

Figure A16: Impact of library capital spending shocks on reading test scores, excluding districts with multiple library construction shocks



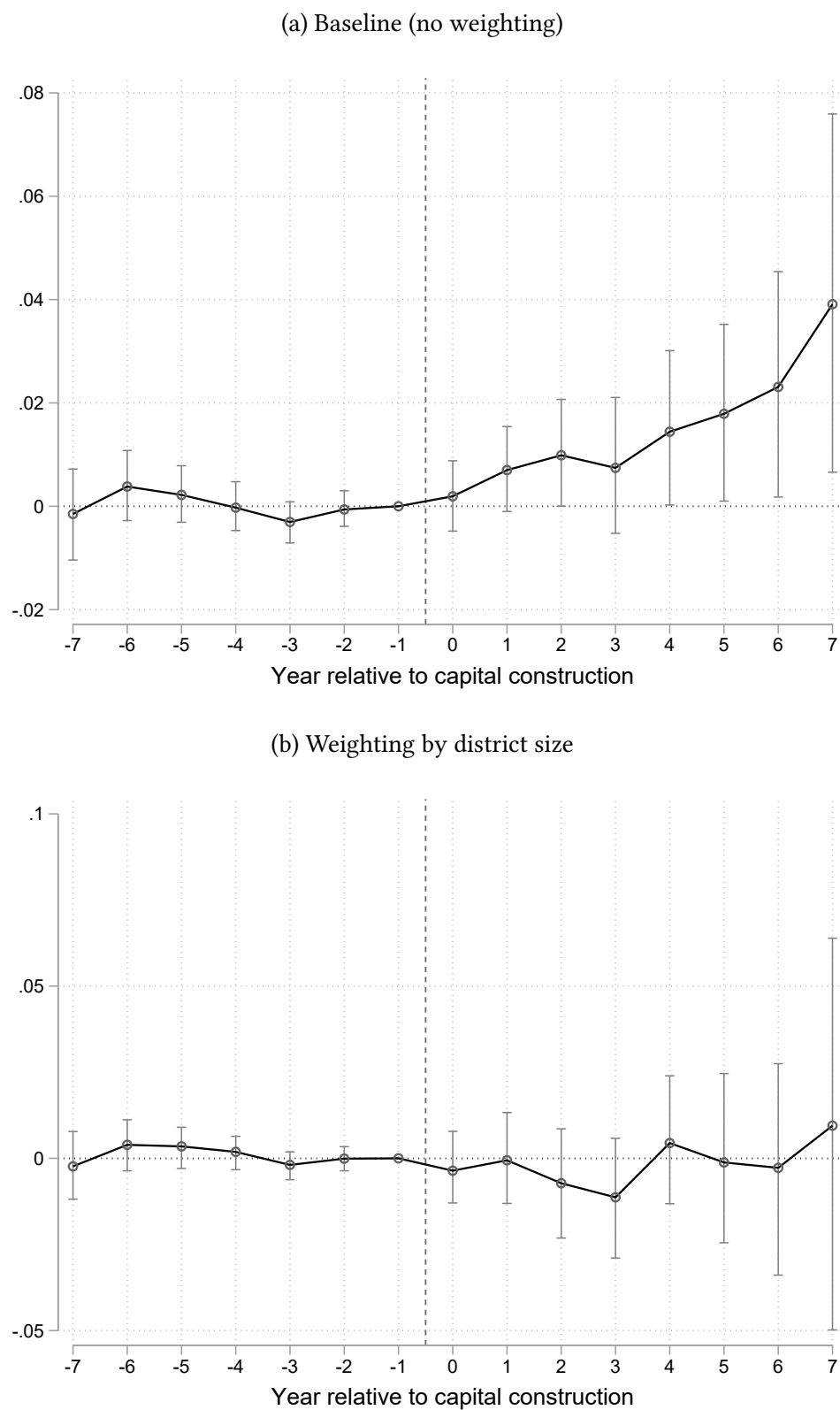
Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects. Panel A shows our baseline results. Panel B shows results that exclude school districts that had more than one capital spending event during our sample period.

