School Spending and Student Outcomes: Evidence from Revenue Limit Elections in Wisconsin

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Introduction

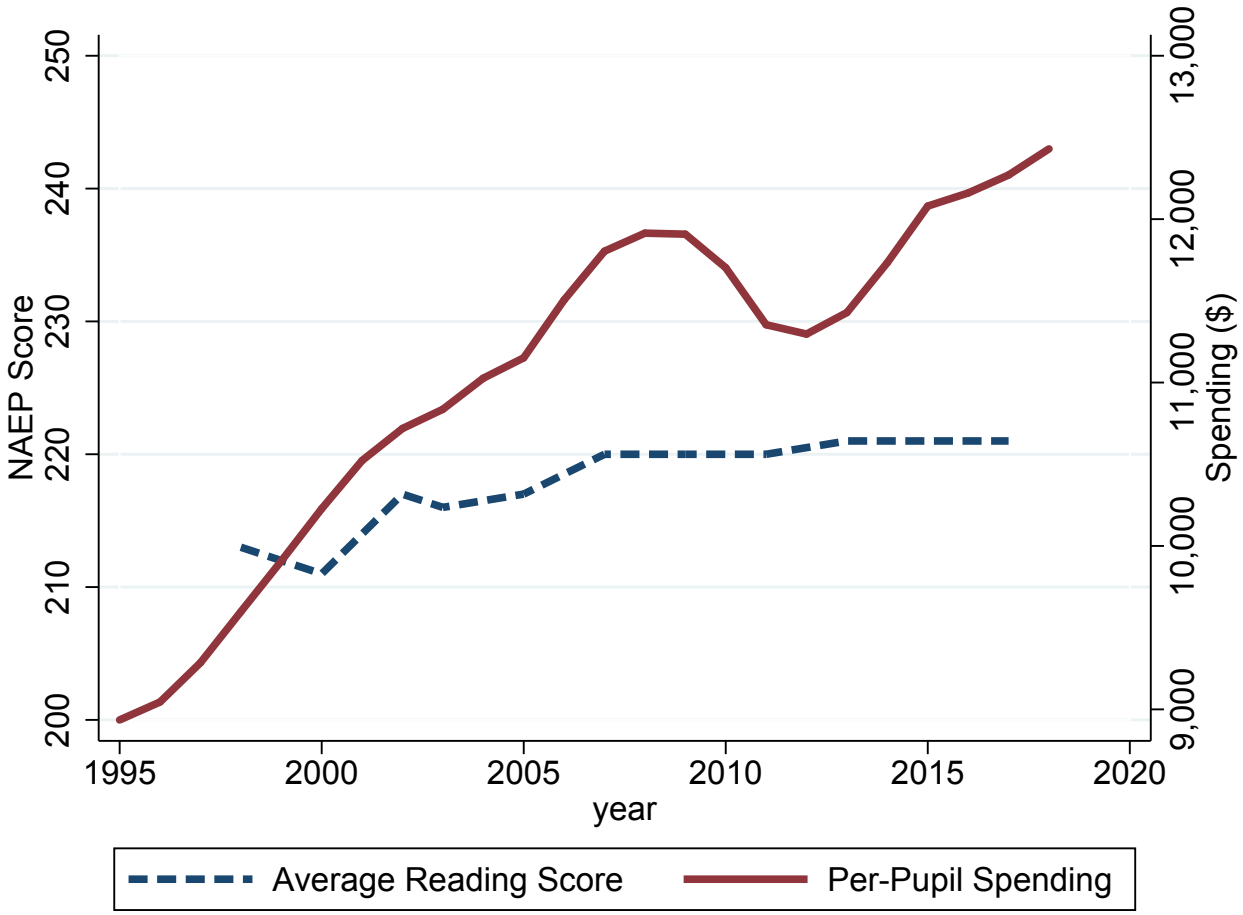
Research Questions

This study examines the relationship between K-12 public school spending and student outcomes.

1. Does additional public school spending improve student outcomes?
2. If so, what is the magnitude of the effect? What are the mechanisms?
3. Which types of expenditures are most effective? (e.g., instructional versus capital)

Introduction

Motivation



Introduction

Empirical Strategy

- The total amount that a school district in WI can spend is capped by state-imposed revenue limits.
- If a district wishes to exceed these caps, it must seek voter approval in a local referendum.
- The empirical strategy leverages close elections in a dynamic regression discontinuity design.
- By law, school districts must hold separate elections for operational and capital expenditure increases.

Introduction

Results

Narrowly passing an "operational referendum" leads to:

- A $500 (5%) increase in per-pupil operational expenditures (no change in capital outlays)
- Improvements in school inputs (reductions in class sizes and teacher turnover, increases in teacher compensation and experience)
- Improvements in student outcomes (test scores, dropout rates, postsecondary enrollment)

In contrast, I find no evidence that narrowly approving a "bond referendum" leads to improvements in student outcomes.

Does money matter in public education?

- Early observational studies found no evidence that additional spending improves student outcomes (Hanushek, 2003; Coleman et al., 1966).

New, quasi-experimental studies generally find more positive effects. However, these studies either:

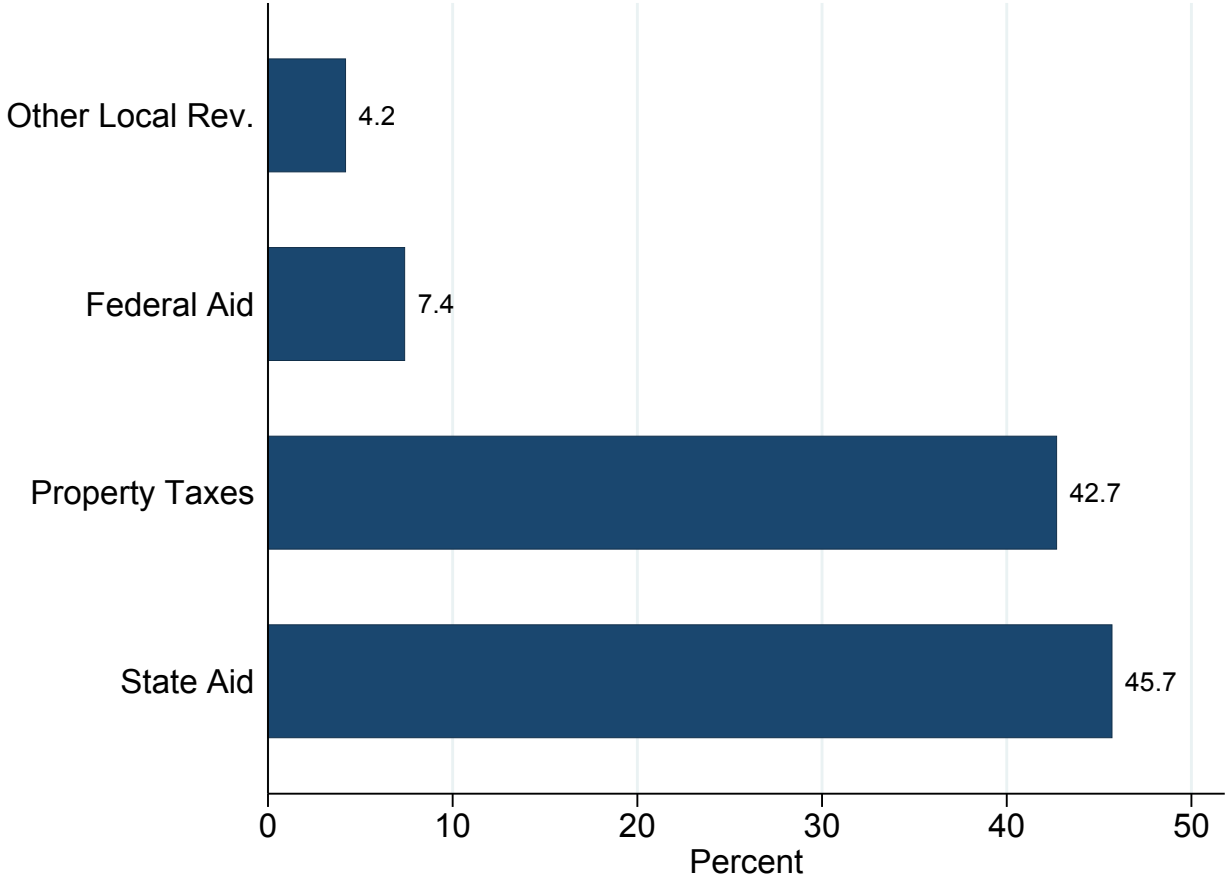
- Estimate the joint impact of increases in operational and capital expenditures (Candelaria and Shores, 2019; Lafortune et al., 2018; Jackson et al., 2015)
- Or focus exclusively on capital expenditure effects (Rauscher, 2019; Hong and Zimmer, 2016; Martorell et al., 2016; Cellini et al., 2010)

My study shows that additional spending can improve student outcomes, but how the additional resources are allocated matters.

