

Institute for
Fiscal Studies

Effect of teacher pay on pupil attainment: a regression discontinuity design

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*****PRELIMINARY RESULTS: NOT FOR CITATION*****

Can higher teacher pay levels improve pupil attainment?

- **Teacher effectiveness, as measured by their pupils' progress, varies dramatically and is uncorrelated with many observable characteristics**
 - Rockoff (2004); Rivkin et al (2005); Aaronson et al (2007); Slater et al (2012).
- **Significant uncertainty about whether variations in pay and conditions can improve teacher effectiveness**
- **Difficult to find convincing exogenous variation in pay and conditions**
- **We exploit geographical discontinuities in teacher pay scales to provide causal estimates of teacher pay levels on pupil attainment**
- **Find little evidence that higher salary levels can improve pupil attainment**

Previous literature on teacher pay levels and attainment

- **Survey by Hanushek (2006) finds little evidence of a positive effect**
- **Previous work struggles to find convincing identification strategies**
 - Few examples of any variation in teacher salaries
 - Where they do, often reflects area amenities, non-wage benefits and prices
- **Notable exceptions**
 - Loeb and Page (2000) argue previous studies biased by exclusion of non-pecuniary factors. Estimate that 10% increase in wages reduces drop-outs by 3-4%.
 - Britton and Propper (2012) exploit centralised wage bargaining and variation in outside wages. They find that a 10% increase in local wages depresses test scores by 2%. Extension of Propper and Van Reenen (2010).

Our empirical strategy

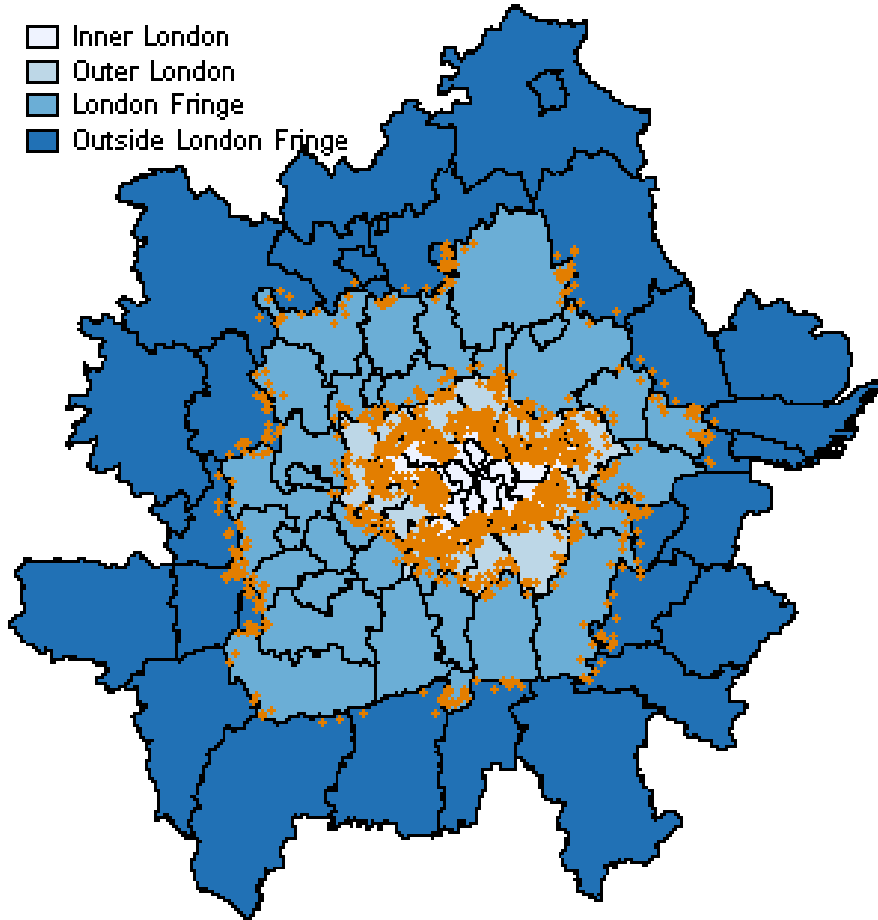
- **Sharp geographical discontinuities in teacher salary scales to estimate effect of teacher pay on pupil attainment**
- **Higher pay scales in London to reflect higher cost of living**
 - Four pay zones: Inner, Outer, Fringe Area, Rest of England and Wales
- **We compare schools either side of each of the three boundaries**
- Boundary discontinuities previously used to estimate effect of school quality on house prices (Gibbons and Machin, 2003) and effect of competition on attainment (Gibbons et al, 2008).

Flavour of identification strategy

Teacher Pay Region

All schools within 2000 metres of boundary

- Inner London
- Outer London
- London Fringe
- Outside London Fringe



Our contribution

- Little evidence that sharp variation in inside teacher wages has a positive effect on age 11 test scores –*can rule out relatively weak positive effects*
 - Much weaker effects than found in Britton and Propper (2012).
- Results for Outer London boundary suggest large gradient in resources associated with significant attainment differences
 - Agreement with Gibbons et al (2012).
- **Policy Implications**
 - Competing for high-quality teachers using pay is unlikely to work well
 - Schools might not be able to observe teacher quality amongst applicants
 - Role of pay might be initial occupational choices, rather than sorting

Outline of the rest of this talk

- Previous Literature
- Institutional Context
- Empirical Methodology and Predictions
- Results
- Conclusions

Previous Literature

Effects of Teacher Pay Levels

- *Student Outcomes*

Hanushek (1986, 2006), Loeb and Page (2000), Britton and Propper (2012), Dolton et al (2011)

- *Teacher Choices*

Clotfelter et al (2007) , Chevalier et al (2007), Dolton et al (1990), Dolton and Van der Klauw (1999), Imazeki (2004), Hanushek et al, (2004), Bonesronning et al. (2005).

