THE CENTRE FOR MARKET AND PUBLIC ORGANISATION

Does Wage Regulation Harm Children? Evidence from English Schools

Jack Britton[1] & Carol Propper[2]

January 2014

Working Paper No. 14/318
This is a revised version of 12/293

Centre for Market and Public Organisation
University of Bristol
2 Priory Road
Bristol BS8 1TX
http://www.bristol.ac.uk/cmpo/

Tel: (0117) 33 10952
Fax: (0117) 33 10705
E-mail: cmpo-admin@bristol.ac.uk

ISSN 1473-625X

CMPO Working Paper Series No. 14/318

Does Wage Regulation Harm Children? Evidence from English Schools

Jack Britton[1] & Carol Propper[2]

[1] Institute for Fiscal Studies

[2] Imperial College, University of Bristol and CEPR

January 2014

Abstract

Teacher wages are commonly set in a manner that results in flat wages across heterogeneous labor markets. Consequently teacher wages will be relatively worse in areas where local labor market wages are high. The implication is that teacher output will be lower in high outside wage areas. This paper exploits the centralized wage regulation of teachers in England to examine the effect of wages on school performance. It uses data on over 3000 schools containing around 200,000 teachers who educate around half a million children per year. We find that teachers respond to pay and schools add less value to their pupils where the regulation bites harder. Our calculations suggest that the removal of regulation would have positive social benefits.

Key words: Teacher wages, Centralised Pay Regulation, School performance, School Value Added

JEL Classifications: I2, J3, J4

Electronic version: www.bristol.ac.uk/cmpo/publications/papers/2014/wp318.pdf

Address for correspondence
CMPO
2 Priory Road, Bristol
BS8 1TX
www.bristol.ac.uk/cmpo/
cmpo-admin@bris.ac.uk
Tel +44(0) 117 33 10799

Acknowledgements

We gratefully acknowledge the comments of two referees and the editor; the DfE for provision of PLASC data; Simon Burgess, Sarah Karlsberg Schaffer, Helen Simpson, Helene Turon and Frank Windmeijer for their comments and discussion; Simon Burgess for help with data access and analysis; and seminar participants at the University of Bristol. We are grateful to the ESRC for funding via grant RC1145. The usual disclaimer applies.

The importance of education means teacher productivity, and the effect of pay on teacher performance, is a central concern for governments worldwide. One feature common to teacher labor markets in many countries is the use of wage setting at a higher spatial level than the school. While such mechanisms avoid the cost of negotiation at school or district level, they also have an effect on the wage structure for teachers, flattening teacher wages across heterogeneous labor markets so the variation that exists does not fully reflect the wage differentials in the external labor markets in which teachers are employed (e.g. Duncombe and Yinger, 1998). The consequence is that teacher wages will be relatively worse in areas where local labor market wages are high: effectively the wage setting sets a ceiling on teacher pay. If pay matters for teaching, teacher output will be lower in high outside wage areas where the wage ceiling bites harder.

This paper uses this insight to test the effect of pay on school performance. Our research design exploits the centralized pay setting of over 200,000 teachers who teach around half a million children each year in the UK public (state) school system and a national system of pupil testing and assessment of school quality. In the UK pay for teachers is set by a central review body that sets pay scales in which there is very limited regional variation.[1] But regional pay differences are considerable in the private sector even after controlling for human capital characteristics and other factors (Bulman, 2002). We would therefore expect to see differences between inside and outside wages reflected in the lower performance of schools operating in high outside wage labor markets.

We use the existence of a national system of pay setting, examinations and school inspections to examine the effect of exogenous local wage shocks on pupil value added and the quality of the school for all public (state) secondary (equivalent to US middle and high) schools. Our design means we are able to control for time constant pupil, family and neighbourhood characteristics that may affect levels of attainment independently of teacher effort. We examine some of the potential pathways by which wages may results in greater pupil attainment including the cross sectional relationship between teacher tenure and outside wages and seek to rule out that our findings are explained by pupil and parental, rather than teacher, responses to wage shocks.

We find a ten per cent shock to the local average outside wage results in an average loss of one exam grade per pupil in the high-stake exams taken at the end of secondary school. This is worth 2% of the overall average score in these examinations. We also find a negative impact on one of the key performance metrics by which schools are compared and assessed by the public and the

[1] Collective wage setting is a feature of many education systems. For example, in the USA, as of 1988, all but seven states had passed a law either allowing for the right of teachers to bargain collectively or explicitly requiring districts to bargain with teachers' unions (Lovenheim, 2009). Wages are also centrally negotiated between the state or national government and the teaching unions in many European countries (Galgóczi and Glassner, 2008).

government. The loss is greater in schools located in areas where the ceiling bites harder and for schools that have no control over the employment conditions of teachers. We find that a measure of teaching quality from inspections by the national school regulator is lower where wage shocks are higher. We also find that higher outside wages are associated with lower lengths of tenure. The results are robust to a wide range of specification tests, and to alternative explanations arising from channels through which the outside wage may affect pupils' performance.

Our paper is connected to several literatures. First, it is connected to the literature on the effect of differences in the educational cost across areas on performance from the USA. Centrally determined financing formulae may lead to systematic differences between costs and finances in local school areas (e.g. Duncombe and Yinger, 1998; Hoxby, 2001), which may also have unintended consequences on student performance (e.g. Duncombe and Yinger, 2011; Eom, Duncombe and Yinger, 2007) and on teacher attrition (Ondrich, Pas and Yinger, 2008). Second, there is a large and growing literature on the impact of teacher pay. Research on the effect of teacher salaries on school performance initially suggested that this was mixed (for example, Hanushek, 1986, highlights that only nine out of sixty teacher salary studies found a positive effect of teacher wages on school performance). But later research has found more response to wages. For example, Loeb and Page (2000) find teacher wages to be a significant determinant of outcomes, estimating that a 10% increase in teacher wages would reduce dropout rates in the US by between 3 and 6%. Dolton and Marcenaro-Gutierrez (2011) finds both relative and absolute levels of teacher salaries exert an important influence on pupil performance using data on 39 countries. A related literature considers the impact of teacher pay on the entry, duration of teaching and mobility (for example, Murnane and Olsen, 1990; Dolton, 1990, 2006; Dolton and van der Klaauw, 1995; Figlio 1997) and teacher absenteeism (Barr and Zeitlin, 2010). Nevertheless, Hanushek and Rivkin (2006) stress that teacher responses to alternative wages may be muted compared to other workers.

More generally, labor economists have long been interested in the impact of labor market changes on firm performance. Theories of "efficiency wages", for example, suggest that improvements in the labor market outside the firm's boundaries could lead to decreased productivity within a firm because there may be more shirking (Shapiro and Stiglitz, 1984), a loss of high quality workers (Weiss, 1980) or perceptions of inequity (e.g. Akerlof, 1982; Mas, 2006). It is difficult to test these ideas in an unregulated labor market. Where pay is set by regulation, however, there is a wedge between inside and outside wages that enables identification of the impact of external labor markets on firm outcomes. So we can effectively use regulation to generate exogenous variation in factor prices.