Background

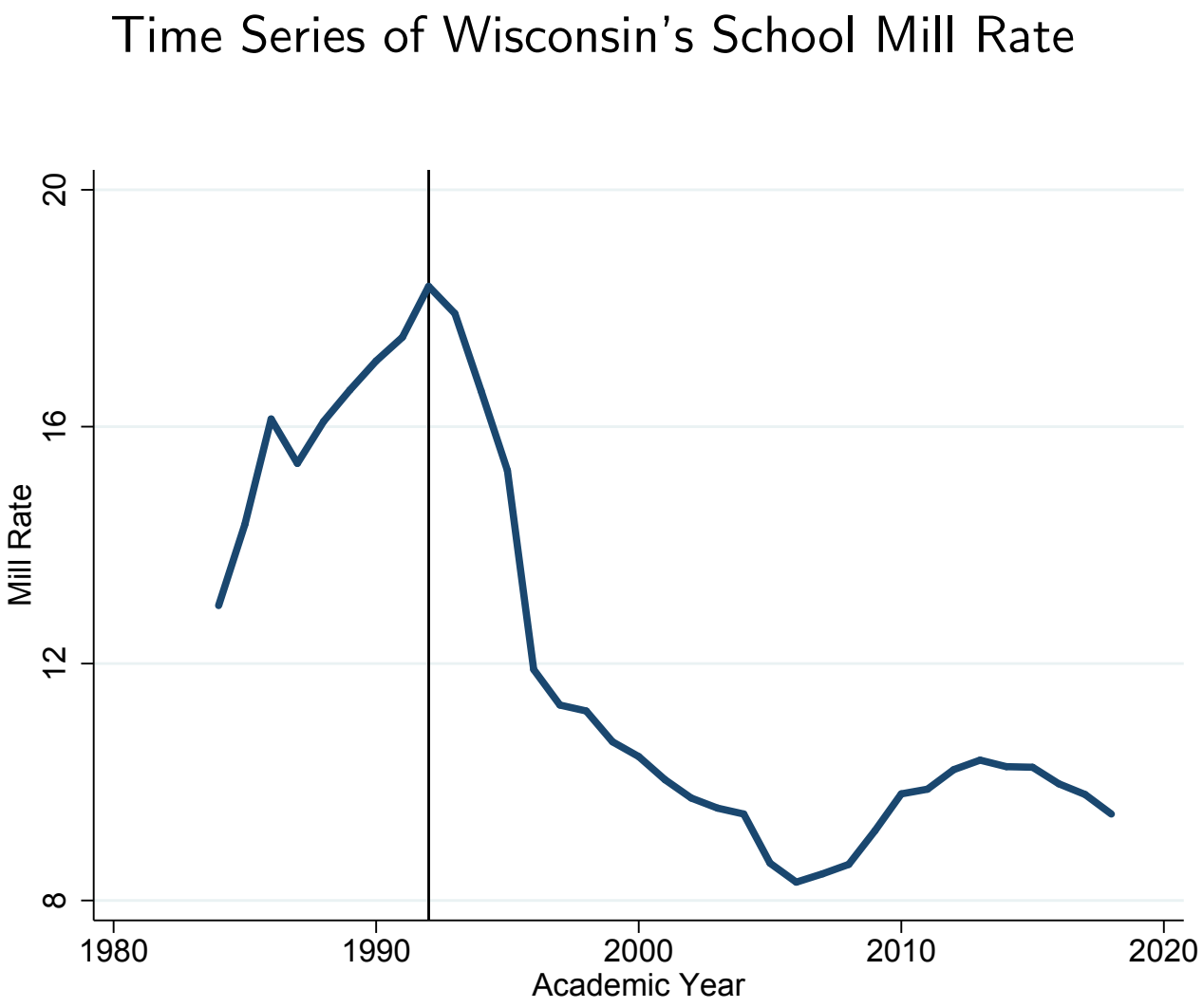
Wisconsin's School Finance System

School District Revenue by Source (2014-15)



Background

Wisconsin's School Finance System



Background

Referenda to Bypass Revenue Limits

- The only means of exceeding revenue limits is through the passage of a local referendum.
- A simple majority vote from residents in the district is required for the initiative to pass.
- Residents who vote in favor implicitly agree to an increase in property taxes.
- Since 1993, roughly 80% of school districts have attempted at least one operational referendum (1,213 individual questions).

Data (1997-2014)

Wisconsin Department of Public Instruction

- Operational Referenda: referendum-level data (type, the amount, intended purpose, actual wording, vote share, voter turnout)
- District-level student outcomes (WKCE test scores, dropout rates, postsecondary enrollment)
- Individual-level teacher data (average teacher experience, student-staff ratios, teacher turnover, and teacher compensation)

National Center for Education Statistics

- Detailed district-level expenditure and revenue data

Summary Stats

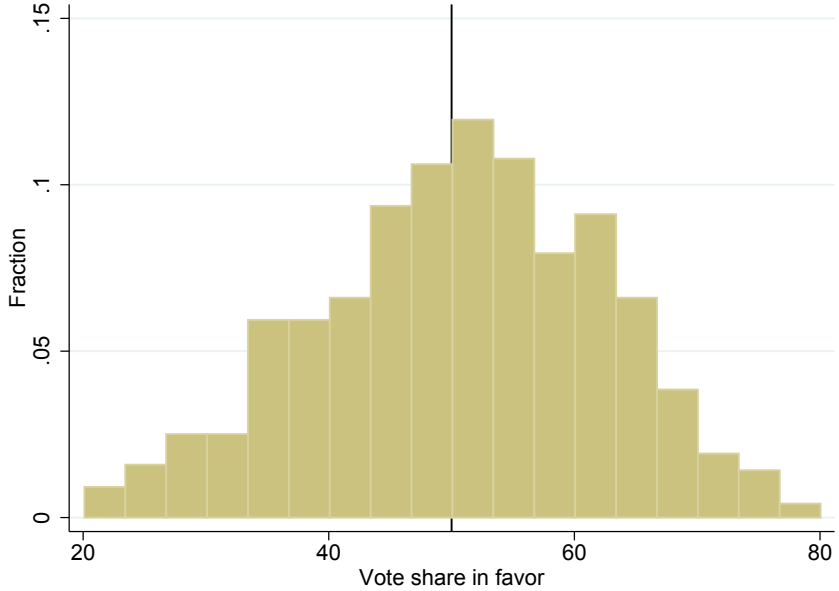
Validity of the RD Design

- Ideally, randomly assign additional spending to some school districts and not others.
- While such an experiment is infeasible, the RD research design uses close elections to approximate it.
- Conditional on having a very close election, referendum success (or failure) is as good as random.
- I examine two diagnostics: continuity of the vote share and pre-election differences in observables.

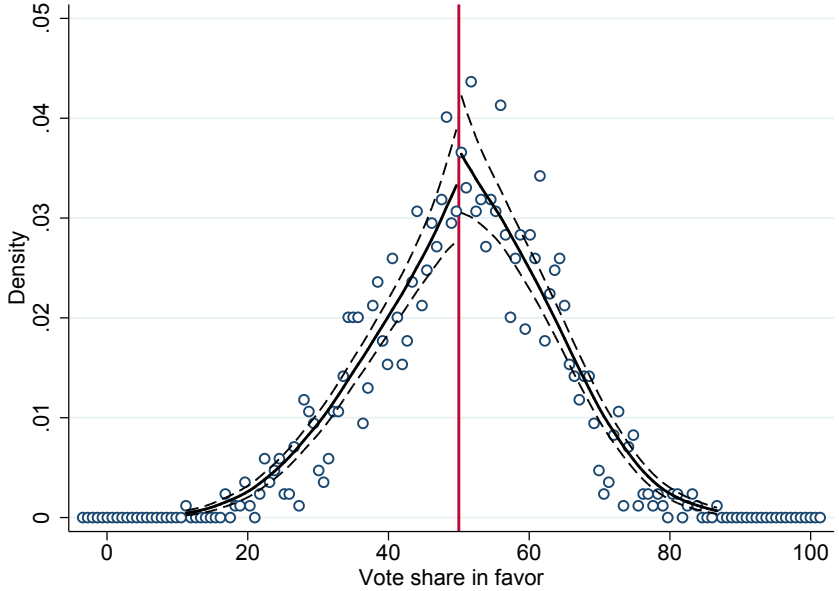
Validity of the RD Design

(1) Distribution of the Vote Share

(a) Vote Share Distribution



(b) Local Linear Density Estimator



Validity of the RD Design

(2) Differences in Pre-Election Outcomes

Dependent Variable	(1)	$(t-1)$ (2)
Panel (a): Fiscal Outcomes		
Revenue Limits PP	**281.63**	-69.52
	(135.19)	(183.72)
Total Expenditures PP	**461.69**	-57.06
	(225.31)	(269.59)
Instructional Expenditures PP	**303.31**	-1.54
	(128.10)	(209.82)
Support Services PP	168.07	-102.65
	(103.25)	(120.17)
Other Expenditures PP	-9.69	**47.13**
	(8.68)	(22.81)
School Year FE	Y	Y
Only Narrow Elections	N	Y