Figure A17: Impact of library capital spending shocks on reading test scores, including all school districts



Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects. Panel A shows our baseline results. Panel B shows results that do not limit the sample to districts with 5 or fewer nearby library branches.

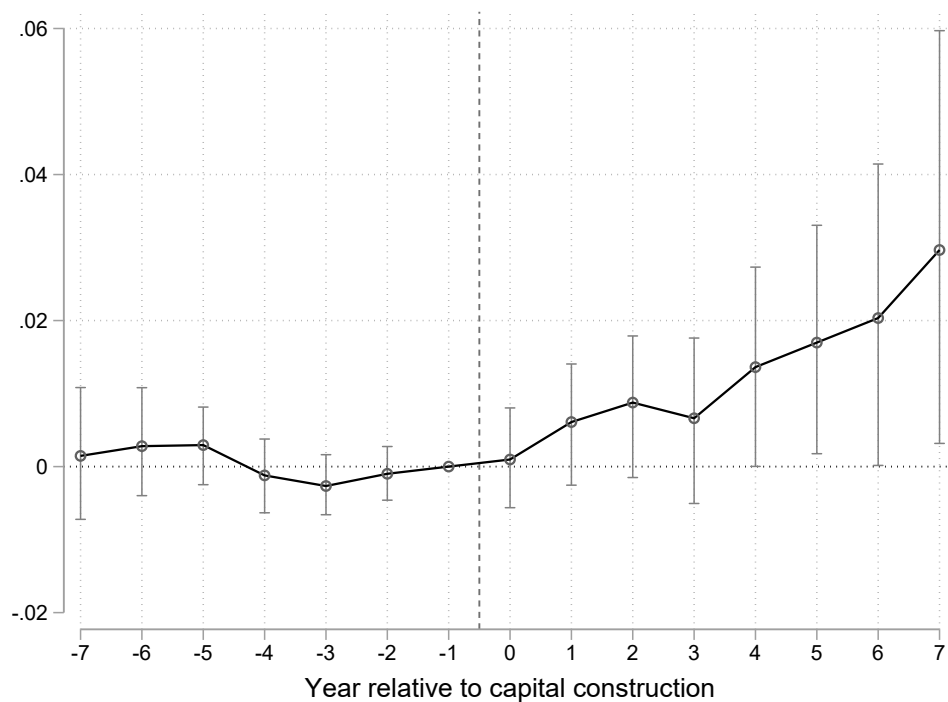
Figure A18: Impact of library capital spending shocks on reading test scores, weighting by district size



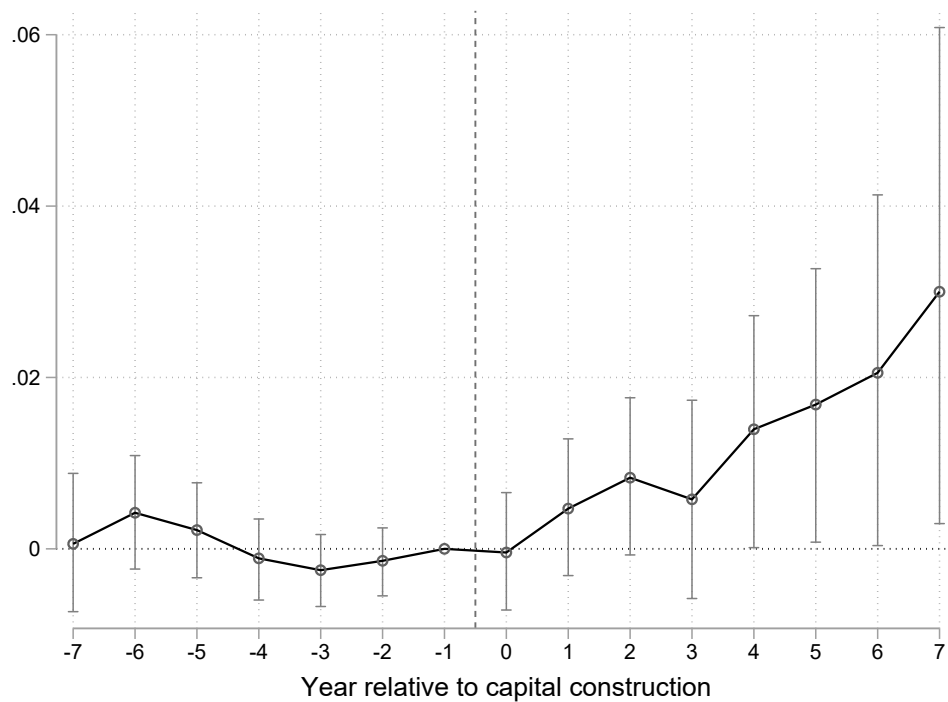
Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects. Panel A shows our baseline results. Panel B shows results that weight observations by the number of test-takers in a given grade-district-year.