In this design, two papers are antecedents to ours. The first is Cappelli and Chauvin (1991) who show that higher outside wages increase shirking in a US auto manufacturer. Like our paper, the authors exploit the fact that the union contract stipulates the same pay rates across diverse metropolitan areas. Unlike our paper, Cappelli and Chauvin exploit a private agreement between a union and a firm, which is likely to be less sub-optimal than a voluntary agreement between a government and a national wide union. In addition, Cappelli and Chauvin have a cross section of 78 plants, whereas we have a much larger panel of around 3000 schools. The second, and closest, paper is Propper and Van Reenen (2010), who examine the impact of centralized wage regulation for nurses on death rates following emergency admissions for heart attacks to English hospitals between 1996 and 2005. They find that the aggregate death rate rises due to the regulation and that removal of centralized wage setting would have positive welfare consequences. Our paper complements theirs by focusing on another aspect of state activity: education in the 3000 secondary schools that educate around 3 million of England's children per annum.

The remainder of the paper is as follows. Section I outlines the institutional background of education in the UK, Section II provides information on the data used and Section III discusses the methodology. The results and a range of robustness checks are given in Section IV. Section V studies potential mechanisms through which the outside wage could operate. Section VI presents a simple calculation of the potential gains from removing wage regulation and Section VII offers concluding comments.

I. INSTITUTIONAL BACKGROUND

Education in England is compulsory between the ages of five and sixteen. While children can be educated privately, the public (state) system dominates. State sector pupils attend primary school from age five to eleven and secondary school from age eleven to sixteen. Pupils can then stay on for a further 2 years to get qualifications that allow them to undertake university level education. In 2007 approximately three million young people (around 84% of eleven to sixteen year olds) were attending public secondary schools. In each secondary school there are five (or seven if the school provides education up to 18) separate age cohorts within the school at any one time.

Pupils take nationally set exams at four points during their ages of compulsory school attendance. At primary school these are Key Stage 1 (KS1) at age 7 and Key Stage 2 (KS2) at age 11 (the year of exit), in Mathematics, English and Science. In secondary schools these are Key Stage 3 (KS3) exams at age 14 in Maths, English and Science and Key Stage 4 (KS4) examinations in multiple subjects (typically between eight and twelve) at the end of compulsory schooling at age 16. We focus on KS4 (GCSE) examinations as our measure of school performance as these are high stake examinations. For pupils

they determine progress into education after age of 16, as a minimum of five pass grades required to continue on to further education, are used by parents to choose secondary schools for their children, by the media to rank school performance to create school 'league tables' and by local and central government to identify 'failing schools'.

Schools in England are heavily regulated by central and local government. Summary statistics on school performance have been published annually since the early 1990's. The key measure used to compare schools has been the number of pupils attaining at least 5 good grades in the KS4 exams (known as 5 A*-C GCSEs), though the number of metrics published increased during the mid- and late 2000's. In addition, in-depth assessments of the quality of the school are undertaken by the schools regulator, OFSTED. Each school is inspected roughly every five years. Inspections often last several days. On the basis of these site visits, OFSTED publishes a report rating the school's performance on numerous dimensions, including an overall rating of the school and an assessment of teaching and learning at the school. More details on these metrics are provided below in Section III.A.

I.A. Teacher pay in England

Teacher wages are set by Local Education Authorities (LEAs) based on guidelines issued by the national Government Department for Education.[2] Despite the existence of four pay bands ('Inner London', 'Outer London', 'The Fringe' and 'The rest of England'), teacher wages have exhibited very little regional variation relative to private sector wages since the early 1970's. For example, the average teacher wage differential outside the South East of England and Inner London is approximately 15%, while the equivalent private sector wage differential can be as large than 45%.[3] Since its formation in the 1990's, the School Teacher Review Body (STRB), an advisory board which comments on teacher conditions and pay, has frequently argued that the Department for Education should be doing more to encourage locally flexible wages.[4] Although an increasing amount of discretion over wages has been granted to LEAs, they have almost entirely failed to utilize the option. This is likely to be due, in part, to the fact that local authorities have faced strong national teaching unions for many years (Zabalza et al., 1979). In addition, there is very little scope for schools to provide differential non-pecuniary benefits for teachers - there is no variation in holidays and contact hours are generally fixed.

[2] LEAs are geographically coterminous with the primary and larger units of local government, the Local Authority (LA). We use the term LEA when discussing education/school issues and data and LA when discussing data available at this level.
[3] Author calculations from ASHE (for non-teacher wages) and the School Teacher Review Body reports (for teacher wages).
[4] STRB annual report (2010).

I.B. How centralized pay may affect school performance

We follow Hall et al. (2008) and propose a simple dual-region model of the English market for teachers. In this market, 'The North' has low living costs and fewer outside options relative to 'The South'. Even when controlling for worker composition, the local private sector wage is therefore lower in the North. Because of these factors, for each given wage, teacher supply is higher in the North than in the South. An ideal pay structure would therefore allow differential wages in each region to equalize supply and demand. As shown in Figure 1, by setting the centrally regulated wage to be constant across the two regions at W^C, even if on average the regulated wage is at equilibrium a wedge exists between it and the equilibrium wage at the regional level. In this model the regulated wage acts as a pay ceiling in the South.

This model presents the case of an invariant regulated wage across regions. In England there is some wage variation across broadly defined regions but, as can be seen from Figure 1, unless the regional variation is such that the teacher wage in the South is set equal to W^S and the teacher wage in the North is set equal to W^N, the nature of the problem persists; disequilibria in local markets will remain, affecting teacher supply in certain regions. Based on the lack of variation that we observe in teacher wages compared with private sector wages (and indeed the focus of the STRB on the issue), it is highly unlikely that the regional variation in England goes far enough.

This model highlights the possibility of insufficient supply in high wage areas, but Figure 1 would be unchanged if it were referring to the supply of quality teachers, or indeed the supply of effort of teachers; in either case there would remain a shortage in the South as a consequence of the invariant wage.[5] This highlights that the effect of an invariant wage on school performance in high wage areas could work through a number of mechanisms. First, problems may arise in recruitment and retention. For England, Dolton (1990) finds that wages are an important factor in recruiting good teachers and Ma et al. (2009) find a negative relationship between relative teacher wages and posted Local Authority level teacher vacancies. Second, public sector wage increases in the UK have been shown to improve the qualifications of new public sector workers (Nickell and Quintini, 2002), suggesting the effect may not be seen just through vacancies, but also through reduced teacher quality. Teacher quality has been shown to be important for school performance (Barrow and Rouse, 2005; Rockoff, 2004; Benton et al., 2003; Rivkin et al., 2005; and for England, Slater et al, 2012) and teachers have been shown to be adversely affected by lower quality colleagues and by high turnover rates (Ronfeldt, Lankford, Loeb and Wyckoff, 2011). Finally there is scope for reductions in effort in response to lower relative wages as the nature of teaching in England means a large proportion of

[5] Propper and Van Reenen (2010) present a more complex two sector, two skills model in which individuals can move sector or move region.

the work is discretionary (time spent lesson planning, engagement in after-school programs, time invested worrying about particular children).[6]

II. METHODOLOGY

We examine the relationship between local wages and school level productivity. Our main measure of school productivity is value added by the school and we exploit the fact that there are national exams taken by all students immediately prior to secondary school entry to control for initial ability of pupils. In a set of extensions we also explore other measures of school productivity.

