



Institute for
Fiscal Studies

Constrained optimisation? Teacher salaries, school resources and student achievement

Luke Sibieta

February 2016

How should individual schools make use of teacher pay flexibility?

- Schools are gaining more autonomy over level and structure of teacher pay
 - Each school in England must have its own teacher pay policy from 2013
 - Charter schools in US also have flexibility
- How can schools use this flexibility to improve teacher quality and student achievement?
 - Change level of pay? How to reward experience? Link to performance?
- And how can they do this within a fixed budget from government
- Focus here on the likely impact of an individual school raising the level of teacher pay given a fixed budget

How teacher pay can affect student achievement

1. Occupational choice to become a teacher

- Career choices driven by overall levels of teacher pay and alternative wage opportunities

2. Motivation effects for existing teachers

- Higher levels of teacher pay increase teacher effort

3. Sorting of existing teachers across schools

- Schools offering higher salaries get more applications
- If extra applicants are of higher quality, schools able to pick higher quality teachers

Existing empirical evidence on link between teacher pay and student achievement

- US evidence shows increases in teacher wages across states is associated with reduced high school drop out rates (*Loeb and Page, 2001*)
- Higher levels of outside wage opportunities in a region reduces pupil attainment in England (*Britton and Propper, 2016*)
- Higher levels of teacher pay or flatter wage profile can reduce teacher drop-out (*Hendrick, 2014*)
- Largely relate to occupational choices and/or motivation mechanisms
- Know little about the effect of individual schools raising teacher pay on student achievement through sorting of teachers across schools

And not forgetting the budget constraint...

- Schools make decisions within fixed budget from government
- But existing evidence on variation in actual teacher pay implies schools compensated with higher budgets
- Over-estimates total effect which will include effects of changes in other resource margins
- Of interest to know how schools would go about adjusting other resources margins in order to pay higher salaries
 - Change numbers or mix of teachers
 - Change number of other staff
 - Change non-staff spending

Institutional Context

School System

- Focus on primary schools (age 4-11)
- Key Stage 2 tests at age 11 – English and Maths

School Funding

Teacher Labour Market

Institutional Context

School System

School Funding

- Central government provides grants to local authorities (to reflect need/costs)
- Local authorities allocate funds to schools using own formulae (pupils, chars, etc...)

Teacher Labour Market

Institutional Context

School System

School Funding

Teacher Labour Market

- Schools post vacancies and teachers apply to individual schools
- National pay and conditions
- Teacher pay scales over period of study (**M1-6, U1-3**)
- Examine period from 2006-2011, before new teacher pay flexibilities