Figure A19: Impact of library capital spending shocks on reading test scores, extended panel

(a) Incorporating NAEP data

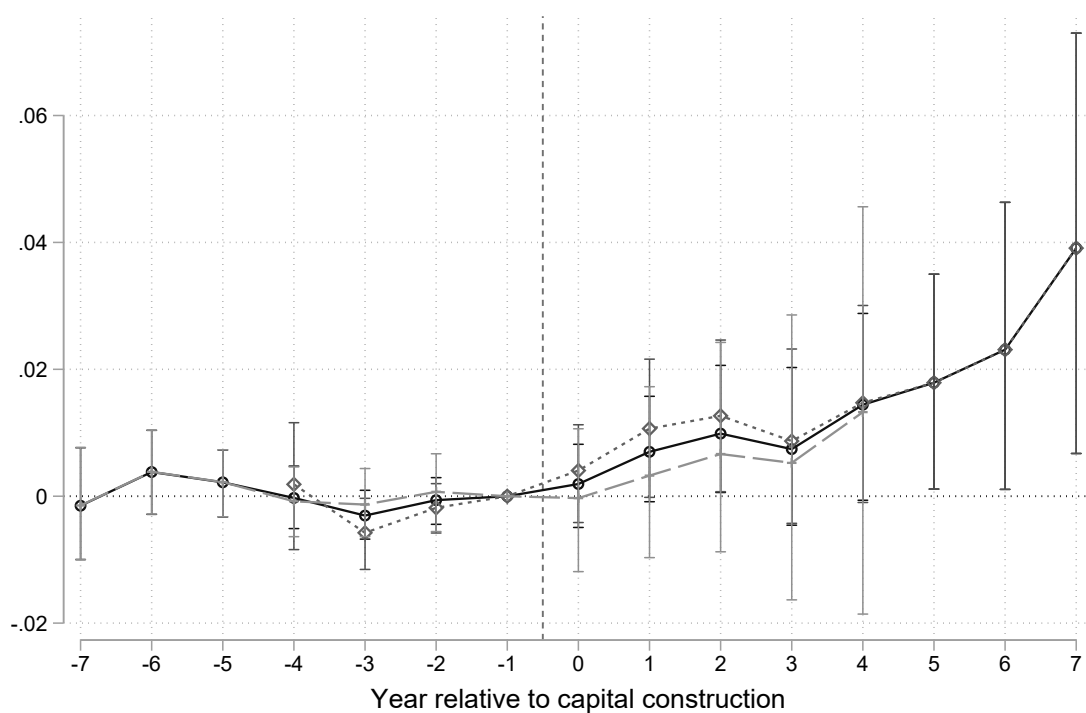


(b) Incorporating NAEP and NLSLSASD data



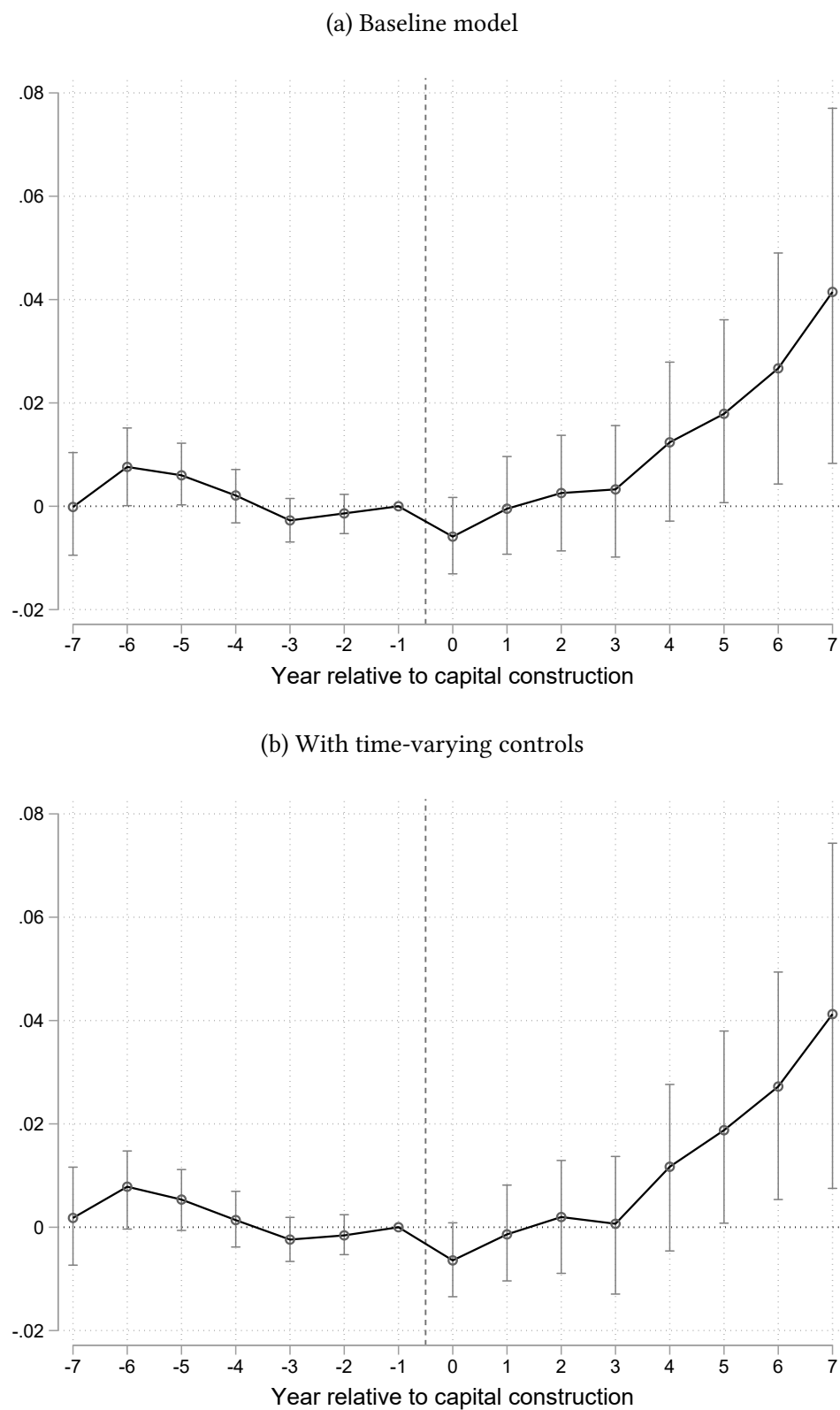
Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include state-year and district-grade fixed effects. Panel A shows results that incorporate data from NAEP. Panel B shows results that incorporate data from both the NLSLSASD and NAEP.

Figure A20: Impact of library capital spending shocks on reading test scores, by treatment timing



Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Results are split by treatment timing: The black line corresponds to all treated units, the dashed line to units treated after or in 2014, and the dotted line to units treated before 2014.