Following Loeb and Page (2000), a simple education production function for value added which considers the importance of controlling for alternative labor market opportunities is:

$$y_{i,t} = \alpha + \beta\left(lnW^{I}_{i,t-1} - lnW^{O}_{i,t-1}\right) + \rho y_{i,t-5} + \gamma' X_{i,t} + \mu_t + f_i + \epsilon_{i,t} \quad (1)$$

where y_{it} is the average exam score at school leaving age (Key Stage 4) for school i at time t, and $y_{i,t-5}$ is the average exam score at entry into the school at age 11 (Key Stage 2). W^{I}_{t-1} is the inside wage, $W^{O}_{t-1}$is the outside wage, X is a vector of controls at cohort (the year group), school and Local Authority levels), μ_t is a set of time dummies and f_i is a time invariant school fixed effect.

In our design, inside (school) wages are fixed over schools in the same (large) region by the pay regulation and any variation which we observe at school level is likely to be endogenous (for example, if schools in high outside areas wages over-promote teachers to retain them). In our main estimation we therefore absorb school level wages in the fixed effect and focus on estimating only the effect of the outside wage, which measures the gap between actual teacher wages and the potential outside labor market wage a teacher could command and is exogenous to teacher wages. In robustness checks we also allow for the inside wage.

The use of a one period lag in wages in equation (1) is problematic in the context of school production. Pupils in England attend the same secondary school for five years. This has two consequences. First, since education is cumulative and final examination results will depend on the education a pupil received in all of the years they attended the school, it is likely that there will be long lags in the effect of the outside wage. In principle, there could even be an effect of wages prior to entry into school of the cohort if this affected the teachers that taught the school cohort (for

[6] Two early English studies of school performance suggest that relative pay is important but neither test this hypothesis. Gordon and Monastiriotis (2007) investigate neighbourhood and regional effects on education performance and conclude that schools from some of the most affluent areas perform worst relative to expectation. They attribute this to 'crowding out' of public sector activity in affluent areas. Zabalza et al. (1979) examine English secondary schools in the 1960s and find fewer qualified teachers and higher turnover rates in London compared to the rest of the country and attribute this to the poor relative wages in London.

example, if wages led to staff leaving and the remaining staff being demoralised as a result). Thus a regression with only one lag in wages is likely to suffer from omitted variable bias. While in principle we could estimate equation (1) with 5 lags of wages, in practice the outside wages in year *t* are likely to be not dissimilar to those in year *t-1*, so identification of the separate effect of each year's wages is likely to be difficult. Second, since teachers teach children across year groups, different year groups will be subjected to the same shocks. This is likely to create high levels of serial correlation in the outcome data. In Appendix B we examine the impact of these two problems. These estimates show the problem of estimating a full dynamic model, but they also confirm that there appears to be a negative relationship between outside wages and value added for almost all lags of the wages, and that this increases over time.

Our solution takes into account that pupils are in secondary schools for five years between entry and sitting KS4 exams. To get round the problem that a shock in year *t* will affect all children in the school, we restrict our estimation sample to have a five-year gap between each school level observation of performance. This means there are no overlapping cohorts of pupils across the school level observations, thus reducing the impact of serial correlation across cohorts. To address the potentially long lag structure, we impose the assumption of common effects in the lagged wages and estimate the effect of an average outside wage, defined over a five-year period (i.e. from *t-1* to time *t-5*). This has the additional advantage of averaging away some of the noise in the annual wages. The model we estimate is:

$$KS4_{i,t} = \alpha + \beta(\tfrac{1}{5}\textstyle\sum_{k=1}^{5} W^{O}_{i,t-k}) + \rho KS2_{i,t-5} + \gamma' X_{i,t} + \mu_t + f_i + \epsilon_{i,t} \qquad (2)$$

The explanatory variable of interest is the school outside wage averaged over five years from *t-1* to *t-5*. The dependent variable is school level mean KS4 points obtained at time *t* for school *i.* $KS2_{i,t-5}$ is the intake performance (measured in the last year of primary school) of the pupils who take their KS4 in year *t.* This boils down to regressing changes in exam scores on changes in outside wages, keeping constant any relevant X_{it} and baseline exam scores. Conditioning on the fixed effects at school level, this is like a difference-in-difference analysis. A disadvantage is that as school performance data which contains both KS4 and KS2 scores is only available from 2002 onwards we only have two observations per school, in 2007 and 2002, matched to wage data starting in 1997. However, we have a large sample of schools, and the two observations per school allow us to control for time invariant heterogeneity at school level.

III. DATA

We use several sources of administrative data. At the center of our analysis is data on school performance matched to data on local outside labor market wages. To test robustness and to examine the potential pathways by which wage regulation may affect school output we augment this with other data on the local labor market, teacher tenure and regulated (inside) wages. This section describes our data: details of sources and the years we use are provided in Appendix A, Table A1.

III.A School performance data

Our main measure of pupil performance at school level is taken from the Pupil Level Annual School Census (PLASC). This dataset records the performance of all pupils in national exams in all 3285 public (state) secondary schools in England. We use data from 2002-2007.[7] Pupils can take up any number of KS4 exams, with a minimum of one and a conventional maximum of around fourteen, in a range of subjects including Mathematics, English language, English literature, Science subjects, and History.[8] KS4 exams are graded from A* to G, and these grades are translated into points, such that an A* is worth eight points, an A is worth seven, a B is worth six, and so on. We use the total number of points that a student obtains (i.e. points from each exam summed across all the exams they take), averaged at school level, as our key measure of output of the school. To control for the effect of pupil type (including effects of peers in the school), we control for the attainment of the same cohort of pupils immediately before they entered the secondary school.[9] This is the pupils' average point score in the KS2 exams, also from PLASC. KS2 exams are graded from 2 to 5, and are taken in Mathematics, English and Science.