Validity of the RD Design

(2) Differences in Pre-Election Outcomes

	$(t-1)$	
Dependent Variable	**(1)**	**(2)**
Panel (b): Student Outcomes		
Dropout Rate	0.00	0.00
	(0.10)	(0.28)
% Adv or Prof, 10th Grade	**2.95**	-0.35
	(1.33)	(5.41)
Postsecondary Enrollment (Share)	0.83	-1.97
	(1.18)	(0.65)
School Year FE	Y	Y
Only Narrow Elections	N	Y

Empirical Approach

Regression Discontinuity

- Traditional RD analysis is complicated by the dynamic nature of referenda.
- Cellini et al. (2010) developed dynamic RD estimators that extend the usual RD in a cross-sectional analysis.
- The estimator can be adjusted to any setting in which an entity holds multiple elections.

Empirical Approach

RD with Multiple Treatments

- Suppose that district d holds a referendum in year $t-\tau$ and that the referendum receives vote share $v_{d,t-\tau}$. Let $P_{d,t-\tau}$ be equal to one if district d passes a referendum in year $t-\tau$ and zero otherwise.
- A district outcome in year t can be specified as a function of the full history of referendum passages:

$$y_{dt} = \sum_{\tau=0}^{\bar{\tau}} P_{d,t-\tau}\beta_\tau + \varepsilon_{dt} \tag{1}$$

- In general, we might expect $E[\varepsilon_{dt}P_{d,t-\tau}] \neq 0$.
- A simple regression like (1) is likely to yield a biased estimate of the β_τ's.

Empirical Approach

Estimating Equation (One-Step Estimator)

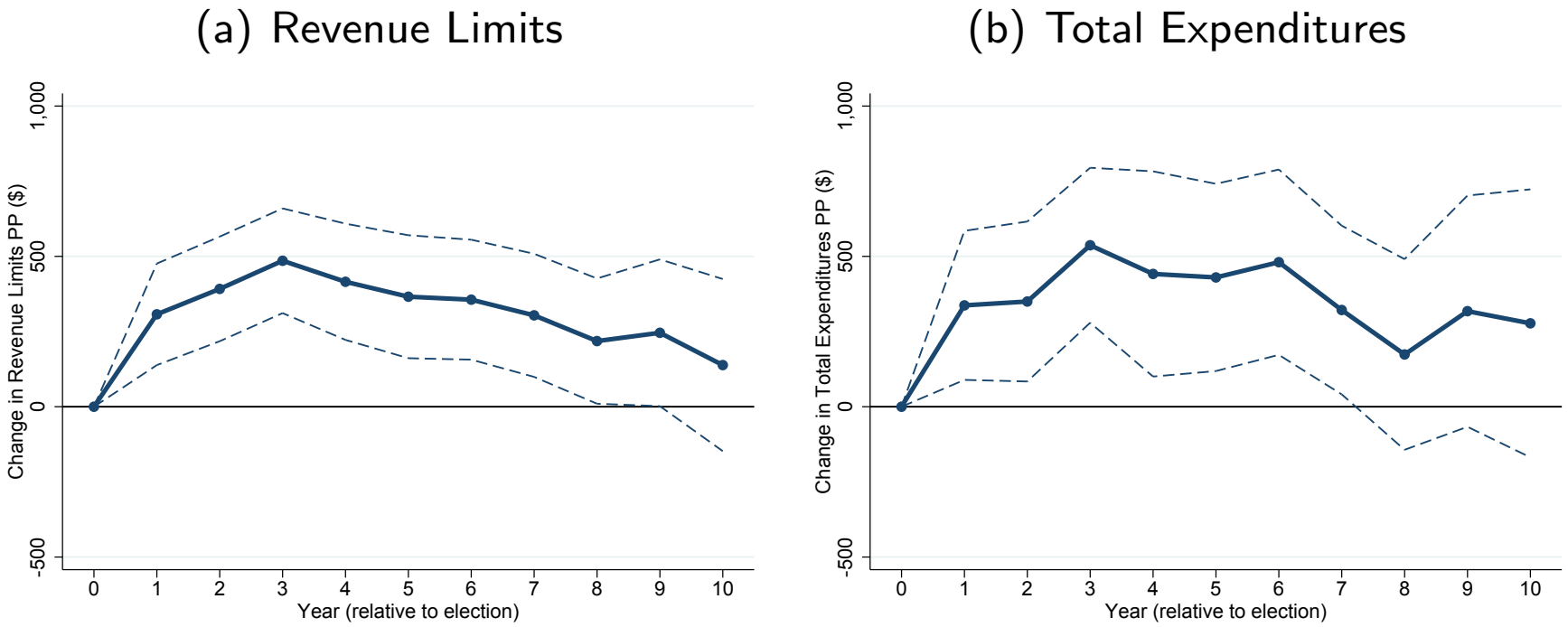
- Under the standard RD assumption, endogeneity can be addressed by augmenting equation (1) in the following way:

$$y_{dt} = \sum_{\tau=0}^{\bar{\tau}} (P_{d,t-\tau}\beta_\tau + m_{d,t-\tau}\kappa_\tau + f_g(v_{d,t-\tau})) + \mu_d + \theta_t + \varepsilon_{dt} \qquad (2)$$

- $m_{d,t-\tau}$ is an indicator for presence of a referendum on the ballot in year $t-\tau$
- $f_g(v_{d,t-\tau})$ is a flexible function of the vote share
- μ_d, θ_t represent district and year FEs, respectively
- β_τ measures the impact of passing a referendum in a narrow election in time $t-\tau$ on outcomes in year t