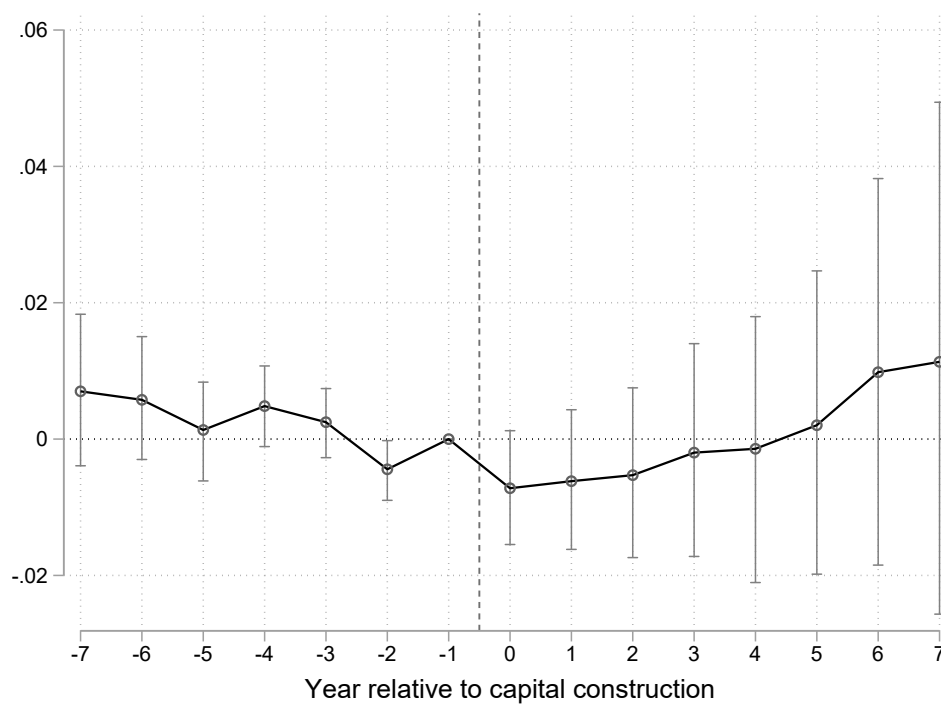
Figure A21: Impact of library capital spending shocks on reading test scores, models without state-year fixed effects



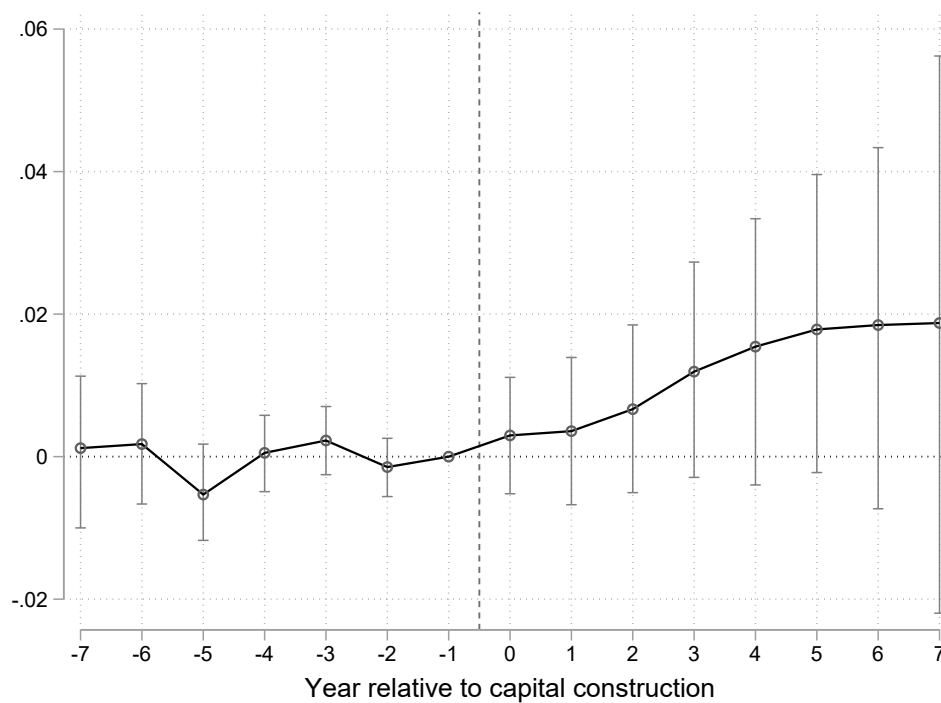
Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. Regressions include district-grade fixed effects. Panel A shows results without time-varying controls. Panel B shows results with the set of time-varying controls described in Sections II and III.