In analyses of other measures of performance we examine the proportion of pupils in the school who achieved 5 GSCEs at grades A*-C or better; the average number of KS4 exams taken by pupils (all from the PLASC dataset); and the number of pupils excluded from school (from the Dept. for Education). We also use measures of school performance derived from the in-depth inspections of schools undertaken by the government schools regulator (OFSTED). OFSTED undertakes expert in-depth inspection of each school to provide a published assessment of the quality of each school. These assessments take place over a number of days and are intended to 'net out' any pupil or parental effect. The school's performance is rated on numerous dimensions, including an overall

[7] The PLASC dataset began in 2002 and links pupils over time. It was preceded by the Annual School Census (ASC) which was at school level and did not contain KS2 scores for the pupils in secondary schools. This means school level value added cannot be observed before 2002.

[8] There is no official maximum, although taking more than fourteen is rare.

[9] There are more primary schools than secondary schools so secondary school pupils will be from a number of different primary schools.

rating of the school and an assessment of teaching and learning at the school.[10] Both are rated on a four-point scale from 1 (outstanding) to 4 (inadequate). Given the frequency of inspections, these data are available for only a sub-sample of the schools in our main analysis. We use inspection data from 2002-2008.

In our analysis of pathways, we use data on teacher tenure at school level from the School Workforce Census. This is a recently released administrative dataset from which the proportion of teachers in a school who are in post for less than a year, and the proportion that have been in post for over 10 years can be extracted. It has only, to date, been released for 2010.

III.B. Wages and employment data

Our key 'outside wage' measure is intended to measure the alternative private sector wage which teachers could command. We define the outside wage for each school as the average wage of all Local Authorities (LA) whose headquarters is within a 30km radius of the school. This circle around the school represents a 'travel to work' area (TTWA), in which teachers at the school could seek alternative employment.[11] In some areas, there are as many as 45 LAs within this radius, whilst in many others there is just one. For schools where there is not a headquarters of a LA within the 30km radius (or the wage data is missing for the LAs within that range) the nearest LA with wage data is allocated to a school, provided that LA is within 60km of the school. If the nearest LA with wage data is outside that distance, the school is excluded from our analysis.[12]

The local wage data are from the Annual Survey of Hours and Earnings (ASHE) dataset, a 1% sample of all employees in Great Britain, covering approximately 300,000 workers per year, sampled in April of each year which provides wage data at Local Authority level. The publicly available dataset contains average wages, split into manual and non-manual, part and full time. As our measure of outside wages we use (the log of) the full time male non-manual hourly earnings.[13] To construct the lagged five-year average wage for each school we use the average of outside wages from *t-5* to *t-1* for all LAs that fall into the TTWA of the school. The five year gaps between our outcome observations in equation (2) mean we use average wages from 1997-2001 and 2002-2006. In robustness checks we use a more complex measure of outside wages which corrects wages for local

[10] Schools are given an overall rating. Within this there are four categories (Achievement & standards/Personal Development & Well-Being/Quality of Provision/Leadership & Management). Teaching and Learning is a subcategory of Quality of Provision. Pre-2005 a 7-point scale was used to rate schools and from 2006 a 4 point scale. As few schools received above 4, we capped scores at 4 for comparability across time.

[11] Propper and van Reenen (2010) use the same labor market definition for nurses in England.

[12] The small distances in England mean only nine schools are dropped from the sample. In robustness tests below we examine the impact of using different radii to define the TTWA.

[13] Our results are robust to use of male and female (separately) weekly wages.

labour market composition. The correction uses Labour Force Survey (LFS) as ASHE does not contain the necessary data to make this correction. We also use the LFS to derive counterfactual wages for our calculations of the costs of wage regulation. Details are provided in Appendix B.

We examine the impact of outside wages and employment prospects for different groups (the youth labor market, manual workers) in the outside labor market on school performance. These wage and employment data are from ASHE. We also examine the effect of inside pay, which is from the Department for Education Teacher Pay and Conditions Handbooks.

In analyses of heterogeneity we define large 'outside wage regions' on the basis of the long run level of outside wages, as measured in ASHE. We group the 10 Government Office Regions (GORs) in England into three (details in Appendix Table A2, Panel (A)) and assign each school to a single 'outside wage region'.[14]

III.C Controls

The PLASC data we use contain extensive information on the final-year (age 16) composition of pupils. But our identification approach means that results with and without controls should give the same estimates and pupil characteristics may be endogenous. So we initially present results with no controls other than prior attainment. We then use a small set of controls (those that we find are associated with value added controlling for outside wages) to allow for the effect on the standard errors of heterogeneity across pupil type.[15] We also use this set of pupil controls to test the common trends assumption in our design.

III.D. Data description

Summary statistics for all variables we use are in Table A3. The table shows the range of KS4 points across school is large, with a minimum score of zero and a maximum of 99. The mean is just under 44. KS2 scores are in different units to KS4 and have a mean of just under 27. Our key wage variable is the (log of the) outside wage, averaged for each school over a five-year period. This has a school level mean of 7.271, which equates to an average salary of £29524 per annum.[16] All variables, particularly the wage variable, exhibit considerable within group variation, indicating change over time within schools.

Table A2, Panel (B) shows the growth in the level of wages by outside wage region. This is given for the two sub-periods corresponding to the average lagged wages used in our main estimates and the

[14] Long run wages based on ASHE average non-manual full time weekly wages

[15] The controls are the proportion of pupils that are Black African, male, have special needs (SEN) and are low income (low income is measured by eligibility for free school meals) and school level expenditure per pupil.

[16] Annual average salary calculated from the level of the school TTWA wage.

full period 1997-2006. Wage growth was highest in the high wage region in both the full and the two sub-periods, but the growth rates have variance and several local authorities within the medium wage region experienced high wage shocks during the period. For example, of the 30 LEAs (there are 148 LEAs) which experienced the highest wage growth between 1997 and 2006, 11 are located in the middle outside wage region. These LEAs are primarily located in the affluent south of England, though outside London and the South East.[17]

Table 1 presents cross sectional estimates year by year between the (log of the) outside wages (lagged one year) and school average GCSE performance. We include controls for mean KS2 scores at intake and local authorities fixed effects. The estimates are the change in average GCSE points per pupil associated with a 10% increase in the outside wage. All the cross-sectional associations are negative, though not all are statistically significant. The association is largest in 2005 at just over half a GCSE point lost per student.

III.E Tests of common trends

Our analysis is essentially a difference-in-difference (DD) estimation in which we have multiple areas and two years per school. To check our common trends assumptions we regress the growth in wages (our treatment variable) between 2002 and 2006 at the LEA level on the average characteristics of school pupils (jointly) in 2002 and the level of total KS4 points per pupil in 2002 (the earliest year for which these data are available). Differences in wage growth that are associated with the initial level of covariates or school output could indicate that areas that differ in terms of wage growth also differ in terms of unobservables and threaten our identification strategy. The results are presented in Appendix A, Table A4, columns [1] and [2]. The results show that there are no significant associations between the 2002 characteristics and the subsequent wage growth at LEA level.