Structure of Rewards

Lavy (2002, 2009) in Israel; Muralidharan and Sundaraman (2011) in India; Glewwe et al (2010) for Kenya; Atkinson et al. (2009) in England; Figlio and Kenny (2007) for US, Podgurky and Springer (2007)

Effects of Resources

- Hanushek (1986, 1997), OECD (2008)
- Recent UK evidence suggests modest, positive relationship: (Machin et al (2004); Holmund et al (2010); Gibbons et al (2012)

Institutional Context

School System

Exams and Pupil Testing

Teacher Labour Market

School Funding

Institutional Context

School System

- Focus on primary schools (age 4-11)
- Parents can express a preference
- If oversubscribed, places usually allocated based on siblings and distance to school

Exams and Pupil Testing

Teacher Labour Market

School Funding

Institutional Context

School System

Exams and Pupil Testing

- Key Stage 2 tests at age 11 - English, Maths and Science (**up to 2009**)

Teacher Labour Market

School Funding

Institutional Context

School System

Exams and Pupil Testing

Teacher Labour Market

- Schools post vacancies and teachers apply to individual schools
- National pay and conditions

School Funding

Institutional Context

School System

Exams and Pupil Testing

Teacher Labour Market

- Schools post vacancies and teachers apply to individual schools
- National pay and conditions
- Teacher pay scales (M1-6, U1-3)