Figure A22: Impact of library capital spending shocks on math test scores, with and without state-year fixed effects

(a) Without state-year fixed effects



(b) With state-year fixed effects

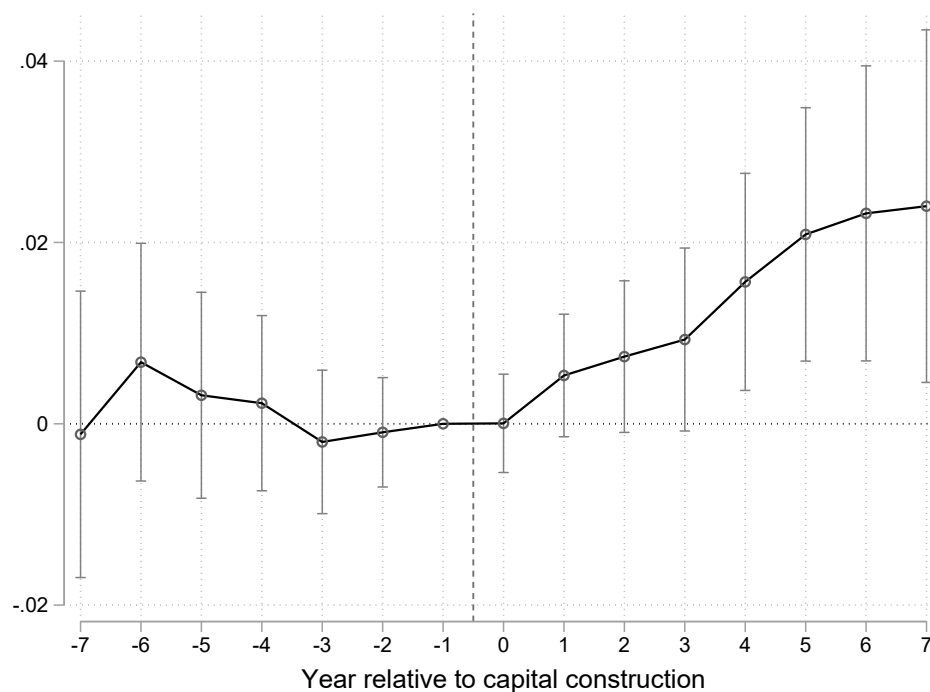


Event study estimates generated using the Gardner estimation procedure described in Section III. All figures show bootstrapped 95 percent confidence intervals that account for within-school district clustering. The outcome variable is mathematics test scores. Regressions include district-grade fixed effects. Panel A shows results without conditioning on state-year fixed effects. Panel B shows results with state-year fixed effects.