While the baseline school covariates and school level average GSCE points are not available before the release of PLASC in 2002, there is available data on the performance at school level on the 5 A*-C metric. As a further test, we examine the association between this metric in 1997 with subsequent wage growth 1997-2006. This therefore spans the full period covered by our wage data (as our analysis uses lagged 5 year average wages). The results are presented in Appendix A, Table A4, column [3] and show no association between baseline performance and wage growth.

[17] The LEAs are Halton, Blackpool, Bath and NE Somerset, North Somerset, Plymouth, Poole, Wiltshire, Luton, Cambridgeshire, Essex, Hertforshire.

The subsequent columns of Table A4 repeat these analyses at the level of the three outside wage regions. Again, we find no association between baseline covariates or baseline school performance and subsequent wage growth. We conclude that our DD assumptions are likely to be satisfied.

IV. RESULTS

IV.A Baseline results

Table 2 presents estimates of the effect of wage regulation on school productivity as measured by test scores. Columns [1] – [4] presents the results for value-added (total exam points per pupil controlling for initial intake scores). Columns [5] and [6] present results for the percentage of pupils who achieved at least 5 A*-C GCSEs. Columns [1] and [2] present OLS estimates. The remaining columns present fixed effects estimates. The first of each pair of estimates has no controls and the second includes those few covariates which are associated with test scores after controlling for school fixed effects and prior attainment.

The table shows all coefficients on the outside wage are negative and significant. The increase in size between the OLS and fixed effects estimates in Columns [1] and [2] indicates that controlling for omitted school level factors is important.[18] On the other hand, the effect of controlling for time varying school level covariates is small, supporting the appropriateness of our identification strategy, as if this is correct the covariates should only affect the standard errors.

The coefficients represent the estimated change in the outcome associated with a 10% increase in the five-year outside average wage. Column [4] indicates a loss of approximately 1 GCSE point per pupil in value added in response to a 10% increase in the outside wage, which is equivalent to dropping one GCSE grade in one subject or around a 2 percent average fall at the mean of 44 points. Column [6] indicates a fall of around 1.8 percentage points in the proportion of pupils achieving 5 or more A*- Cs, which equates to a 3 percent fall at the mean of 56.5 percent. Thus the estimates suggest that a wage increase leads to a similar small, but significant, fall in both measures of school productivity.

We now subject our results to a large battery of tests. We begin by examining econometric issues: we test our identification strategy and the robustness of the results to the definition of the local labor market and definition of the outside wage. We then test the salience of our design by examining whether the effects of regulation are larger in various settings in which the wage ceiling

[18] The increase in estimates between OLS and the fixed effects specification suggests an unobservable factor that is positively correlated with both outside wages and school performance. An example might be a board of governors (the quality of the board of governors could be greater in high outside wages, improving school performance), or the quality of the head-teacher, whose wages are not subject to regulation.

should have greater bite. Finally we examine robustness of the results to potential gaming by schools that may be correlated with the outside labor market shocks.

IV.*B Further tests of identification*

As a further check of our DD design, we re-estimate our baseline model for value added including all the baseline covariates plus interactions of all covariates with a dummy for the second time period. Differences in the estimated wage effects between this and our baseline specification would indicate that there may be changes in school or area composition which are driving our results. Table 3, row [2] presents the results. Comparison of these with our baseline estimates (reproduced in Row [1]) shows the coefficient on the outside wage falls a little but remains well defined and negative. Rows [3] and [4] report two placebo checks. We use the future outside wages at *t+1* and *t+2* rather than past ones. As these are after the cohort has left school they should have no effect on performance. The results confirm this.

IV.C. Alternative specification of the attractiveness of the outside labor market and controls for the inside wage

Our primary specification uses the (five year) average of the non-manual male outside wage, lagged one year, for a 30km TTWA. We subject this to a number of robustness tests. First, in the spirit of a placebo test, we check that there is less response to a less relevant measure of outside wage. As teachers are graduates, if the outside wage has an effect on their performance, they should be less likely to respond to shocks to the wages of less skilled workers. In row [5] of Table 3 we replace the non-manual wage with the wages of less skilled workers (manual workers). We find a smaller and insignificant wage coefficient.

Second, we check robustness to the definition of the TTWA. Our main specification uses a radius of 30km round each school to define each school's unique TTWA. We change this radius in 10km steps from a minimum of 10km to a maximum of 120km. The estimated wage coefficient for each radius and the associated 95% confidence intervals are plotted in Figure 2. This figure clearly shows the results are insensitive to the precise choices of the radius for distances between 20 and 60km. Larger areas cannot really be considered to be a TTWA for a school and we also find no effect at the very small radius of 10km. It is possible at this small radius wages are endogenous; we return to this below in Section V.C. [19]

[19] This smaller coefficient is not due to the reduced sample size as the coefficient with the same set of schools as in the 10km regression but with a TTWA radius of 30km is -1.389 (s.e.=0.597). In further analyses we weighted wages by the inverse of the distance from the school to each LA headquarter used in the construction of the wage. This did not materially alter the results. The results are also not sensitive to how we treat assign wages to schools that have no Local Authority whose headquarters lie within a 30km radius (available from the authors).

Third, outside employment prospects may matter as well as wages. At the very least, if employment falls, average wages rise due to composition effects. To check that this is not materially affecting our results we add the employment rates of 25-49 year old at the local authority level over the 5-year period for which the cohort is in school as an additional control. Row [6] shows that this does not affect the estimated wage coefficient and the coefficient on the employment rate is small and insignificant.

Fourth, our model is driven by the difference between inside and outside wages. The inside wage at school level is endogenous if schools try to circumvent wage setting. But there is variation in the regulated teacher wage across the four pay band areas. To examine the robustness of our results to our assumption that it is changes in outside wages that drive our results, we add controls for the inside wage.[20] The results in row [7] show that the coefficient on the outside wage drops a little with this control (from -0.98 to -0.87), indicating that areas with higher changes in outside wages also have higher changes in regulated wages, which is as expected given the pay setting process. But the coefficient on the outside wage remains significant at the five percent level. Row [8] presents estimates using the wage gap (outside wages minus inside wages) and the results are little changed.

Fifth, we use a more sophisticated measure of outside wages that creates an area- and time-specific outside wage for teachers using the observed characteristics (age, gender, years of schooling, etc.) of teachers in a particular area-year cell (we do not observe these characteristics at the school level).[21] This follows Propper and Van Reenen (2010) who use this approach to construct a wage which corrects for labour market composition appropriate to nurses. The results in Row [9] show that this has little effect on the estimated wage coefficient. Examination of the adjusted wage series shows that the difference in characteristics between teachers and those working in other sectors does not vary greatly over time in an area. Thus the main cause of area-specific time-series changes in outside wages is simply the growth in the non-manual wage in an area rather than changes in observables (or the price of these observables) over time. This supports our use of a measure that does not adjust for composition.