Institutional Context

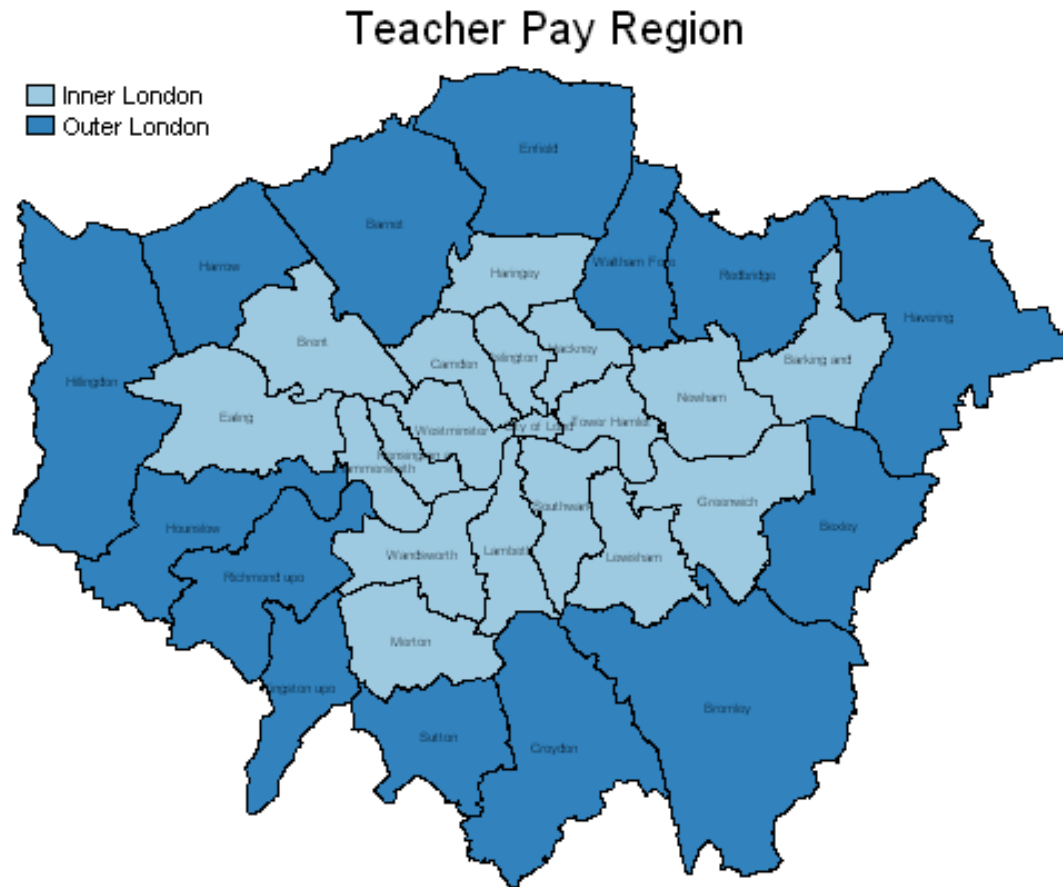
School System

School Funding

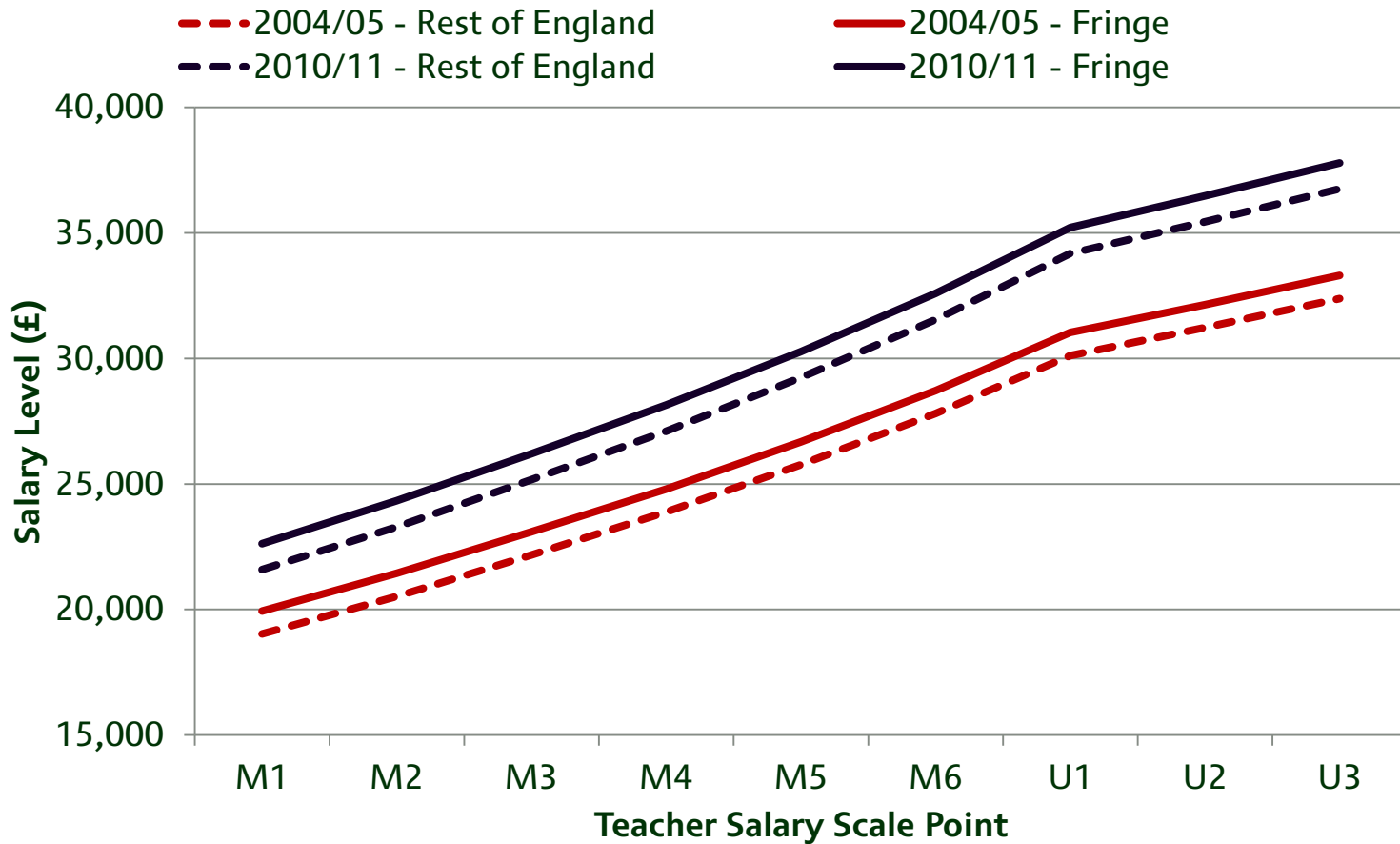
Teacher Labour Market

- Schools post vacancies and teachers apply to individual schools
- National pay and conditions
- Teacher pay scales over period of study (M1-6, U1-3)
- *Higher Pay Scales in London Area to reflect higher cost of living*
- *Compare schools either side of pay boundaries to look at effects of teacher pay*

Inner and outer London pay zones coincide with other relevant administrative boundaries



Pay differential between Fringe and Rest of England has remained at £1,000 throughout scale over time



Resource choices and student achievement

- Interpret pay boundary as increase in minimum salary for teachers
 - Schools can pay more if they want to...
- What happens to school funding at boundary crucial for interpretation
 - No evidence of a difference in funding per pupil at boundary (see later)
 - Schools must pay higher teacher salaries from a fixed budget
- **Potential resource choice effects**
 - Reduction in teacher numbers; increase in other inputs
 - Quantity regulation and discrete nature of teacher numbers could limit such effects
 - Smoothing of differences in actual teacher pay levels through other means?
 - Change in mix of teachers
- **Effect on student achievement represent combined effect of resource choices**

Empirical Methodology