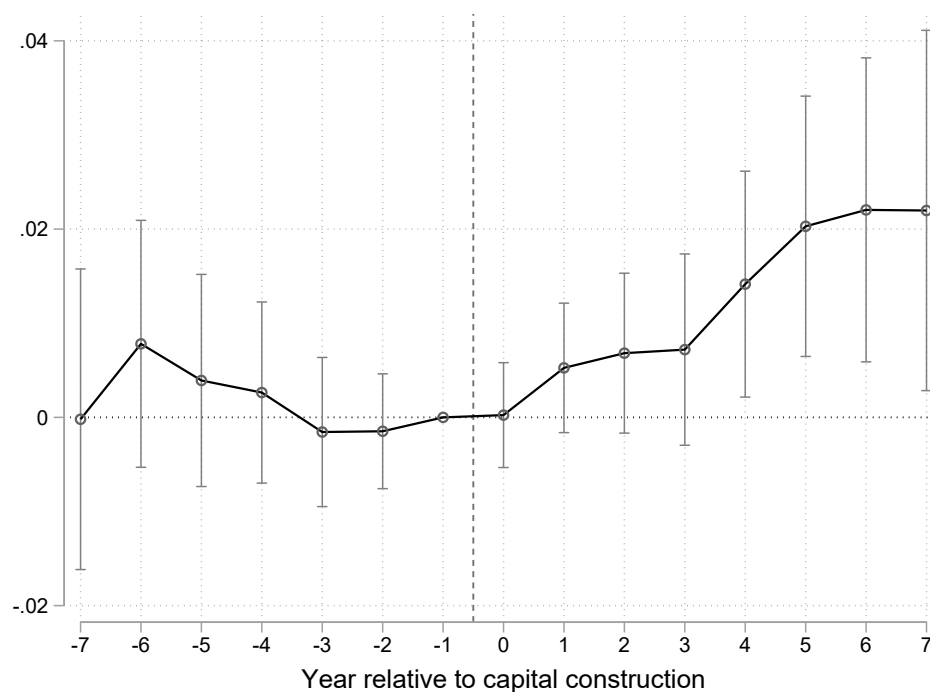


Figure A23: Impact of library capital spending shocks on reading test scores, TWFE method