Each school has its own TTWA. So the treatment (wage shocks) in our design is at school level. But as there may be common unobserved shocks to wages at the local geographical level, we test robustness to (i) clustering at the LEA level and to (ii) clustering schools with the same combination of LAs used to derive their TTWA average wage. Rows [10] and [11] show the standard errors rise (the result of clustering at a much small number of units - there are 148 LEAs and 529 unique LA

[20] We use the M6 pay grade which is the category that most teachers are in. It remained constant when slight amendments were made to teacher regulated pay scales during our sample period.
[21] Construction details in Appendix B.

combinations compared to 3048 schools), but the coefficient on wages remains significant at the 10 percent level. Finally, to account for the fact that LA wages provide only an estimate of outside wages, we provide estimates with bootstrapped standard errors (clustering at school level) in Row [12]. The wage estimate remains significant at the 5% level.

IV.D Tests of the salience of our research design

Our argument is that pay regulation acts as a ceiling and we exploit this to identify the impact of pay on school productivity. However, we do not observe what the unregulated wage for teachers would be. While it is difficult to estimate the exact counterfactual wage for a teacher in the outside labor market (see Ma et al., 2009, for one approach) even without observing this counterfactual we should expect to find more effect where the ceiling is more likely to bite. This is in labor markets where outside wages are highest and where schools have least power over wage setting and conditions of employment.

To compare the effect of an outside wage shock across heterogeneous outside labor markets we estimate the response to an outside wage shock separately for schools in each of the three 'outside wage regions'. The results presented in Table 4 show a greater effect of wage regulation in schools located in the higher two outside wage regions. Column [1] of Table 4 shows a negative interaction term for the highest wage region, which is around one third of the size of the main effect. Column [2] shows a positive interaction term for the lowest wage region. Column [3] presents estimates for each outside wage region. These show a larger negative (and very similar) effect in the top two regions than in the lowest outside wage region. Estimates for the 5 A*-C margin also show a similar pattern: the coefficients (robust standard errors) from separate estimates by outside wage region are -1.53 (0.66), -1.42 (0.64) and -0.62 (0.69) in the high, medium and low wage regions respectively. We also check that our results are not driven by London schools: Column [4] of Table 4 shows they do not.

These results fit with the pattern in regional wage changes that were discussed in Section III.D. While London and the South East may have the highest long run level of outside wages, our effect is driven by shocks to outside wages. These have been large in several labor markets in the middle 'outside wage region'. For example, we noted above that of the LAs in the top quartile of highest wage growth in our period, 35 percent are in the middle outside wage region. For these LAs our estimates of the counterfactual wage (what would be paid in the absence of regulation) is £1750 higher than the regulated wage.[22] Other LAs in the middle wage area also have a positive gap

[22] For method of estimation of the counterfactual wage see Appendix B.

between the counterfactual and regulated wage. Thus regulation bites in the middle, as well as the highest wage area, and we find a response to wages in both.

Certain types of schools should be more affected than others by wage shocks. Schools which have more schools close to them are likely to have more problems in recruiting and retaining staff when subject to outside wage shocks and thus, if our identification strategy is correct, wage shocks should have more impact on their value added. We re-estimate our baseline model excluding schools which face little spatial competition from other schools.[23] Table 4, column [5], presents the estimate, which shows that the wage coefficient increases by around 40%. These results suggest that competition, by providing further bite to the ceiling, amplifies the effect of a wage shock. We also examine the relationship between outside wages and value added for the sub-set of schools which have least power over their terms and conditions of employment. In England, secondary schools are classified into a number of types, the most common being Community Schools. These schools are not permitted to select pupils and LEAs have control over their curriculum and teacher wages. In the other types of state schools pupil selection is sometimes an option (for example, publicly run religious schools) and there is, in theory at least, more flexibility in terms of teacher wage setting. In column [6] we present the estimates for Community Schools only. The magnitude of the coefficient increases by around 60%. These results provide support for our argument: there is a stronger effect amongst schools with the least (no) power over their wage setting.

IV.E School gaming

KS4 exams are high stake exams, not just for children, but also for schools. This may lead to school gaming and if this is associated with higher wage growth it could bias our results. By looking at both a measure of total performance (adjusted for intake) and performance on the key 5 A*-C metric, we have looked at performance at different parts of the ability distribution. So if gaming only affects the performance of low or high ability students, our approach should deal with that.

To further investigate this we first consider whether schools subject to wage shocks try to prevent children from sitting exams by excluding them. We can examine this only at regional (the 10 GORs) level due to lack of published data on exclusions at the school or LEA level.[24] The results of a regression of wage shocks on exclusions at the regional level are presented in Table 3, row [13]. This shows no relationship between the outside wage and the number of exclusions, suggesting schools do not react to wage shocks by baring pupils from exams. Second, it is possible that schools react to outside wage pressure by limiting the number of exams that pupils take in order to get better

[23] A school with low local competition is defined as a school with eight or fewer schools within a 10km radius (28% of the sample).

[24] Data from the Department for Education, which provides exclusion data at GOR level only.

average performance. To examine this we re-estimate our baseline model using the average number of exams taken as the dependent variable. The results in row [14] show that schools do respond at this margin: a 10 percent increase in the outside wage causes schools to reduce the average number of exams taken by each pupil by just under 0.2. They may be doing this to hit the key 5 A*-C metric. However, as Table 2 shows, this strategy does not appear to prevent them from having lower performance on this metric. But it may mean that our results are under-estimates of the impact of the outside wage as schools subject to shocks divert more of their effort to hitting the targets, at the expenses of higher scores above the target.

Third, we examine the impact of potential gaming on the ability of the initial intake on our results. Estimates without controls for student performance at intake in row [15] of Table 3 show that our results are essentially unchanged, suggesting that schools do not game intake in response to shocks. As shocks take place after initial intake, this also serves as a further test of the robustness of our identification strategy. Row [16] presents estimates for value-added as the dependent variable. Again, the estimates are little changed.[25]

We conclude that while wage shocks may induce schools to game, gaming does not drive our results. Schools subject to wage shocks do not exclude pupils to avoid poor performance and while they reduce the number of exams their pupils take, wage shocks still negatively affect performance at both the high end (students who take many exams) and at the lower end (those students aiming for the 5 A*-C minimum) of the ability distribution.

On the basis of this battery of tests, we conclude that our identification strategy is robust. Student performance at school level appears responsive to shocks to wages in the local labor market, the relationship is stronger where the wage ceiling has more bite, and shocks affect school performance for both high and low ability pupils.

V. MECHANISMS

Our argument is that shocks to outside wages can drive teacher effort (through an efficiency wage effort) and labor supply (the loss of good teachers) and that this lowers the quality of teaching. But it is possible that the results are not due to responses of teachers but are driven by responses of pupils and their parents to outside market conditions.