School Funding

Institutional Context

School System

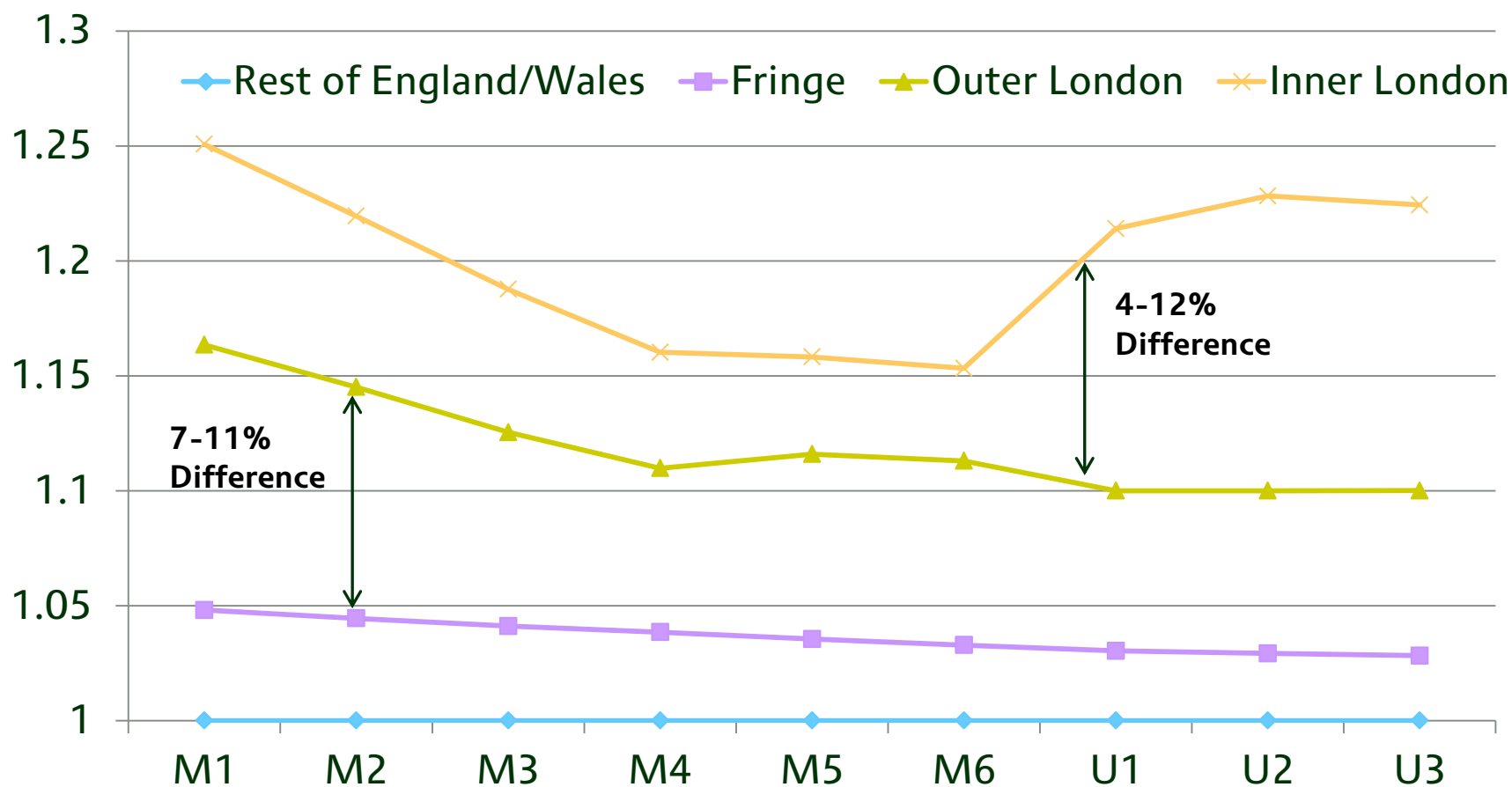
Exams and Pupil Testing

Teacher Labour Market

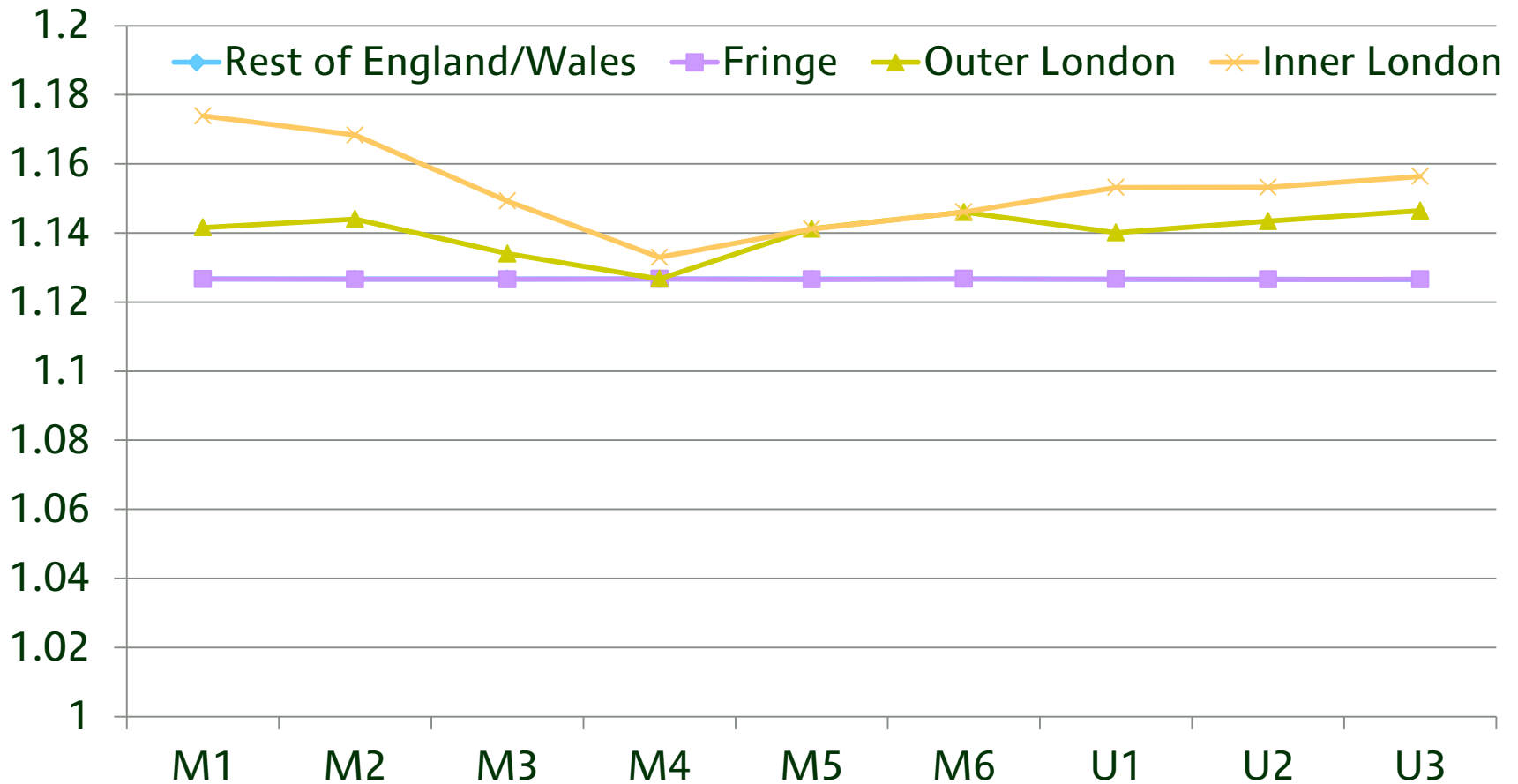
- Schools post vacancies and teachers apply to individual schools
- National pay and conditions
- Teacher pay scales (M1-6, U1-3)
- *Higher Pay Scales in London Area to reflect higher cost of living*
- *Source of variation for identification*
- *Fixed absolute amounts until 2003, variable across pay scale after 2003*

School Funding

Variation in Teachers Pay scales by Area in 2010 (Rest of England/Wales = 1)



Growth in Pay scales by Area 2005-2010



Institutional Context

School System

Exams and Pupil Testing

Teacher Labour Market

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...)
- *Gibbons et al (2012) use anomalies in Area Cost Adjustment and local authority differences to estimate effect of expenditure per pupil*

