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

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November 22, 2019
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)
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.
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.
Wisconsin’s School Finance System

School District Revenue by Source (2014-15)

- **State Aid**: 45.7%
- **Property Taxes**: 42.7%
- **Federal Aid**: 7.4%
- **Other Local Rev.**: 4.2%

Percent

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Background
Wisconsin’s School Finance System

Time Series of Wisconsin’s School Mill Rate

Academic Year

Mill Rate


8 12 16 20
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).
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
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
### Dependent Variable

<table>
<thead>
<tr>
<th>Panel (a): Fiscal Outcomes</th>
<th>(t − 1)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue Limits PP</td>
<td>281.63</td>
<td>-69.52</td>
</tr>
<tr>
<td></td>
<td>(135.19)</td>
<td>(183.72)</td>
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<tr>
<td>Total Expenditures PP</td>
<td>461.69</td>
<td>-57.06</td>
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<td></td>
<td>(225.31)</td>
<td>(269.59)</td>
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<tr>
<td>Instructional Expenditures PP</td>
<td>303.31</td>
<td>-1.54</td>
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<tr>
<td></td>
<td>(128.10)</td>
<td>(209.82)</td>
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<tr>
<td>Support Services PP</td>
<td>168.07</td>
<td>-102.65</td>
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<tr>
<td></td>
<td>(103.25)</td>
<td>(120.17)</td>
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<tr>
<td>Other Expenditures PP</td>
<td>-9.69</td>
<td>47.13</td>
</tr>
<tr>
<td></td>
<td>(8.68)</td>
<td>(22.81)</td>
</tr>
</tbody>
</table>

| School Year FE             | Y       | Y       |
| Only Narrow Elections      | N       | Y       |
## Validity of the RD Design

### (2) Differences in Pre-Election Outcomes

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

$$y_{dt} = \sum_{\tau=0}^{\bar{\tau}} P_{d,t-\tau} \beta_\tau + \varepsilon_{dt}$$  \hspace{1cm} (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 $\beta_\tau$'s.
Under the standard RD assumption, endogeneity can be addressed by augmenting equation (1) in the following way:

$$y_{dt} = \sum_{\tau=0}^{\bar{\tau}} (P_{d,t-\tau} \beta_{\tau} + m_{d,t-\tau} \kappa_{\tau} + f_{g}(v_{d,t-\tau})) + \mu_{d} + \theta_{t} + \epsilon_{dt}$$

- $m_{d,t-\tau}$ 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
- $\mu_{d}, \theta_{t}$ represent district and year FEs, respectively
- $\beta_{\tau}$ 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

(a) Revenue Limits

(b) Total Expenditures
Operational Referenda Results
First Stage

(c) Instructional Expenditures

(d) Expenditures in Support Services

Detailed Support Services
Operational Referenda Results
Placebo for Bond Measures

(a) Capital Outlays

(b) Operation and Maintenance
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

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Operational Referenda Results
Mechanisms

(c) Teacher Compensation

(d) Teacher Attrition
- 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?
- E-mail: ejb15c@my.fsu.edu
- Website: www.ejasonbaron.com


## Data

### Summary Statistics

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>All Districts</th>
<th>Never Proposed</th>
<th>Proposed At Least One</th>
<th>Diff (2)-(3)</th>
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</thead>
<tbody>
<tr>
<td><strong>Fiscal Outcomes</strong></td>
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<tr>
<td>Revenue Limits PP</td>
<td>9,767</td>
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<td>(1,800)</td>
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<td>10,528</td>
<td>10,622</td>
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<td></td>
<td>(1,992)</td>
<td>(2,847)</td>
<td>(1,599)</td>
<td>(66)</td>
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<td>Inst. Expenditures PP</td>
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<td>(1,042)</td>
<td>(1,430)</td>
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<td>Support Services PP</td>
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<tr>
<td>Number of School Districts</td>
<td>421</td>
<td>314</td>
<td>107</td>
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</table>
## Summary Statistics

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>All Districts</th>
<th>Never Proposed</th>
<th>Proposed At Least One</th>
<th>Diff (2)-(3)</th>
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<tbody>
<tr>
<td>Student Outcomes</td>
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<tr>
<td>Dropout Rate</td>
<td>1.51</td>
<td>2.68</td>
<td>1.01</td>
<td>1.67</td>
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<td>(1.97)</td>
<td>(2.91)</td>
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<td>% Adv or Prof, 10th Grade</td>
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<td>43.94</td>
<td>46.16</td>
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<td>(12.81)</td>
<td>(13.48)</td>
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<td>Postsecondary Enrollment</td>
<td>0.43</td>
<td>0.42</td>
<td>0.44</td>
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<td>(0.11)</td>
<td>(0.12)</td>
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<td>(0.01)</td>
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<tr>
<td>Number of School Districts</td>
<td>421</td>
<td>314</td>
<td>107</td>
<td>421</td>
</tr>
</tbody>
</table>
Results
First Stage: Detailed Support Services Accounts

(a) Pupils

(b) School Administration
Results
First Stage: Detailed Support Services Accounts

(c) General Administration

(d) Student Transportation

Back to First Stage Results
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

![Graph showing percent change in enrollment over years relative to election, comparing linear and quadratic specifications.](image)
Results
Robustness: District-Level Demographics

(a) Share of Economically Disadvantaged

(b) Share of Minority Students
Results

Heterogeneity by Institution Level

(a) Enrollment in Four-Year Institutions

(b) Enrollment in Two-Year Institutions
## Mechanisms
### Effects on Student-Staff Ratio by Staff Category

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Year Relative to the Election</th>
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<td></td>
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<tr>
<td>Student-Total Staff Ratio</td>
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<td>(0.10)</td>
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<td>Student-Licensed Staff Ratio</td>
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<td>Student-Support Staff Ratio</td>
<td>-1.15</td>
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<tr>
<td></td>
<td>(0.75)</td>
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<tr>
<td>Student-Administrative Staff Ratio</td>
<td>11.72</td>
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<td>(13.44)</td>
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</tbody>
</table>

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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)?