Operational Referenda Results

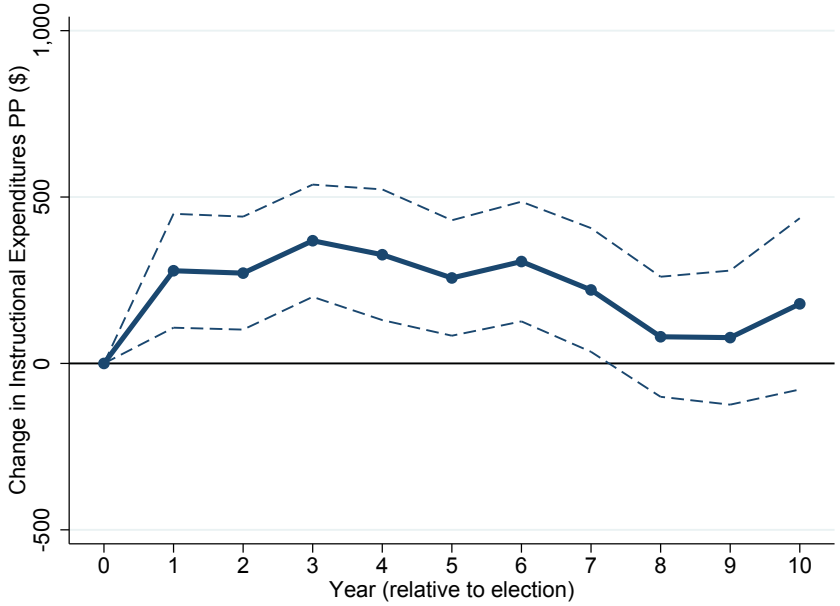
First Stage



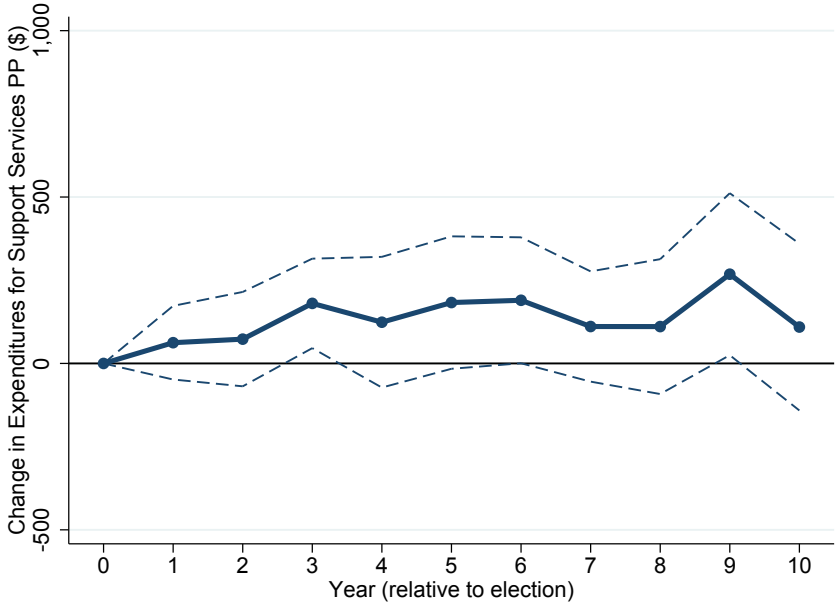
Operational Referenda Results

First Stage

(c) Instructional Expenditures



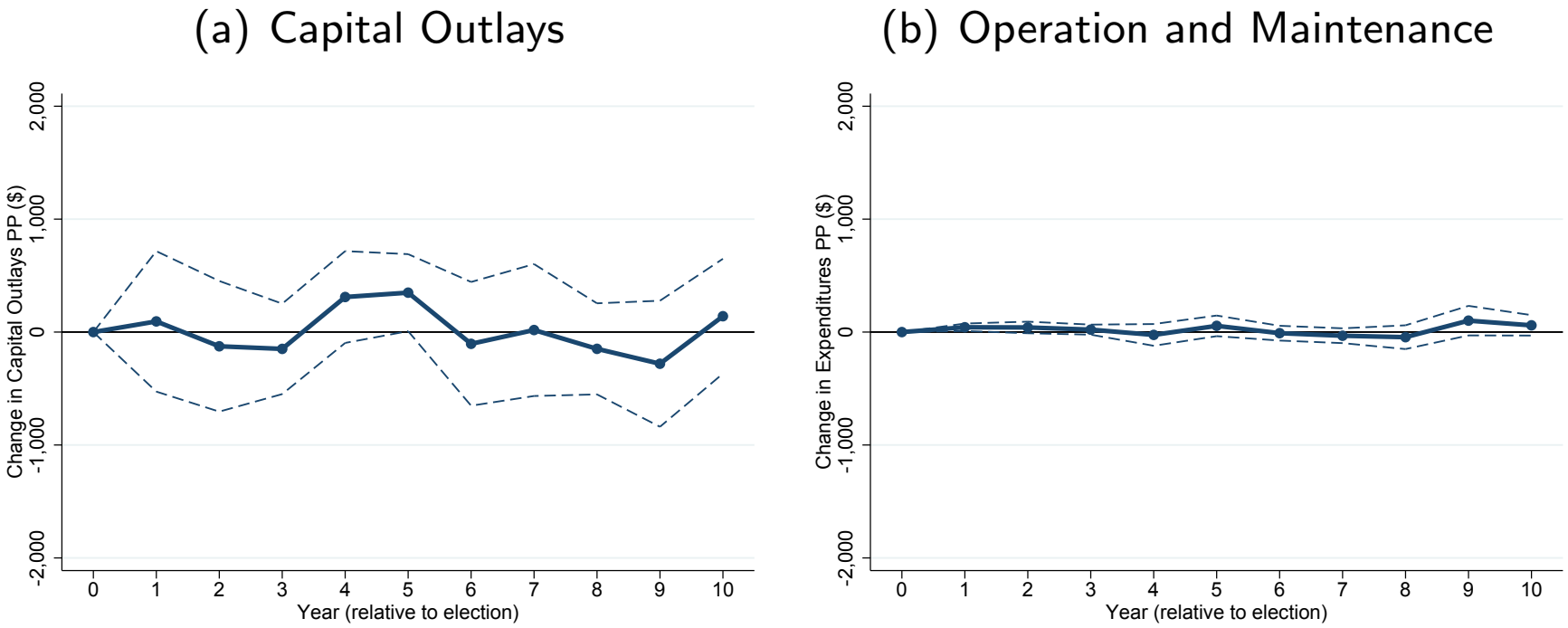
(d) Expenditures in Support Services



Detailed Support Services

Operational Referenda Results

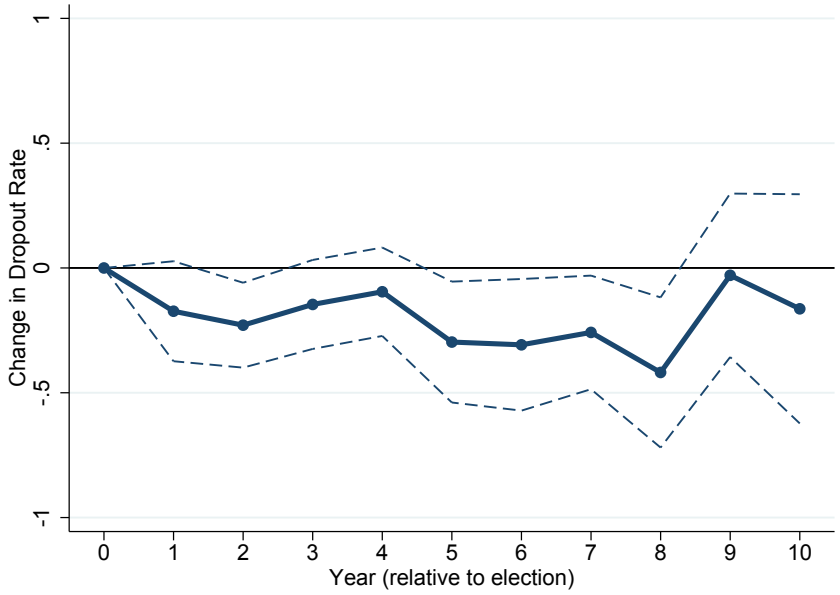
Placebo for Bond Measures



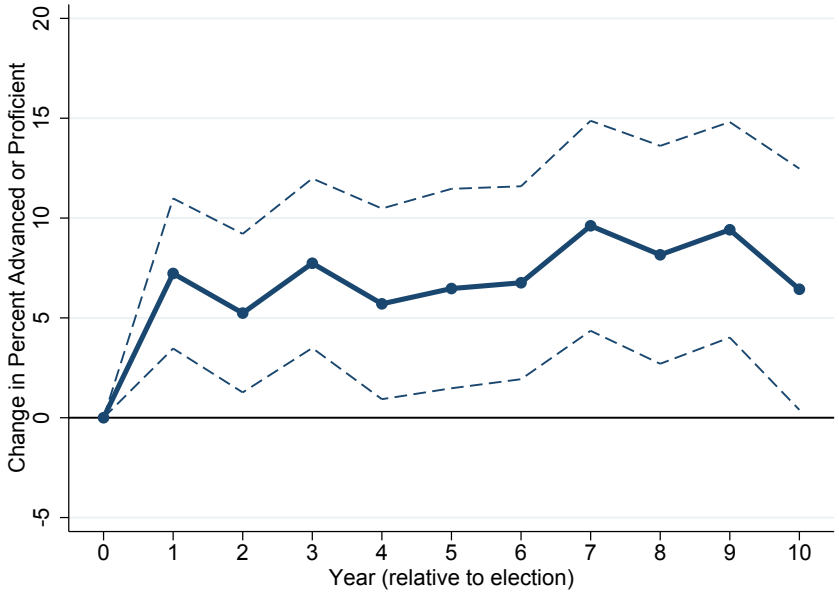
Operational Referenda Results

Second Stage

(a) Dropout Rate



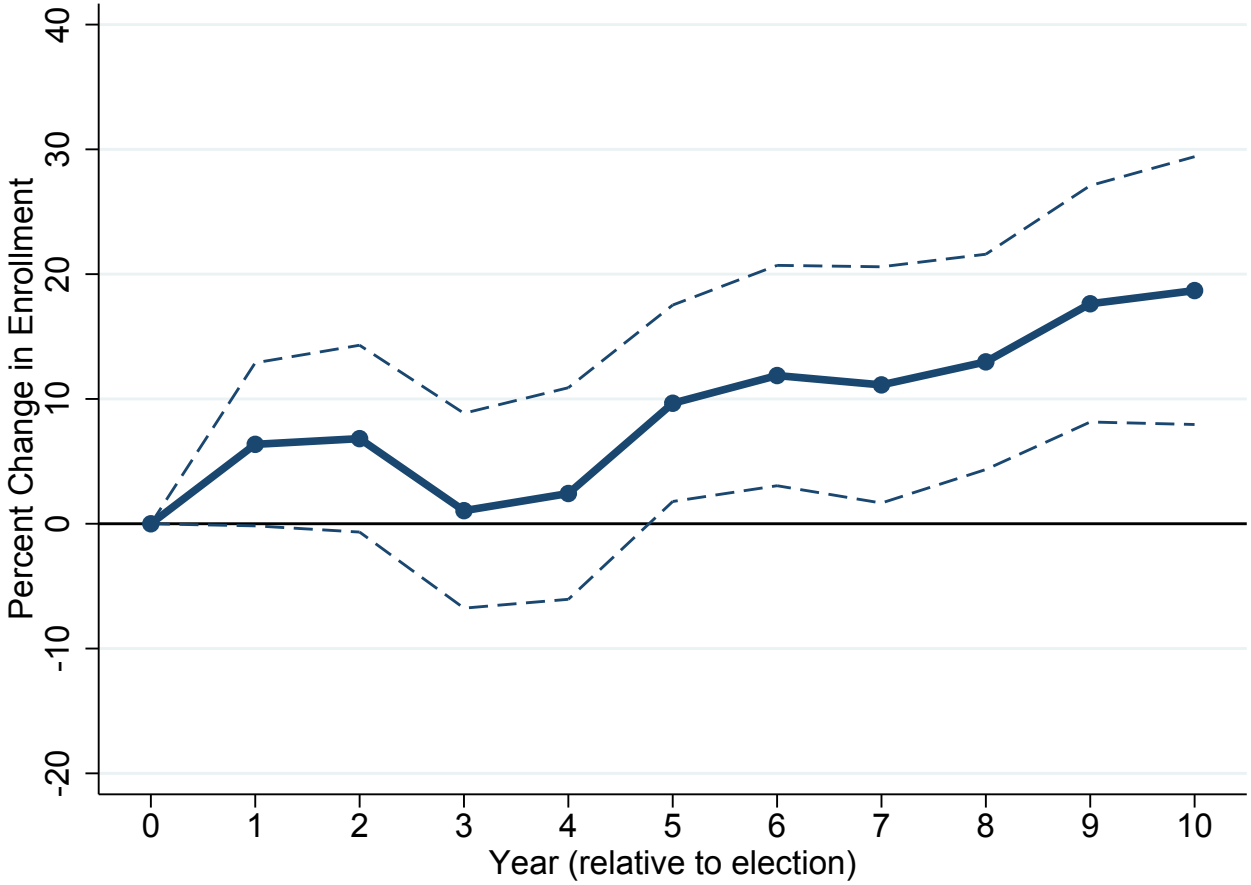
(b) 10th Grade WKCE



Operational Referenda Results

Second Stage

(c) Postsecondary Enrollment

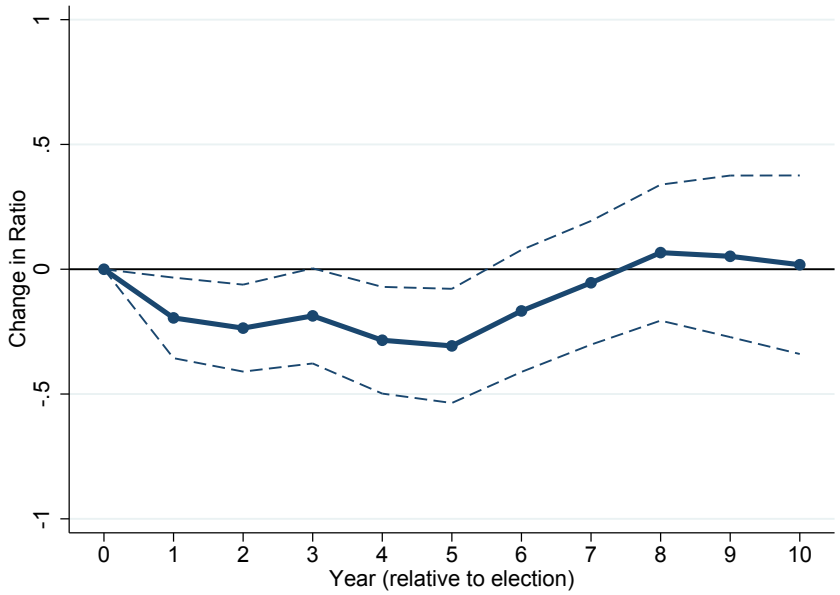


Robustness | Heterogeneity by Institution Type

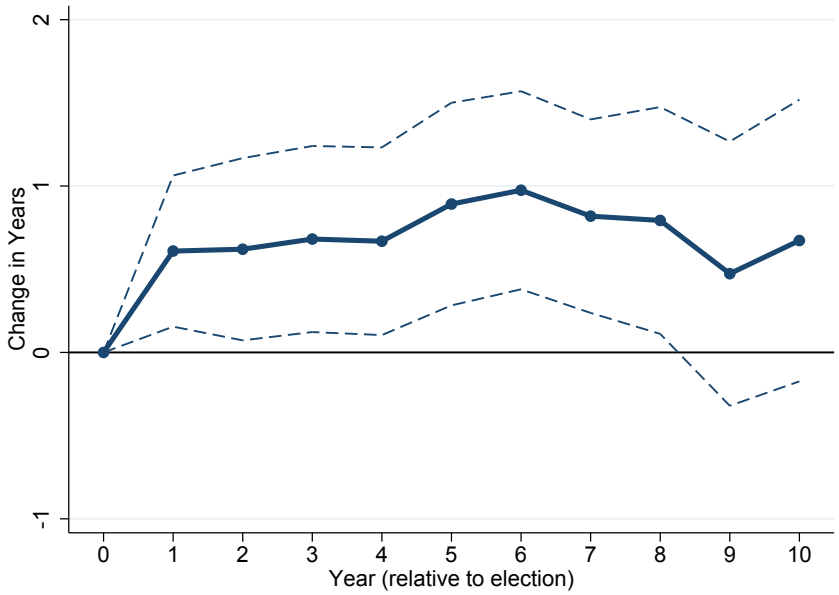
Operational Referenda Results

Mechanisms

(a) Student-Staff Ratio



(b) Average Teacher Experience

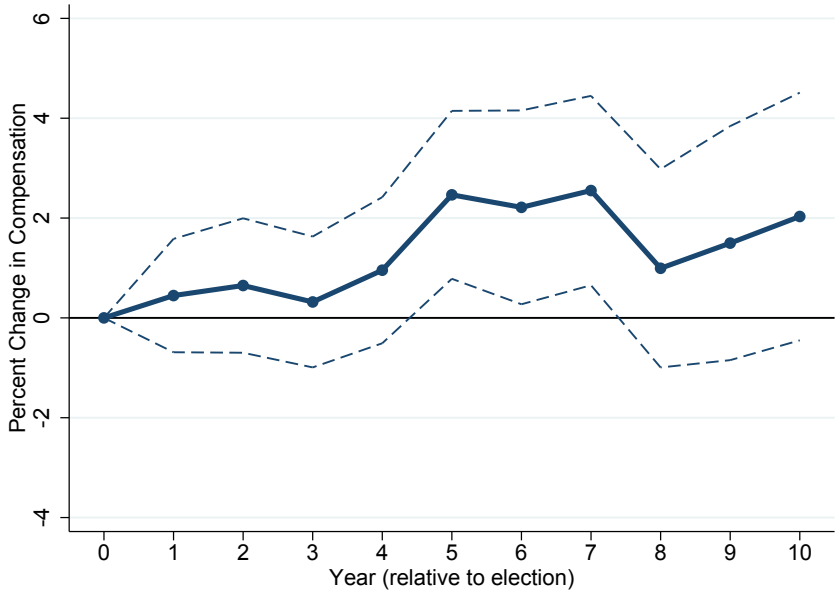


Effects by Staff Category

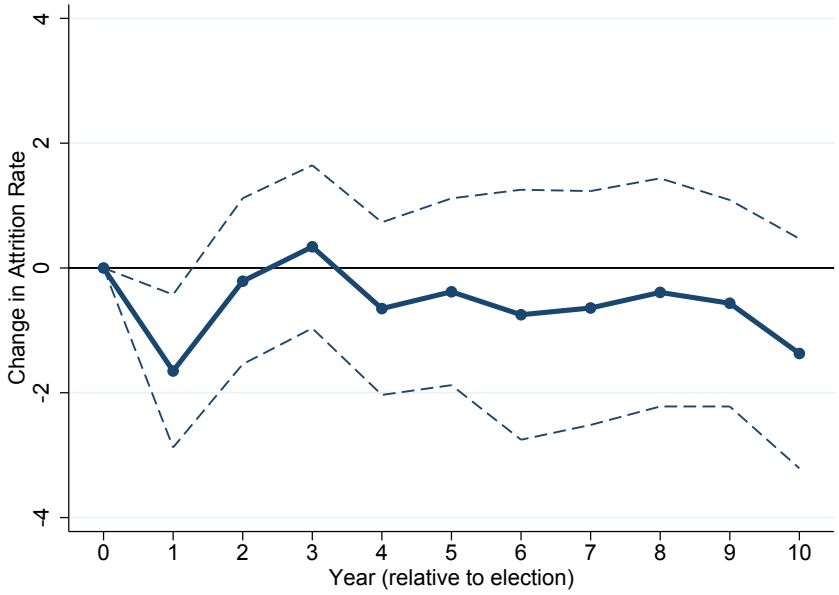
Operational Referenda Results