Empirical Methodology

- Aim: estimate causal effect of differences in teacher pay on pupil attainment
- Compare schools within (x) km of each teacher pay boundary
 - Example of regression discontinuity design
 - Focus on 2km with robustness checks for varying distance
- Similar cost of living for teachers, who have free residential choices
- No discontinuity in other input prices
- **Continuity assumption: smooth differences in observables and unobservables across teacher pay boundaries**
 - Test for smooth differences in observables
- Estimate school-level conditional differences in resources and attainment between high-pay and low-pay areas
 - Separately for each year and each boundary
 - Controls for pupil intake and school characteristics
 - Raw difference, OLS, FILM and Kernel Matching

Data

- National Pupil Database (2005-06 to 2010-11)
 - Age 11 test results, pupil characteristics, school characteristics
 - Exclude 2009-10 data due to SATs boycott
- LEASIS/Edubase – School characteristics
- Section 251 – Income and expenditure data for schools
- Teacher Pay Region – School Teachers Pay and Conditions

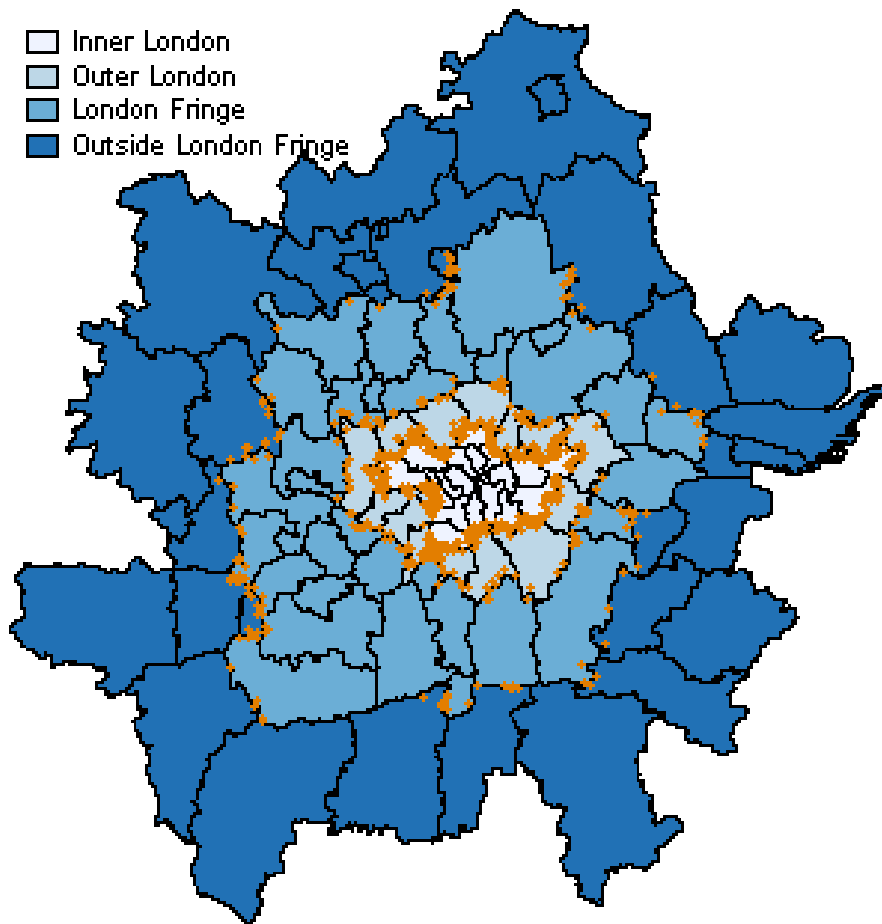
- Outcomes: Funding per pupil, Pupil:Teacher Ratio, Age 11 English and Maths Scores (standardised)
- Vary distance: 1km, 2km, 3km