While we cannot rule this out completely, we provide evidence on this by examining a measure of teacher quality that should not be affected by pupil type, so shutting down a pupil effect; we directly

[25] We undertook further sensitivity tests, to which our results were robust. We excluded KS4 outliers; the coefficient (se) rose slightly to -1.279 (0.358). Our results are also robust to exclusion of small school cohorts (less than 30 students), so addressing potential problems in measurement of school outcomes (Kane and Staiger, 2002).

examine the relationship between wages and teacher tenure to see if schools subject to wage shocks experience problems with teacher retention; and we examine whether the plausible responses of pupils to outside labor market conditions drive our results. Finally, we discuss evidence relevant to parental behaviour.

V.A. The effect of wage regulation on quality of teaching

One way to examine the effect between wages and quality of teaching would be to examine the qualifications of teachers. However, teacher qualifications are not likely to be a useful margin. First, research on teacher qualifications suggests there is little correlation between teacher qualifications and teacher effectiveness (e.g. Rockoff, 2004, Rivkin et al., 2005, Aaronson et al., 2007, for the USA and Slater et al., 2012, for England). Second, in the LFS data, most teachers are graduates and this figure does not vary systematically across regions. Instead we examine a direct measure of the effectiveness of teaching in the school: the ratings the school received in their OFSTED inspection of school quality between 2003 and 2008. School performance is rated on a number of dimensions, each using a four-point scale which ranges from 1 (outstanding) to 4 (inadequate). In Table 5, column [1] we examine the relationship between overall performance of the school and outside wages and in column [2] we examine the relationship between the 'quality of teaching' score and outside wages.[26] We use the same lagged five-year average definition of outside wages and include pupil characteristics for the year of observation as in our baseline model. As there is only one observation per school we do not include school fixed effects but include LEA fixed effects.

The results show that a higher outside wage is associated with a poorer overall rating of the school (a positive coefficient indicates an increase in wages is associated with poorer performance). More importantly, it is also associated with poorer teaching quality. A 10% increase in outside wages decreases the quality of teaching by 1.4 points.[27] This is a large effect: as the mean teaching quality score is 2.6 this is essentially a doubling of the teaching quality score.

V.B The effect of outside wages on teacher tenure

In our model, one effect of wage regulation is that teachers leave schools in high wage areas. This is likely to affect student performance: time will need to be spent by the senior management team on recruitment rather than other activities, less experienced teachers may be less effective (Dolton and Newson, 2003, provide UK evidence on this) and there may be spillovers on the morale of the remaining teachers that may dampen effort (Ronfeldt, Lankford, Loeb and Wyckoff, 2011).

[26] There was a change in 2006 in the exact definition of the teaching quality component of the assessment from 'teaching' to 'effectiveness of teaching in meeting learners needs', so we demean the scores within year.

[27] Due to the change in the teaching quality variable in 2006, we also estimate the effect pre- and post-2006 separately. The coefficient (se) on the lagged average wage for 2003-2005 is 1.63 (0.331) and for 2006-2008 is 0.597 (0.327).

To look at this channel we examine the relationship between outside wages and teacher tenure in each school.[28] We exploit a recently released data set, which presently covers only 2010. We cannot, using these data, examine hires and separations, but we can examine the association between average tenure in schools in time bands and outside wages. We present the association between the proportion of the teachers who have very short tenure (less than a year in the school) and long tenure (over 10 years in the school) and lagged outside wages, averaged over five years to replicate the modelling of wages in our baseline specification.[29] We only have one observation per school so estimate equation (2) using LEA rather than school fixed effects, and report the results in Table 5, columns [3] and [4]. Column [3] presents estimates of wages on short tenure while column [4] examines long tenure.

The results show that where outside wages are high, schools have a higher proportion of teachers who have been in tenure less than one year and a lower proportion of teachers who have been in tenure for ten years only. The wage effect is little altered by controls for pupil type.[30] A £1000 increase in the outside wage results in a 0.25 percentage point increase in the proportion of teachers who have been in the school less than a year, and a 0.43 percentage point decrease in the proportion of teachers who have been in the school more than 10 years. While the magnitude of these effects is not large (the coefficients represent a 2 percent change for both short and long tenure), schools in high wage areas lose teachers faster and also have less experienced teachers.

V.C A Pupil or parental effect?

An alternative hypothesis is that our results are due to the responses of pupils and/or their parents to outside wages. The relationship we find could be driven by pupils responding to better labor market opportunities by decreasing their effort at school because they know there is an employment alternative. If this is the case, we would expect to find a negative relationship between school performance and higher outside wages and/or the demand for youth labor in the local labor market. To examine this we estimate the relationship between school performance and the demand for youth labor, as measured by local authority wages and, separately, the unemployment rate, of

[28] Ma et al. (2009) show a negative cross-sectional association between teacher vacancies and local authority amenity adjusted wages for 2004-2007.

[29] We use wage data from the LFS, averaging wages at LA level between 2005 and 2009 (we use full time wages of all 22-61 year olds in order to preserve sample sizes). The wage for each school is constructed as the average of all LA's whose HQ lies within a 30km radius of the school.

[30] Wage coefficients (se) without controls are 0.268 (0.040) and -0.45 (0.050) respectively. Results are robust to the precise definition of the TTWA over which wage is defined (results available from authors).

16-25 year olds, lagged one year.[31] Regressions are at school level and include the same controls as our baseline specification and school fixed effects.

Table 5, column [5], presents the results for the association of school performance and youth wage rates. Column [6] presents the association with youth unemployment. Neither association is large or statistically significant. Further, for the negative relationship we find between outside wages and school performance to be driven by a pupil response, pupils would have to be responding negatively to positive outside wage or employment shocks. Whilst this is plausible, it seems equally plausible that at least some pupils respond to positive wage shocks by putting in more effort at school, on the grounds that if they get better exam grades they are more likely to get a (better) job. These plausibly heterogeneous responses do not fit with our finding of a negative outside wage effect for both low ability students (those at the 5 A*-C margin) and all students (total exam points achieved).

An outside wage shock would also be a positive shock to parental income, which could result in worse performance if greater parental income means less supervision of children or more leisure time for children. While we cannot rule this out, the lack of significance of the full time male manual wages in the robustness checks in Section IV brings into doubt whether the effect is working through parental income. If parental income was important, it is not clear why a parental income effect should operate only for parents in non-manual occupations. In addition, the large (though often correlational) literature shows a positive rather than a negative association between parental income and child attainment. It thus seems less likely that the negative relationship we find between outside wages and child attainment is driven by a parental effect.