- Schools should be similar either side and close to Fringe Pay Boundary
 - Pupil characteristics are very similar
- Compare school-level resource choices and student achievement within 2 km of Fringe Boundary
 - Vary measure of closeness as robustness check
 - Estimate raw and conditional differences
- **Data**
 - National Pupil Database (2005-06 to 2010-11) for age 11 test results, pupil & school characteristics; exclude 2009-10 data due to SATs boycott
 - LEASIS/Edubase – School characteristics
 - School Workforce Census – Teacher Pay Levels and Characteristics
 - Section 251/CFR – Income and expenditure data for schools

Expenditure choices

Table 2: Difference in funding and expenditure across Fringe/Rest of England Boundary 2006 to 2011: various distances to pay boundary

Standard Errors: Clustered by Local Authority
Fully Interacted Linear Matching Estimates

Outcome	(1) Within 1 km of boundary	(2) Within 2 km of boundary	(3) Within 3 km of boundary
Grant funding per pupil (£)	12.75 [42.42]	-14.68 [30.76]	-49.72 [27.24]
Total income per pupil (£)	-44.75 [46.71]	-38.94 [34.42]	-57.05 [30.05]
Total expenditure per pupil (£)	-74.17 [47.29]	-56.46 [56.1]	-65.75 [30.7]*
School and Year Controls		Yes	
Observations (schools)	599 (120)	1277 (256)	1831 (368)

Note: OLS, FILM and Matching include detailed school-level controls for number of pupils, %FSM, %SEN, %EAL, %Non-white, IMD, IDACI, region of London and school-type.