School within 1 km of boundary

Teacher Pay Region

All schools within 1000 metres of boundary

- Inner London
- Outer London
- London Fringe
- Outside London Fringe

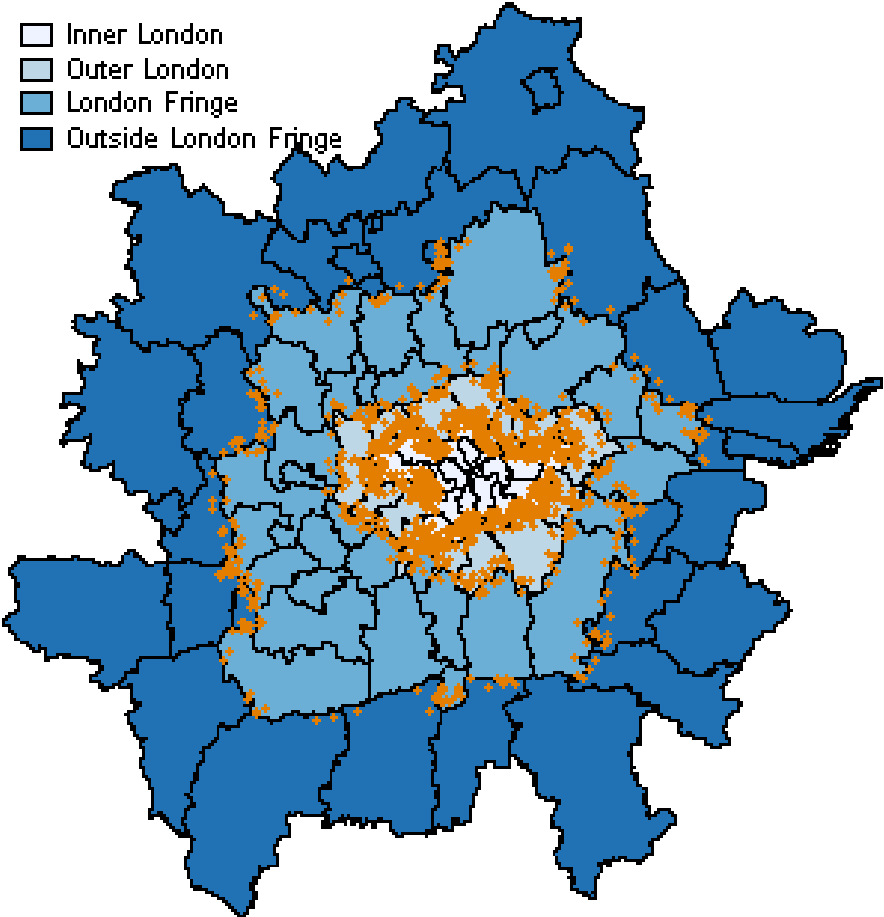


Even more within 2km

Teacher Pay Region

All schools within 2000 metres of boundary

- Inner London
- Outer London
- London Fringe
- Outside London Fringe



Empirical Predictions for Resources

- **Teacher salaries**
 - Expect positive effect in line with salary scale differences
 - But, schools do have freedom to smooth the difference using other pay freedoms
 - Results: awaiting teacher pay data...
- **Funding per pupil**
 - Expect higher funding levels to pay for higher salaries
 - Teacher pay accounts for about 50% of schools budget
 - Expect funding differential equal to about 50% of salary differential
- **Actual Resources - (Pupil:Teacher Ratio, Pupil:Assistant Ratio)**
 - No difference if funding differential allows schools to purchase same bundle
 - Lower (higher) staff ratios if funding differential is over (under) generous

Empirical Predictions for Attainment

1. Selection

- Larger pool of applicants
- **Positive effect** if higher salaries attracts higher quality teachers and potential quality is observable amongst applicants
- **Negative effects** could occur if intrinsic motivation is important and unobservable to schools when making hiring decisions (Delfgauww and Dur, 2007)

2. Efficiency wage - higher effort levels amongst existing teachers

3. Positive Re-enforcement – higher salary implies greater respect

- Expected magnitude of pure salary effect given existing empirical estimates
 - Britton and Propper: 10% increase in outside wage reduces GCSE scores by 0.1 standard deviation

Potential Problems for Identification and Interpretation

1. Local authorities allocate more funding to “low-pay” schools

- Test actual differences in funding per pupil and then assess extent to which schools have ability to purchase same bundle

2. Schools respond by paying teachers more in “low-pay” schools

- Future work to focus on differences in pay for similar teachers
- Important for interpretation of results

3. Parents sort into higher quality “high-pay” schools

- Upwardly bias estimates of pay effect
- If true effect is zero, bias would need to reflect preference for better paid teachers

4. Teacher pay boundaries coincide with other relevant administrative geography or other forces driving discontinuities in pupil characteristics

- Inner and Outer Boundaries **do** coincide with other administrative geography (LA boundaries)
- No reason to expect systematic differences across teacher pay boundaries
- Test for continuity in pupil characteristics

Summarising predictions and results

	Boundary 1 (Inner/Outer)	Boundary 2 (Outer/Fringe)	Boundary 3 (Fringe/Rest)
Pupil Characteristics	Smooth	Smooth	Smooth
Salary Scale Differential	4-12%	7-11%	4-5%
Actual Teacher Salaries	Waiting for data	Waiting for data	Waiting for data
Funding differential required to purchase same bundle	2-6%	3.5-5.5%	2-2.5%
Actual Funding Differential		<i>Table 2</i>	
Difference in Actual Resources (PTR)		<i>Table 3</i>	
Differences in KS2 English		<i>Table 4</i>	
Differences in KS2 Maths		<i>Table 5</i>	

Table 1 -Summary Statistics (within 2 km)

