Does additional spending help urban schools? An evaluation using boundary discontinuities

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Motivation (1)

• This is a school resources and achievement paper
• Spotlight on city schools
• Central question for high-level policy making
• If we give schools more money will children benefit?
• Particularly pertinent to coalition education funding policy
• i.e. the Pupil Premium
Motivation (2)

• New evidence based on interesting spatial policy anomaly in England

• Area Cost Adjustments (ACA) in central government funding formulae to compensate for labour costs

• Close neighbouring primary schools are (self-evidently) in same labour market but different Local Authorities (LAs)

• Receive different LA-income from ACAs
A Fair Deal for Haringey Children!

Haringey’s schools are short changed because the Government gives them less money to teach each child than other Councils with similar costs.

Government cash per pupil
(DSG per pupil 2008/9)

Hackney £6170
Camden £6161
Haringey £4987

The Government thinks each child in Haringey is worth about £1000 less (each year) than in Hackney, Camden or Islington.

£1000 per pupil would pay for smaller classes, more books and computers, and better equipment – more individual attention for your child!

It’s plainly unfair that schools on one side of a road, teaching similar children, get more cash than schools on the other side:

* A school on the Haringey side of Seven Sisters Road receives £1183 less per child than a school on the Hackney side.
* A school on the Haringey side of Highgate High Street receives £1174 less per child than a school on the Camden side.

HARINGEY CHILDREN NEED SMALLER CLASSES JUST AS MUCH AS HACKNEY, CAMDEN AND ISLINGTON CHILDREN.

The government’s own figures show similar levels of need in all four Councils.
Empirical issues in SR literature

- School funding follows student needs
- Both in allocation from central government, and (less so) from LAs to schools
- Schools raise additional income – dependent on leadership quality, and on intake
- School resources potentially dependent on various aspects of school quality
- Also, potential sorting of students according to resources.
- Hard to find good research designs
Existing evidence

• ... therefore, generally little conclusive evidence from effects of resources (money, teacher-pupil ratios).

• Some experimental studies have more (but contestable) positive findings

• Relatively few recent GB studies e.g.:
  – Levacic, Jenkins et al (2005, 2006) find (mixed) +ve effects on KS3 (maths and science) and GCSE (science) using political and school size IV
Our research design (1)

- Estimates the ‘causal’ effects of resources on test scores from diffs. in school expenditure between neighbouring schools on opposite sides of LA boundaries
- Discontinuity design ensures similarity of school locality, but dissimilarity in expenditure
- Instrument differences in expenditure with LA-level income or ACA index used in central gov funding formula
- Assumes diffs. in LA-income/ACA uncorrelated with diffs. in school Xs across boundaries
Our research design (2)

- Not possible to show which expenditure categories matter
  - Not enough instruments

- We provide some indirect evidence by looking at relationship between expenditure shares and income differences for cross-boundary neighbouring schools
Data

- National Pupil Database (NPD), England, covers large majority of population 2004-2009
- National tests Year 6 (age 11, primary school) in Maths Science and English (and age 7)
- Pupil characteristics – age, gender, FSM, ethnicity, SEN, EFL. Census OA code for home.
- School postcodes used to find distances to nearest schools and LA boundaries (GIS)
- School expenditure data from CFR
- Central gov. funding from DfE spreadsheets
Data setup

• K-nearest-neighbour school clusters
• Used to give group fixed effects to generate cross-boundary diffs.
• Each school $s$ matched to nearest schools $r$ - same type, within 5 percentiles of FSM, within 2km - in different LA
• Panel with school $s$ repeated for multiple years, and multiple schools $r$
• Students joined to school panel.
Data setup: k-nn school cluster FE
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Test scores: estimation (FE)

- Effect of total school expenditure on Key Stage 2 test scores

\[ \Delta ks2_{ist} = \beta \Delta expenditure_{st} + \Delta \varepsilon_{ist} \]

- Where \( \Delta \rightarrow \) deviation from k-nn school means
- \( ks2_{ist} \): is ks2 score of student i, school s, year t
- \( expenditure_{st} \): is total expenditure per student (4 year mean) in school s, year t
- \( \varepsilon_{ist} \): other stuff
Instruments for expenditure

- Potential predictors for $\Delta expenditure_{st}$
- Average income paid to schools from LA:
  
  \[ expenditure = \text{school and other sources} + \text{LA income} \]

- Area cost adjustment in cent gov grant to LA
  
  \[ \text{LA grant} = \text{base allocation} + \text{needs index} + \text{ACA} \]

- Diffs in LA-income (mean in all LA’s schools) or ACAs provide potential instruments for diffs in expenditure across LA boundaries
The 4-nn school sample
## Results: Key descriptives