Mechanisms

(c) Teacher Compensation



(d) Teacher Attrition



Conclusion

- Earlier studies found little association between school spending and student outcomes, though they were unable to draw causal claims.
- Exploiting a novel source of plausibly exogenous variation in school spending, I find substantial improvements in test scores, retention, and postsecondary enrollment.
- Importantly, in the paper I show that how the additional resources are allocated matters: operational expenditures appear to be more effective at impacting student outcomes.

Thank You

- Additional Questions or Comments?
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- Website: www.ejasonbaron.com

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Martorell, P., K. Stange, and I. McFarlin Jr (2016). Investing in schools: capital spending, facility conditions, and student achievement. *Journal of Public Economics 140*, 13–29.

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Data

Summary Statistics

Dependent Variable	All Districts	Never Proposed	Proposed At Least One	Diff (2)-(3)
Fiscal Outcomes				
Revenue Limits PP	9,767	9,853	9,738	115
	(1,800)	(2,726)	(1,346)	(63)
Total Expenditures PP	10,598	10,528	10,622	-94
	(1,992)	(2,847)	(1,599)	(66)
Inst. Expenditures PP	6,373	6,340	6,384	-45
	(1,042)	(1,430)	(871)	(34)
Support Services PP	3,817	3,806	3,821	-15
	(1,060)	(1,508)	(856)	(35)
Other Expenditures PP	408	383	417	**-34**
	(125)	(146)	(116)	(4)
Number of School Districts	421	314	107	421

Data

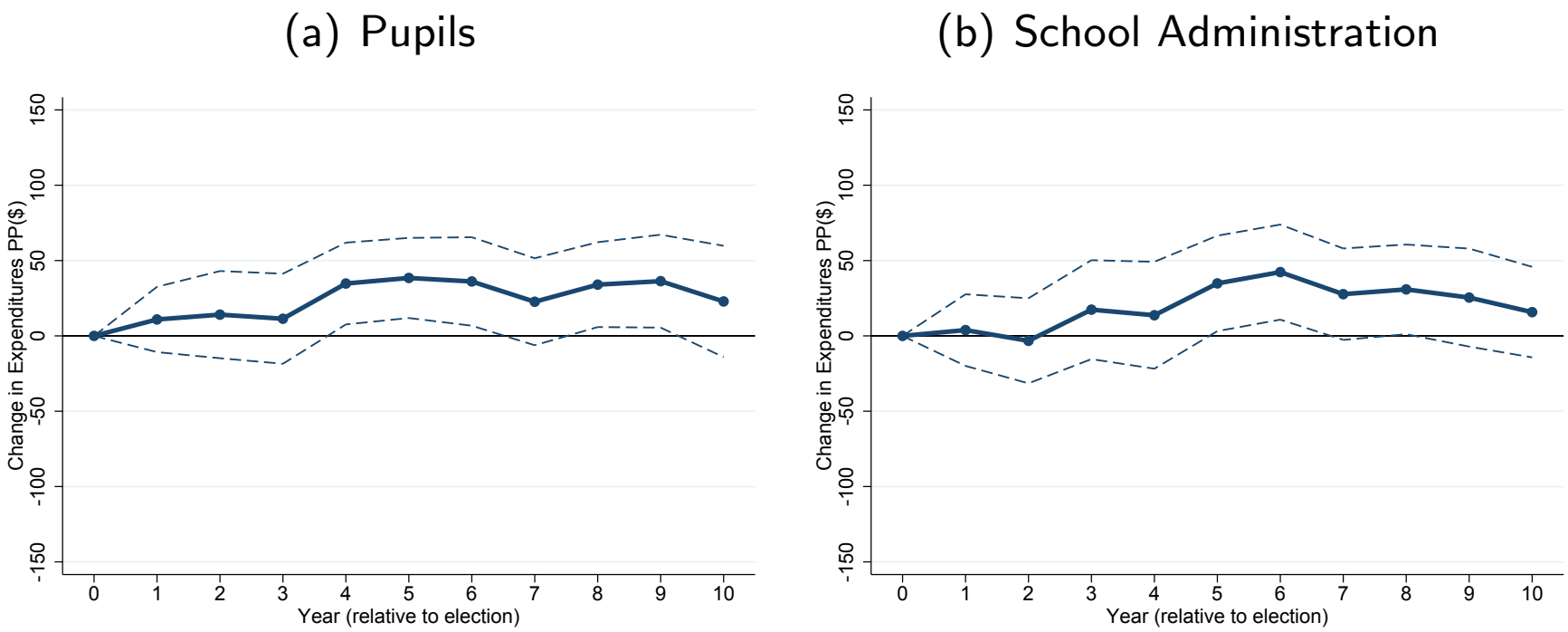
Summary Statistics

Dependent Variable	All Districts	Never Proposed	Proposed At Least One	Diff (2)-(3)
Student Outcomes				
Dropout Rate	1.51	2.68	1.01	**1.67**
	(1.97)	(2.91)	(1.03)	(0.31)
% Adv or Prof, 10th Grade	45.67	43.94	46.16	**-2.22**
	(12.81)	(13.48)	(12.57)	(0.55)
Postsecondary Enrollment	0.43	0.42	0.44	**-0.02**
	(0.11)	(0.12)	(0.11)	(0.01)
Number of School Districts	421	314	107	421

Go back

Results

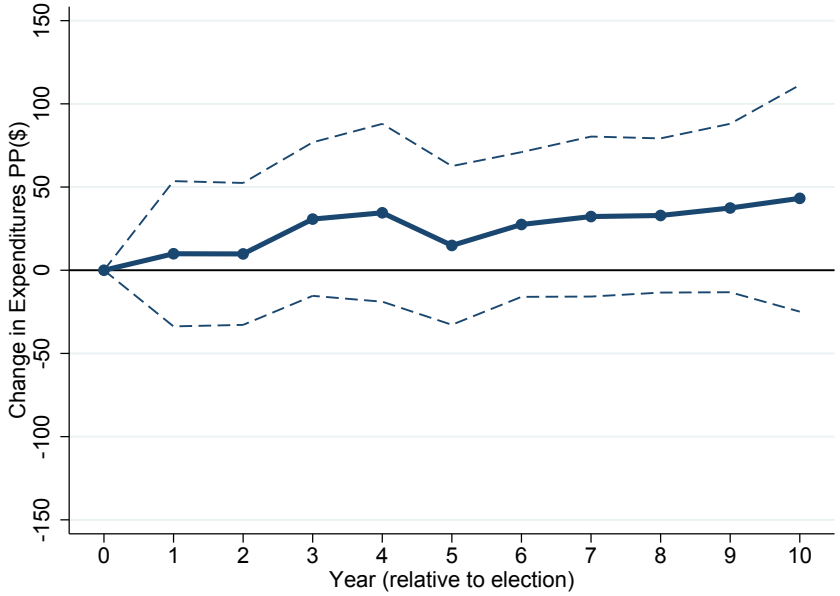
First Stage: Detailed Support Services Accounts