	Inner London			Outer London			Fringe Area		
	<i>Inside</i>	<i>Outside</i>	<i>Diff</i>	<i>Inside</i>	<i>Outside</i>	<i>Diff</i>	<i>Inside</i>	<i>Outside</i>	<i>Diff</i>
% FSM	0.29 (0.15)	0.20 (0.13)	0.09***	0.17 (0.13)	0.11 (0.09)	0.06***	0.08 (0.07)	0.08 (0.08)	0
% SEN non-statemented	0.27 (0.11)	0.24 (0.11)	0.03***	0.23 (0.11)	0.22 (0.10)	0.02**	0.21 (0.10)	0.21 (0.11)	0
% SEN statemented	0.02 (0.02)	0.02 (0.02)	0	0.02 (0.02)	0.02 (0.02)	0.00*	0.02 (0.02)	0.02 (0.02)	0.00***
% EAL	0.47 (0.23)	0.37 (0.27)	0.10***	0.20 (0.16)	0.10 (0.08)	0.10***	0.07 (0.11)	0.07 (0.10)	0
% non-white	0.72 (0.22)	0.59 (0.28)	0.13***	0.39 (0.19)	0.23 (0.12)	0.16***	0.16 (0.12)	0.16 (0.13)	0
Number of Pupils	349.7 (117.2)	351.9 (118.5)	-2.2	319.4 (121.7)	265.3 (96.1)	54.2***	259.8 (119.8)	250.2 (110.2)	9.6
IMD Rank	0.27 (0.14)	0.45 (0.18)	-0.18***	0.50 (0.19)	0.62 (0.19)	-0.12***	0.73 (0.17)	0.70 (0.17)	0.03**
IDACI Rank	0.21 (0.14)	0.35 (0.18)	-0.15***	0.40 (0.19)	0.53 (0.18)	-0.13***	0.66 (0.17)	0.65 (0.18)	0.01
Log inc per pupil	8.43 (0.17)	8.29 (0.17)	0.14***	8.32 (0.18)	8.19 (0.16)	0.13***	8.20 (0.18)	8.20 (0.19)	0
Log exp per pupil	8.42 (0.17)	8.28 (0.17)	0.14***	8.31 (0.18)	8.17 (0.16)	0.13***	8.20 (0.18)	8.19 (0.19)	0
Pupil:Teacher Ratio	21.6 (3.0)	22.1 (3.0)	-0.5***	21.3 (3.0)	22.6 (3.0)	-1.3***	21.4 (3.1)	21.3 (3.3)	0
Pupil: Assistant Ratio	106.0 (148.3)	119.0 (167.6)	-12.9*	105.7 (213.8)	127.8 (148.8)	-22.1*	137.1 (177.6)	119.4 (173.4)	17.7
KS2 English Points	-0.03 (0.35)	0.07 (0.36)	-0.10***	0.07 (0.34)	0.06 (0.35)	0.02	0.12 (0.36)	0.10 (0.36)	0.02
KS2 Maths Points	-0.04 (0.34)	0.07 (0.37)	-0.11***	0.08 (0.33)	0.04 (0.35)	0.04*	0.08 (0.35)	0.10 (0.34)	-0.01
Number of Observations	1830	1352		711	565		600	677	
Number of schools	366	271		143	113		120	136	

Summarising predictions and results

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Table 2 - Funding per pupil (within 2km)

	Raw		OLS		FILM		Kernel Matching	
	b	se	b	se	b	se	b	se
Boundary 1 - Inner/Outer								
2006	0.143	<i>0.01***</i>	0.092	<i>0.02***</i>	0.082	<i>0.02***</i>	0.1	<i>0.02***</i>
2007	0.13	<i>0.01***</i>	0.081	<i>0.02***</i>	0.078	<i>0.02***</i>	0.101	<i>0.02***</i>
2008	0.144	<i>0.01***</i>	0.087	<i>0.02***</i>	0.088	<i>0.02***</i>	0.102	<i>0.02***</i>
2009	0.148	<i>0.01***</i>	0.093	<i>0.02***</i>	0.092	<i>0.02***</i>	0.102	<i>0.02***</i>
2011	0.149	<i>0.01***</i>	0.088	<i>0.02***</i>	0.092	<i>0.02***</i>	0.114	<i>0.02***</i>
Boundary 2 – Outer/Fringe								
2006	0.124	<i>0.02***</i>	0.114	<i>0.02***</i>	0.113	<i>0.02***</i>	0.118	<i>0.04***</i>
2007	0.133	<i>0.02***</i>	0.137	<i>0.03***</i>	0.119	<i>0.02***</i>	0.084	<i>0.03**</i>
2008	0.13	<i>0.02***</i>	0.121	<i>0.02***</i>	0.112	<i>0.02***</i>	0.105	<i>0.03**</i>
2009	0.133	<i>0.02***</i>	0.119	<i>0.02***</i>	0.11	<i>0.03***</i>	0.062	<i>0.04</i>
2011	0.139	<i>0.02***</i>	0.13	<i>0.02***</i>	0.117	<i>0.01***</i>	0.108	<i>0.03**</i>
Boundary 3 – Fringe/Rest								
2006	0.017	<i>0.02</i>	0.013	<i>0.02</i>	0.01	<i>0.01</i>	0.007	<i>0.02</i>
2007	-0.01	<i>0.02</i>	0.004	<i>0.01</i>	0.003	<i>0.01</i>	-0.004	<i>0.02</i>
2008	-0.005	<i>0.02</i>	-0.005	<i>0.01</i>	-0.008	<i>0.01</i>	-0.02	<i>0.02</i>
2009	0.008	<i>0.02</i>	0.011	<i>0.00*</i>	0.005	<i>0.01</i>	-0.01	<i>0.02</i>
2011	0.013	<i>0.02</i>	0.015	<i>0.01</i>	0.005	<i>0.01</i>	0.012	<i>0.02</i>

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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.