<table>
<thead>
<tr>
<th></th>
<th>Full data set</th>
<th>4-nn boundary sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>s.d.</td>
</tr>
<tr>
<td>Age-11 Total score</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>School total expenditure pp</td>
<td>£3256</td>
<td>£645</td>
</tr>
<tr>
<td>Income from LA grants pp</td>
<td>£2589</td>
<td>£277</td>
</tr>
<tr>
<td>ACA index</td>
<td>1.041</td>
<td>0.063</td>
</tr>
<tr>
<td>Distance to LA boundary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>0.509</td>
<td>-</td>
</tr>
<tr>
<td>FSM</td>
<td>0.166</td>
<td>-</td>
</tr>
<tr>
<td>Age in months (within year)</td>
<td>5.47</td>
<td>3.48</td>
</tr>
<tr>
<td>English first language</td>
<td>0.881</td>
<td>-</td>
</tr>
<tr>
<td>White British</td>
<td>0.820</td>
<td>-</td>
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<tr>
<td>Student observations</td>
<td>3318152</td>
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</table>
Results: the instruments

Note: s.d of cross-boundary differences in school expenditure = £440

LA-mean income to schools (£000s per pupil)

s.d. = £242

School expenditure predicted from ACA differentials (£000s per pupil)

s.d. = £116
OLS/FE : £1k pp on std ks2 scores

- OLS: -0.154
- OLS/x: -0.013
- FE school exp: -0.054
- FE school exp x: 0.019
- FE LA exp: 0.139
- FE LA exp x: 0.179
IV/IV-FE: £1k pp on std ks2 scores

1st stage F-stats: LA-inc>170; ACA >66

- LA-inc IV: -0.092
- LA-inc IVx: 0.088
- ACA-IV: -0.078
- ACA-IVx: 0.089
- FE-LA-inc IV: 0.234
- FE-LA-inc IVx: 0.245
- FE-ACA-IV: 0.201
- FE-ACA-IVx: 0.320
Sensitivity to school cluster max size

![Bar chart showing sensitivity to school cluster max size with different school cluster sizes and sensitivities indicated by bars.]
### Boundaries without roads, rail etc.

<table>
<thead>
<tr>
<th>Control variables</th>
<th>LA income FE-IV</th>
<th>LA income FE-IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Total expenditure 4 yr mean per pupil (1000s)</td>
<td>0.225*** (0.067)</td>
<td>0.209** (0.064)</td>
</tr>
<tr>
<td>First stage: F-stat</td>
<td>195.8</td>
<td>160.1</td>
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</tbody>
</table>

297138 students in 833 4-school clusters
### School non-LA income sources

<table>
<thead>
<tr>
<th>Control variables</th>
<th>All non-LA</th>
<th>Charitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

| Mean LA income per pupil (1000s) | 0.056 (0.063) | 0.074 (0.045) |

8123 schools in 973 4-school clusters
### Subject specific effects

<table>
<thead>
<tr>
<th>Control variables</th>
<th>LA income FE-IV</th>
<th>LA income FE-IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maths score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total exp. pp (£000s)</td>
<td>0.198***</td>
<td>0.221***</td>
</tr>
<tr>
<td></td>
<td>(0.059)</td>
<td>(0.055)</td>
</tr>
<tr>
<td>Science score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total exp. pp (£000s)</td>
<td>0.260***</td>
<td>0.261***</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>English score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total exp. pp (£000s)</td>
<td>0.169**</td>
<td>0.175**</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td>(0.063)</td>
</tr>
</tbody>
</table>
Expenditure shares: estimation

• Effect of total school expenditure on expenditure shares

\[ \Delta \text{share}^c_{st} = \gamma^c \Delta \text{expenditure}^t_{st} + \Delta \varepsilon^c_{st} \]

• Where \( \Delta \rightarrow \) deviation from k-nn school means

• \( \text{share}^c_{st} \): is share of item c, school s, year t

• \( \text{expenditure}^t_{st} \): is total expenditure per student in school s, year t; IV using income (mean) from LA

• \( \varepsilon^c_{st} \): other stuff
Expenditure shares: effects of £1k pp

- Teachers: 56.4%
- Educ support staff: 14.7%
- Develop & Train: 0.5%
- Premises: 6.6%
- Learning resources: 0.014
- Professional services: 0.014
- Supplies: 3.8%
- Other: 1.8%

Chart showing expenditure shares with specific values for each category.
Summary and conclusions (1)

- Evidence for causal effects of school spending on achievement from LA-income differentials and Area Cost Adjustments
- £1000 per student school spending (per year) raised achievement by ~0.25 s.d. age 11
- Spending more effective in schools with more ‘disadvantaged’ students
- Similar order of magnitude to Levacic, Jenkins et al (2005) for ks3 (using political IV). Larger than McNally et al 2010 (who use changes over time)
Summary and conclusions (2)

• This effect is equivalent to moving 19% of students currently achieving Level 4 in maths (the target grade) to Level 5 (the top grade) and 31% of students currently at Level 3 maths to Level 4
Summary and conclusions (3)

• Caveats: context dependent – results based on existing institutional arrangements
• Doesn’t tell us how heads should spend money
• Although no evidence of big differences in expenditure patterns between high and low income schools
• Results imply that the average boundary school responds to £1000 pp by reducing share on teachers (56.4% to 52.7%) and increase share on supplies and resources (11.5% to 15.2%)
Summary and conclusions (4)

- Coalition ‘Pupil Premium’ targets £430 to each FSM student rising x4 (?) by 2014
- worth ~£80 per student in 2011/12
- Redistributive, but don’t expect big effects on average
- Actual income differences from LAs had consequences for achievement
- 1.s.d in the x-boundary income difference is over £440 of which £116 due to ACA