(a) Without time-varying covariates

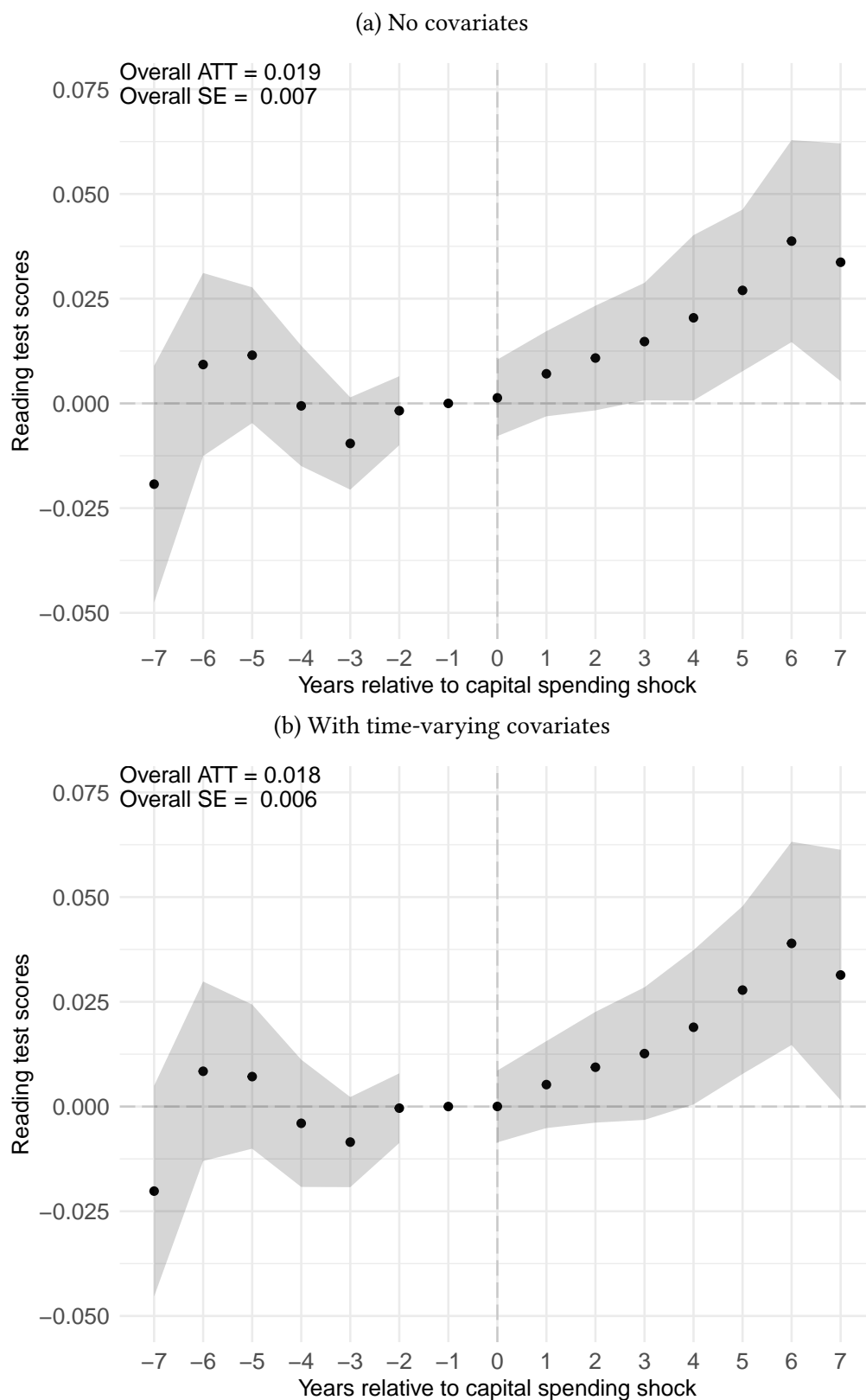


(b) With time-varying covariates



Event study estimates generated using two-way fixed effects estimators, as described in Section III. All figures show 95 percent confidence intervals that account for within-school district clustering. Panel A shows results after conditioning on state-year and district-grade fixed effects. Panel B shows results that additionally control for the time-varying, district-level covariates described in Sections II and III.

Figure A24: Impact of library capital spending shocks on reading test scores, Callaway and Sant'Anna (2021) method

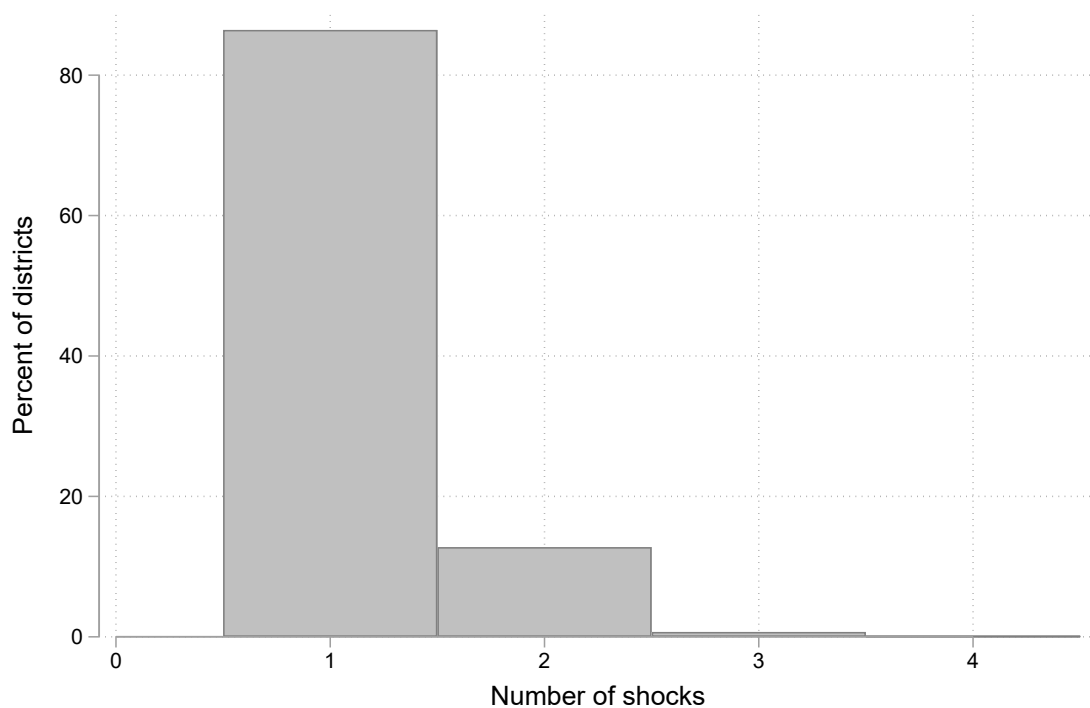


Event study estimates generated using the Callaway and Sant'Anna (2021) method. Standard errors are clustered by school district. Panel A shows baseline results, Panel B shows results that condition on pre-treatment covariates. The list of pre-treatment covariates is described in Sections II and III.



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Figure A26: Distribution of number of library capital construction shocks, conditional on having at least one



This figure shows the distribution of library capital construction shocks, conditional on having at least one in the school district sample for the sub-sample of districts with observed shocks.