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Actual Funding Differential	≈9%	≈11%	≈0%
Difference in Actual Resources (PTR)		Table 3	
Differences in KS2 English		Table 4	
Differences in KS2 Maths		Table 5	

Table 3 – Pupil:Teacher Ratio (within 2km)

	Raw		OLS		FILM		Kernel Matching	
	b	se	b	se	b	se	b	se
Boundary 1 - Inner/Outer								
2006	-0.637	0.27*	-0.807	0.38*	-0.888	0.35*	-1.099	0.43*
2007	-0.226	0.27	-0.135	0.41	-0.211	0.37	-0.589	0.43
2008	-0.775	0.27**	-0.537	0.47	-0.687	0.41	-1.06	0.46*
2009	-0.531	0.25*	-0.26	0.51	-0.466	0.46	-0.6	0.41
2011	-0.328	0.26	-0.149	0.51	-0.302	0.52	-0.796	0.44
Boundary 2 – Outer/Fringe								
2006	-1.368	0.38***	-1.283	0.34**	-1.367	0.48**	-2.5	0.76***
2007	-1.536	0.39***	-1.83	0.81*	-1.632	0.49**	-1.379	0.65*
2008	-1.426	0.40***	-1.648	0.72*	-1.287	0.73	-1.703	0.78*
2009	-1.423	0.39***	-1.649	0.70*	-1.816	0.96	-0.754	0.85
2011	-0.884	0.37*	-0.976	0.56	-0.806	0.6	-0.775	0.66
Boundary 3 – Fringe/Rest								
2006	-0.198	0.4	-0.248	0.39	-0.302	0.28	-0.22	0.41
2007	0.084	0.44	-0.242	0.55	-0.354	0.34	-0.291	0.47
2008	-0.366	0.41	-0.511	0.4	-0.462	0.31	-0.17	0.43
2009	-0.232	0.37	-0.366	0.5	-0.25	0.25	-0.112	0.4
2011	-0.027	0.38	-0.208	0.29	-0.2	0.18	-0.241	0.43

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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.

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Actual Funding Differential	≈9%	≈11%	≈0%
Difference in Actual Resources (PTR)	≈-0.6	≈-1.4	≈-0.2
Differences in KS2 English		Table 4	
Differences in KS2 Maths		Table 5	

Table 4 – English KS2 std.(within 2km)

	Raw		OLS		FILM		Kernel Matching	
	b	se	b	se	b	se	b	se
Boundary 1 - Inner/Outer								
2006	-0.171	0.03***	-0.017	0.05	0.008	0.03	-0.054	0.05
2007	-0.117	0.03***	0.03	0.05	0.039	0.04	-0.025	0.05
2008	-0.117	0.03***	-0.011	0.04	-0.007	0.03	-0.052	0.06
2009	-0.085	0.03**	0.033	0.04	0.034	0.03	-0.022	0.06
2011	-0.053	0.02*	0.049	0.04	0.053	0.03	-0.008	0.04
Boundary 2 – Outer/Fringe								
2006	0.058	0.05	0.13	0.03***	0.169	0.04***	0.052	0.1
2007	0.014	0.04	0.067	0.04	0.113	0.04**	0.126	0.07
2008	0.027	0.04	0.132	0.04**	0.182	0.04***	0.133	0.07
2009	0.059	0.04	0.127	0.05*	0.175	0.05**	0.173	0.09*
2011	0.096	0.04*	0.171	0.04***	0.203	0.02***	0.156	0.07*
Boundary 3 – Fringe/Rest								
2006	-0.053	0.05	-0.049	0.02	-0.047	0.02*	-0.054	0.05
2007	-0.004	0.05	-0.017	0.03	-0.026	0.01	-0.023	0.05
2008	0.008	0.04	0.012	0.01	0.011	0.01	0.017	0.04
2009	-0.028	0.04	-0.048	0.02	-0.04	0.02*	-0.043	0.05
2011	-0.007	0.04	-0.014	0.03	-0.019	0.02	-0.025	0.05

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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.

Table 5 – Maths KS2 std.(within 2km)

	Raw		OLS		FILM		Kernel Matching	
	b	se	b	se	b	se	b	se
Boundary 1 - Inner/Outer								
2006	-0.15	0.03***	0.014	0.06	0.05	0.04	-0.012	0.05
2007	-0.114	0.03***	0.047	0.05	0.068	0.04	-0.008	0.05
2008	-0.105	0.03***	0.011	0.04	0.004	0.03	-0.034	0.06
2009	-0.071	0.03**	0.063	0.05	0.076	0.03*	0.036	0.04
2011	-0.064	0.03*	0.056	0.04	0.073	0.03*	0.01	0.04
Boundary 2 – Outer/Fringe								
2006	0.003	0.05	0.056	0.04	0.08	0.05	-0.092	0.11
2007	0.011	0.05	0.071	0.03*	0.091	0.04*	0.125	0.08
2008	-0.004	0.04	0.077	0.04	0.119	0.04*	0.08	0.07
2009	0.037	0.04	0.131	0.04**	0.186	0.07*	0.227	0.09*
2011	0.067	0.04	0.153	0.04***	0.171	0.03***	0.097	0.07
Boundary 3 – Fringe/Rest								
2006	0.002	0.05	0.01	0.03	0.018	0.01	0.01	0.05
2007	0.027	0.05	0.027	0.03	0.018	0.02	0.025	0.05
2008	0.014	0.04	0.002	0.03	0.006	0.02	0.007	0.05
2009	0.025	0.04	0.005	0.03	0	0.02	-0.022	0.05
2011	0.011	0.04	0.012	0.03	0.01	0.03	-0.003	0.05

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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.