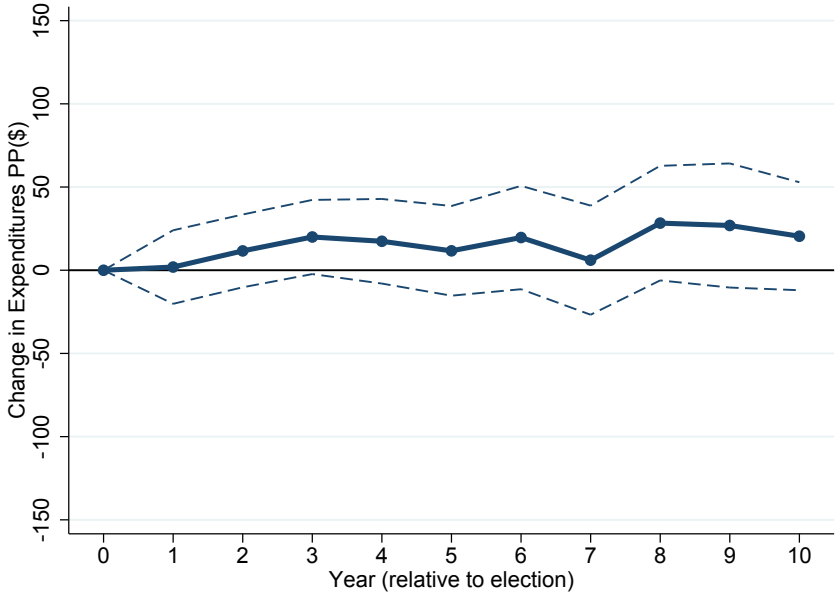
Results

First Stage: Detailed Support Services Accounts

(c) General Administration



(d) Student Transportation



Back to First Stage Results

Results

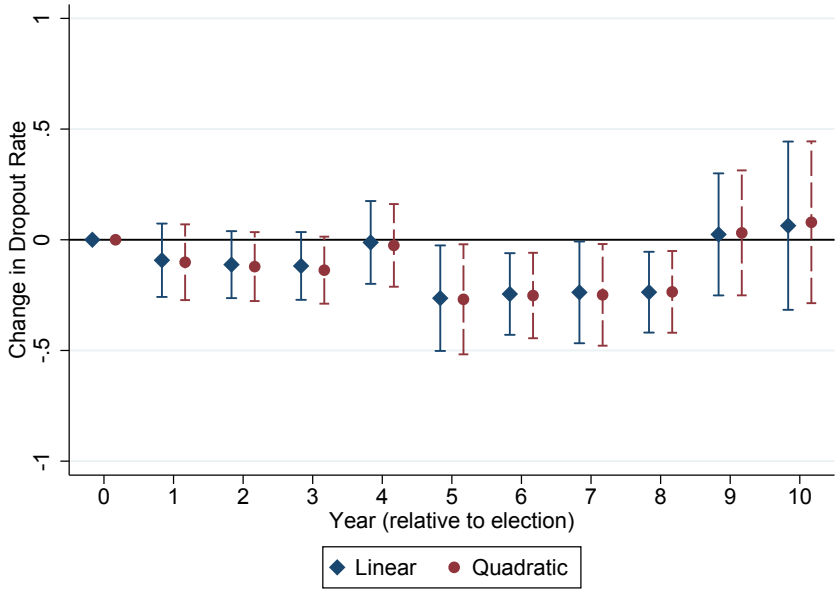
Robustness

- **Linear, quadratic specification of the vote share**
- **District-level demographics**
- Non-parametric RD with optimal bandwidth (Calonico et al., 2014)
- ITT Estimator
- Controls for election turnout
- Controls for the presence of a bond measure
- Controls for recurring vs nonrecurring
- End analysis prior to Act 10
- Estimate leads and leave out the year prior to the election