Detailed resource margins

Table 3: Difference in staffing and teacher pay across Fringe/Rest of England Boundary 2006 to 2011: various distances to pay boundary

Standard Errors: Clustered by Local Authority
Fully Interacted Linear Matching Estimates

Outcome	(1) Within 1 km of boundary	(2) Within 2 km of boundary	(3) Within 3 km of boundary
<u>Teacher Remuneration (2011 only)</u>			
Teacher Salary, £	639.99 [637.57]	950.26 [413.50]*	758.66 [323.28]*
Teacher Total Pay, £	995.14 [903.39]	1080.97 [518.19]*	850.48 [386.21]*
Average salary Scale Point (1-9)	-0.12 [0.18]	-0.01 [0.14]	-0.07 [0.11]
School and Year Controls			
Pooled observations (schools)	599 (120)	1277 (256)	1831 (368)
2011 Schools	115	243	349

Note: OLS, FILM and Matching include detailed school-level controls for number of pupils, %FSM, %SEN, %EAL, %Non-white, IMD, IDACI, region of London and school-type.

Expenditure choices

Table 2: Difference in funding and expenditure across Fringe/Rest of England Boundary 2006 to 2011: various distances to pay boundary

Standard Errors: Clustered by Local Authority
Fully Interacted Linear Matching Estimates

Outcome	(1) Within 1 km of boundary	(2) Within 2 km of boundary	(3) Within 3 km of boundary
Grant funding per pupil (£)	12.75 [42.42]	-14.68 [30.76]	-49.72 [27.24]
Total income per pupil (£)	-44.75 [46.71]	-38.94 [34.42]	-57.05 [30.05]
Total expenditure per pupil (£)	-74.17 [47.29]	-56.46 [56.1]	-65.75 [30.7]*
School and Year Controls		Yes	
Observations (schools)	599 (120)	1277 (256)	1831 (368)

Note: OLS, FILM and Matching include detailed school-level controls for number of pupils, %FSM, %SEN, %EAL, %Non-white, IMD, IDACI, region of London and school-type.

Differences in Student Achievement at Age 11

Table 4: Difference in student achievement across Fringe/Rest of England Boundary 2006 to 2011: various distances to pay boundary

Standard Errors: Clustered by Local Authority
Fully Interacted Linear Matching Estimates

Outcome	(1) Within 1 km of boundary	(2) Within 2 km of boundary	(3) Within 3 km of boundary
KS2 Fine Points Score (std)			
English	0.01 [0.03]	0.02 [0.02]	0.01 [0.02]
Maths	-0.01 [0.03]	-0.02 [0.02]	-0.01 [0.02]
School and Year Controls		Yes	
Pooled observations (schools)	599 (120)	1277 (256)	1831 (368)

Note: OLS, FILM and Matching include detailed school-level controls for number of pupils, %FSM, %SEN, %EAL, %Non-white, IMD, IDACI, region of London and school-type.

Summary and policy implications

- Schools must pay higher teacher salaries from within fixed budgets
- Actual teacher pay is in line with salary scale differences, despite opportunities for schools to smooth difference
- Schools reduce non-teaching expenditures to pay higher salaries
- No differences in student achievement resulting from resource shifts

- Using pay differentials to compete for high-quality teachers is unlikely to be an effective strategy for schools
 - Greater importance attached to non-pecuniary factors?
 - Unobservability of potential quality amongst applicants?
 - Outweighed by negative effects of reductions in other resources?

- More effective strategies could include providing better information on potential applicants or performance-related pay

Further challenges for public sector pay policy

- Relative public sector pay levels set to decline to lowest levels since at least mid-1990s
 - Clear implications for quality of workers entering public sector professions
 - Maybe sorting of teachers across schools will become more sensitive to pay differentials as relative pay declines and schools need to recruit more teachers
- Local pay variation would require consideration of funding systems
 - Fringe pay zone is relatively simple example of a local pay zone, yet funding system seems to fail to compensate schools for higher teacher salaries
 - More intricate set of pay zones might require intricate funding system to go with it