Summarising predictions and results

	Boundary 1 (Inner/Outer)	Boundary 2 (Outer/Fringe)	Boundary 3 (Fringe/Rest)
Pupil Characteristics	Very Sharp	Sharp	Smooth
Salary Scale Differential	4-12%	7-11%	4-5%
Actual Teacher Salaries	Waiting for data	Waiting for data	Waiting for data
Funding differential required to purchase same bundle	2-6%	3.5-5.5%	2-2.5%
Actual Funding Differential	≈9%	≈11%	≈0%
Difference in Actual Resources (PTR)	≈-0.6	≈-1.4	≈-0.2
Differences in KS2 English	≈0.00	≈0.14	≈-0.02
Differences in KS2 Maths	≈0.03	≈0.1	≈0.01

Varying distance at Fringe Boundary - English

	Raw		OLS		FILM		Kernel Matching	
	b	se	b	se	b	se	b	se
Within 1 km of boundary								
2006	0.018	0.07	0.006	0.05	-0.001	0.03	-0.021	0.07
2007	0.123	0.07	0.101	0.08	0.076	0.05	0.087	0.08
2008	0.004	0.06	-0.039	0.04	-0.02	0.02	-0.058	0.07
2009	0.066	0.07	0.027	0.05	0.006	0.04	-0.056	0.08
2011	-0.017	0.06	0.016	0.05	0.004	0.05	-0.021	0.07
Within 2 km of boundary								
2006	0.002	0.05	0.01	0.03	0.018	0.01	0.01	0.05
2007	0.027	0.05	0.027	0.03	0.018	0.02	0.025	0.05
2008	0.014	0.04	0.002	0.03	0.006	0.02	0.007	0.05
2009	0.025	0.04	0.005	0.03	0	0.02	-0.022	0.05
2011	0.011	0.04	0.012	0.03	0.01	0.03	-0.003	0.05
Within 3 km of boundary								
2006	0.01	0.04	0.023	0.03	0.025	0.01*	0.022	0.04
2007	0.006	0.04	0.009	0.02	0.005	0.02	0.003	0.04
2008	0.01	0.04	0.007	0.03	0.007	0.01	0.008	0.04
2009	-0.01	0.05	0.008	0.03	-0.013	0.02	-0.018	0.04
2011	-0.012	0.04	0.017	0.03	0.006	0.03	-0.009	0.04

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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.

Varying distance at Fringe Boundary - Maths

	Raw		OLS		FILM		Kernel Matching	
	b	se	b	se	b	se	b	se
Within 1 km of boundary								
2006	-0.02	0.06	-0.019	0.05	-0.032	0.03	-0.056	0.07
2007	0.053	0.07	0.036	0.07	0.019	0.03	0.019	0.07
2008	-0.017	0.06	-0.034	0.04	-0.027	0.03	-0.059	0.06
2009	0.044	0.06	0.024	0.03	0.013	0.04	-0.003	0.07
2011	-0.031	0.06	-0.003	0.05	-0.015	0.04	-0.029	0.06
Within 2 km of boundary								
2006	-0.053	0.05	-0.049	0.02	-0.047	0.02*	-0.054	0.05
2007	-0.004	0.05	-0.017	0.03	-0.026	0.01	-0.023	0.05
2008	0.008	0.04	0.012	0.01	0.011	0.01	0.017	0.04
2009	-0.028	0.04	-0.048	0.02	-0.04	0.02*	-0.043	0.05
2011	-0.007	0.04	-0.014	0.03	-0.019	0.02	-0.025	0.05
Within 3 km of boundary								
2006	-0.024	0.04	-0.014	0.02	-0.016	0.02	-0.016	0.04
2007	-0.003	0.04	0.001	0.02	-0.004	0.01	-0.012	0.04
2008	-0.012	0.04	0.001	0.03	-0.012	0.02	-0.008	0.05
2009	-0.045	0.04	-0.034	0.02	-0.04	0.01*	-0.041	0.04
2011	-0.039	0.04	-0.011	0.03	-0.025	0.02	-0.039	0.04

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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 of Results for Attainment

- **Fringe Area** – continuity holds
 - No significant differences for maths or English scores and can rule out quite small positive effects
 - Smaller than Britton and Propper (2012)
- **Inner London** – no continuity in observables
 - Funding is slightly over-generous, but no significant differences in actual resources
 - Pay effect is close to zero if you think unobservables are well balanced
- **Outer London** - no continuity in observables
 - Overly generous funding differential and large resource gradient
 - Significant positive effects on maths and English scores
 - Likely to reflect a resource effect given other estimates

Conclusions and Policy Implications

- Little evidence of an effect of teacher pay differentials on pupil attainment
 - Positive effects only found when there are differences in resources
- Much lower effects than Britton and Propper (2012)
 - Difference in samples? Primary vs secondary, Boundaries vs England
 - Our effects only incorporate effects of selection by existing teachers
 - Britton and Propper incorporate initial occupational choices
- 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?
 - Academies lack of use of pay flexibilities may be rational
- Resource results consistent with Gibbons et al (2012)

Plans for further work

- Estimate differences in actual teacher pay to aid interpretation
 - Are schools at the Fringe Area smoothing the salary scale differential?
- Potential mechanisms: effect on vacancies and number of applications
- Investigate implications for resource choices in greater detail
 - Expenditure shares, age profile of teachers
- Different effects for secondary schools?