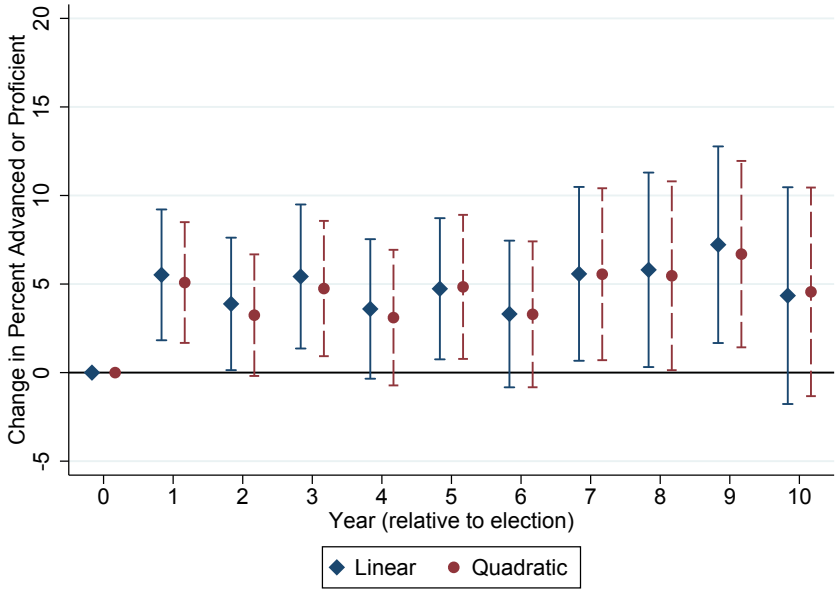
Results

Robustness: Linear and Quadratic Specifications

(a) Dropout Rate



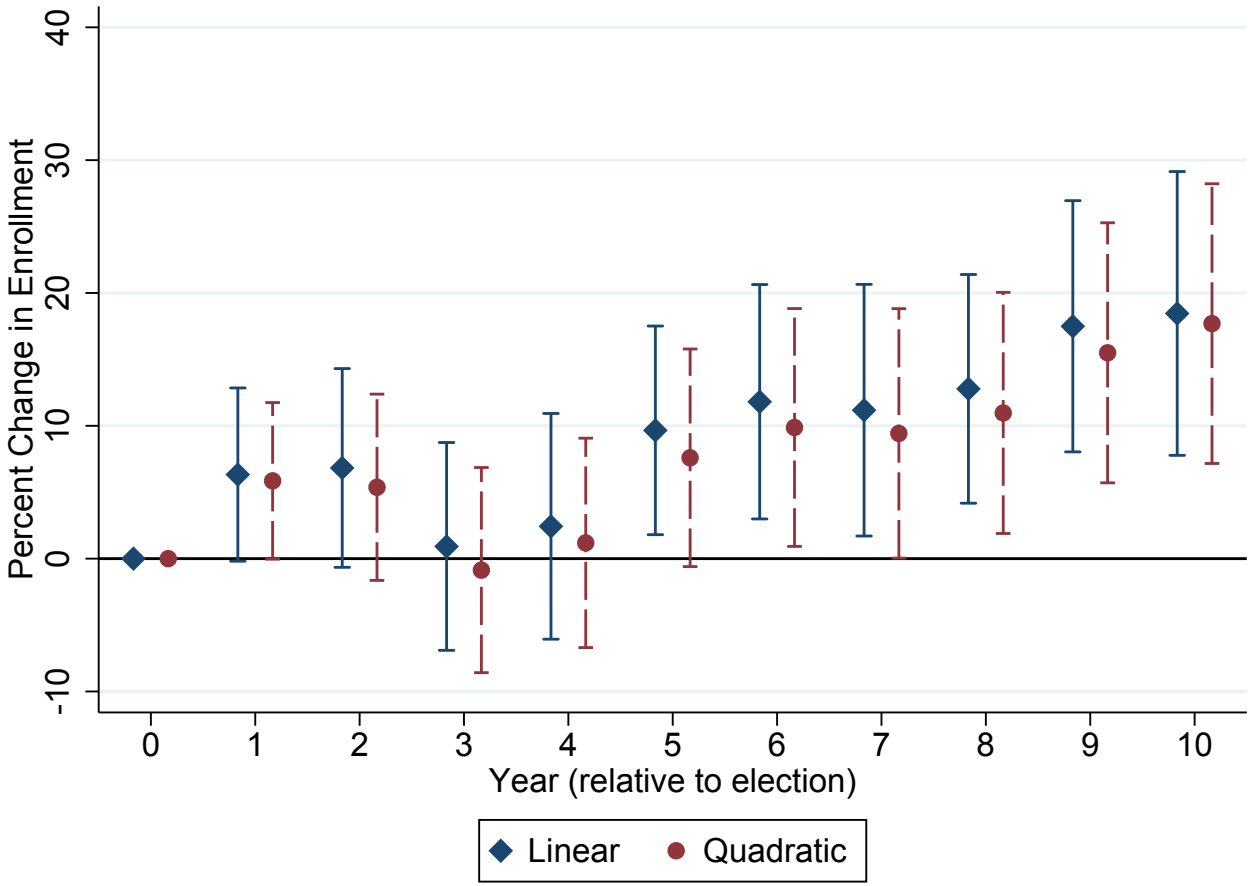
(b) 10th Grade WKCE



Results

Robustness: Linear and Quadratic Specifications

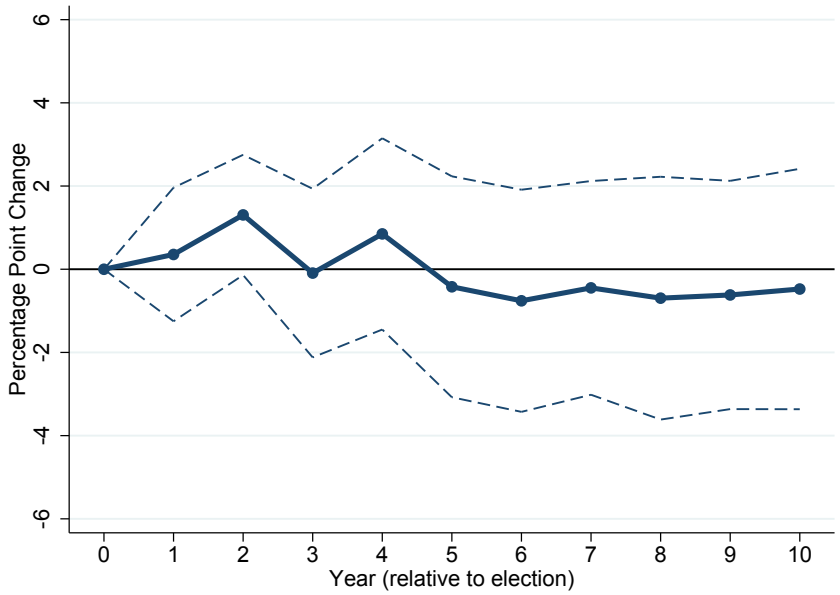
(c) Postsecondary Enrollment



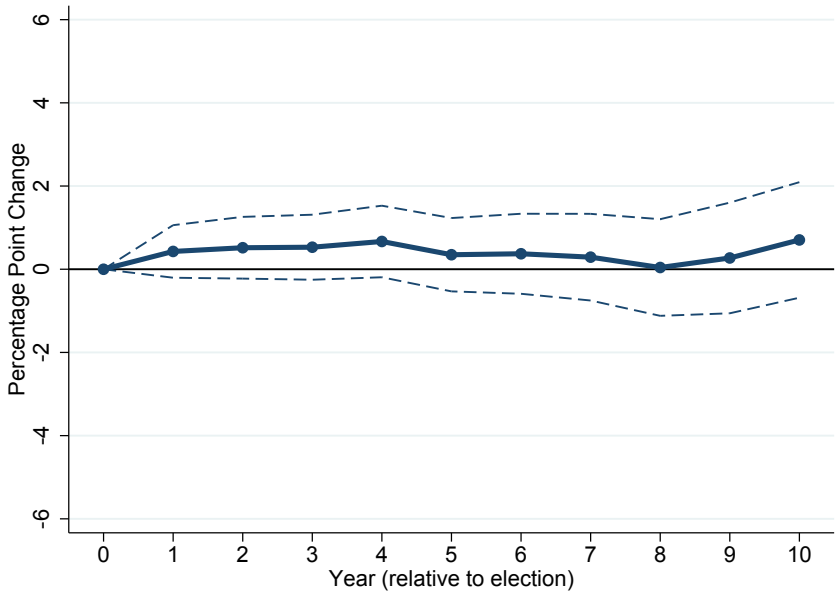
Results

Robustness: District-Level Demographics

(a) Share of Economically Disadvantaged



(b) Share of Minority Students

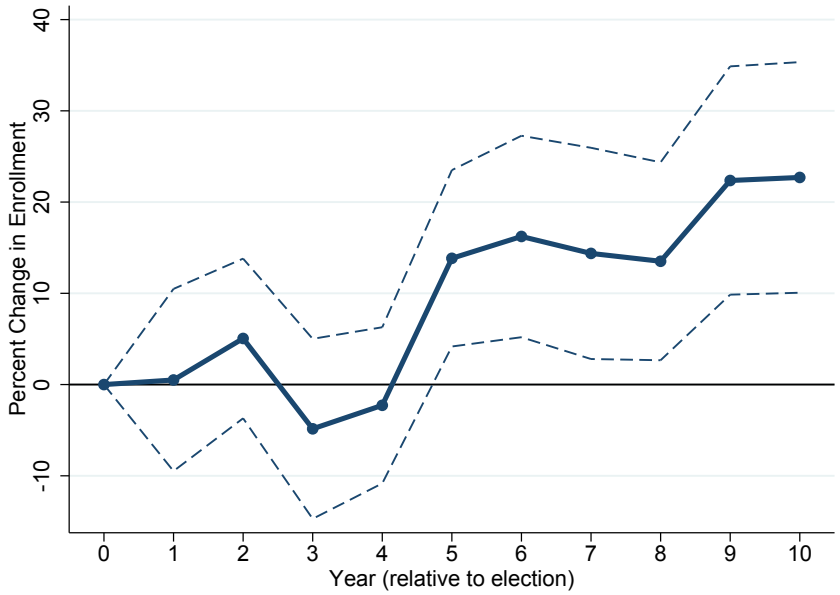


Go Back to Second Stage

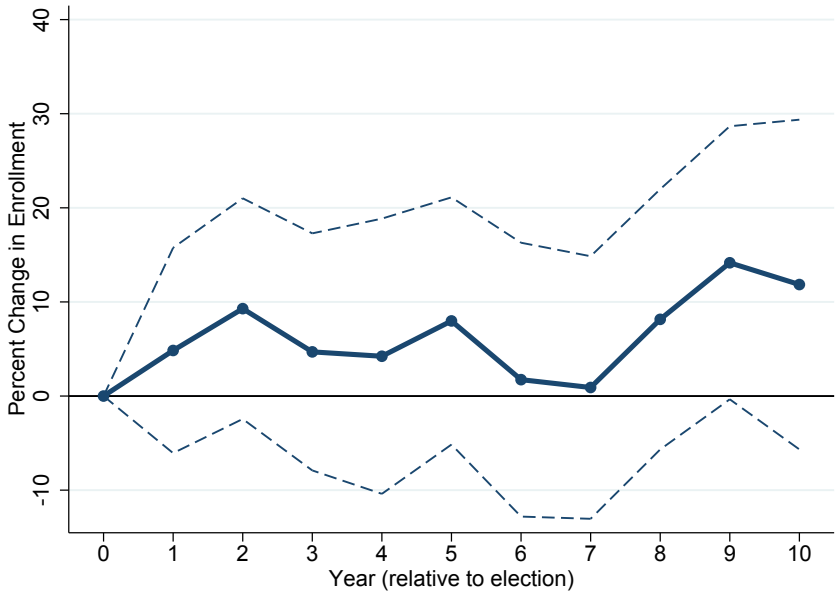
Results

Heterogeneity by Institution Level

(a) Enrollment in Four-Year Institutions



(b) Enrollment in Two-Year Institutions



Go Back to Results

Mechanisms

Effects on Student-Staff Ratio by Staff Category

	Year Relative to the Election			
Dependent Variable	**1 yr**	**2 yrs**	**3 yrs**	**4 yrs**
Student-Total Staff Ratio	**-0.19**	**-0.24**	-0.19	**-0.28**
	(0.10)	(0.11)	(0.12)	(0.13)
Student-Licensed Staff Ratio	**-0.28**	-0.28	-0.24	**-0.38**
	(0.13)	(0.14)	(0.17)	(0.19)
Student-Support Staff Ratio	-1.15	**-1.79**	-1.63	**-1.78**
	(0.75)	(0.79)	(0.85)	(0.89)
Student-Administrative Staff Ratio	11.72	2.67	0.01	7.23
	(13.44)	(10.80)	(11.60)	(11.46)

Go Back to Mechanisms

Future Work

- Heterogeneity by district demographics and socioeconomic characteristics / before and after Act 10
- Additional outcomes (crime, disciplinary incidents, test score gaps)
- Within-district effects: how do districts allocate the additional money across schools?
- Do increases in property taxes crowd out local private contributions?
- School finance effects: after 1993, state aid increases and property taxes decline - where does the additional money come from (e.g., income taxes)?