School performance could affect outside wages, which would bias our results. The most obvious mechanism by which school performance may affect outside wages is through sorting: good schools attract high income parents to move into the area surrounding a school.[32] This would give a positive shock to the average outside wage and would bias our estimated coefficients upwards. However, the 30 km radius TTWA we use weakens this argument. If we had used the catchment area of a school to determine the outside wage this would be problematic, as parents try to buy houses in the catchment areas of 'good' schools. But much of that gaming is within area. Individuals are likely to choose areas based on their job and general lifestyle choice and then select their specific within-area locations based on the schools available. Figure 2 shows a smaller relationship between outside wages and school performance at radii of 10km and at 20km. The TTWA radii at these distances give

[31] We match Local Authority level NOMIS data into our PLASC dataset and include the lagged employment rate in our regressions. As the pupils who are at the margin between staying on and leaving are likely to be most affected by recent shocks, we use wages and unemployment rates lagged one year.

[32] English schools have pre-set catchment areas which define pupil eligibility to attend the school.

more weight to the local catchment area round each school, which may indicate endogeneity at this smaller spatial distance. Our analysis uses 30 km distance to avoid this problem.[33]

In summary, these results suggest that the effect of shocks in outside wage on school performance is, at least in part, through lower teaching quality and labor supply and not from responses of parents and children to the local labor market. In fact, whilst pupils (and their parents) might respond, they probably do so in a way which biases our estimated coefficients towards zero.

VI. POTENTIAL GAINS FROM REMOVAL OF WAGE REGULATION

Our results suggest that regulation which imposes a common wage across heterogeneous outside wage regions has costs. Removal of such regulation may therefore bring benefits. We therefore conduct a thought experiment in which we remove the regulation and allow teacher wages to be more reflective of broad local labor market conditions. To do this, we need to estimate a counterfactual wage for teachers in each of the three broad outside wage regions we define above. We estimate the former using LFS data, adjusting non-manual wages to estimate wages that would be paid to individuals with the human capital level of teachers (for details see Appendix B).[34] We also need to value the gain from the removal of the policy. To do this we focus on the effect at the key 5 GCSE A*-C margin, ignoring other gains in terms of higher grades for pupils at other points in the ability distribution.

Table 6 presents our estimated costs and benefits. Column [1] presents the estimated costs of removing the regulated ceiling on wages under various experiments. Column [2] presents the social cost of this. As teacher wages come from the public purse, they are a transfer, so the social cost (saving) associated with a rise (fall) in the overall teacher wage bill is only the excess (saved) deadweight loss from taxation. We set this as 30% but increase this to 60% in one experiment. Column [3] estimates the number of students affected by the removal of the regulation. This uses our estimates of the wage coefficient in each of the three outside wage regions to calculate the effect of raising wages to the regional counterfactual on the change in the number of pupils who would get 5 A*-C GCSEs.[35] Column [4] presents estimates of the value of this gain. Sianesi (2003)

[33] In Figure 2 the effect at 30km is slightly larger than from our main regressions (-0.980). In the main regressions we match schools to the nearest LA when there is no LA within the 30km radius. For Figure 2 schools with no LAs within the given radius are dropped.

[34] The difference between the counterfactual wages and current outside wages are £3082, -£23 and –£1058 for the high, medium and low outside wage region respectively.

[35] The wage coefficients are from separate estimates by outside wage region and are -1.53 (0.66), -1.42 (0.64) and -0.62 (0.69) in the high, medium and low wage regions respectively. In this exercise we set the latter to 0. In this experiment, we assume that teacher response to the removal of regulation is equivalent to the effect of wages being lower than the outside wage. Ballou and Podgursky (1997) note that the short term implications of a change in relative earnings are not clear cut, because salary affects both the supply of new teachers and retention of currently employed teachers. We allow for this by increasing and decreasing the response to the wage change in two experiments.

estimates the earnings premium from attaining five A*-C GCSE grades (compared to attaining four) to be 12%. We increase the regional average wage of individuals with fewer than 5 GCSEs by 12% and multiply this by the extra number of pupils gaining these qualifications to give an annual gain. This is then multiplied by 20, as a conservative estimate of the increase in lifetime earnings, and discounted using a discount rate of 0.95.

Column [5] presents the simple 'political headline' figure of the cost per pupil of removing regulation: the ratio of the increase in teacher wages to the change in the number of pupils who get five A*-C GCSEs. But this is not the overall net social benefit, as it ignores the fact that the increase in teacher pay is a transfer and does not value the gain to the pupils. This is given in column [6] and is the sum of the increase in lifetime earnings (column [4]) minus the deadweight loss associated with the increase in the teacher wage bill (column [2]).

Our baseline estimate is given in row [1] of Table 6. The increase in the wage bill would be £102m and the deadweight loss of this just under 31m. The increase in the total number of pupils crossing the 5 A*-C threshold is 2014 with an estimated total gain from increased earnings of £77m. The financial cost per pupil is in the order of £50,000 and the net social gain is £46m.

The other rows vary the key assumptions. In row [2] the deadweight loss is increased to 60%. This reduces the net social benefit to £16m. In row [3] we reduce the wage gain to only 6% and this has the effect of making the policy have nearly zero social gain. Rows [4] and [5] increase and decrease the wage coefficient estimates by 1 standard error respectively. This increases and decreases the net social gain respectively, but it is still positive even with the reduction in response in row [5]. Rows [6] and [7] reduce and increase respectively the counterfactual wages by 10%. Under the reduction in row [6] the teacher wage bill becomes negative, but is matched by a fall in the number of pupils getting across the threshold, so the overall net social gain remains positive. An increase in the counterfactual wage has the opposite effect, but again the net social gain is positive.

In sum, Table 6 shows that for our baseline estimates, and variation in the key parameters, there is a small but positive gain from removing wage regulation. In addition, these estimates are conservative in that they do not take into account gains to other pupils or any longer term benefits.

VII. CONCLUSIONS

Unionization on the supply side, and public ownership on the demand side, of the teacher labor market means that teacher wages are frequently set to be flat across heterogeneous local labor markets. This paper exploits the national regulation of teacher wages, national exams at entry into

and exit from secondary (middle/high) schooling and a national school inspection system in England to estimate the effect of pay on teacher performance. We find that regulation reduces school performance as measured by both student performance and the quality of teaching as assessed by the government regulator of schools, that the effect is larger where the ceiling imposed by regulation bites harder, and for schools that have no control over pay and conditions at school level. While data constraints mean that we cannot trace through all the pathways through which the pay effect operates, we find indication that schools subject to high wages have higher staff turnover and that the results are not driven by pupil response to local labor market conditions.

The average effect is relatively small. At the average a 10% increase in the local labor market wage would result in an average increase of 2% in the scores attained in the high stake exams taken by pupils at the end of compulsory schooling in England. But the effect in areas or schools where the ceiling bites harder is approximately double this size. Our simple calculations of the gain of removal of the wage regulation are positive under a number of scenarios.

In sum, our findings support the view that teacher pay is important for performance. While the recent focus of many governments has been on pay for performance for teachers (e.g. Lavy 2009), centralized pay setting affects teachers in many more countries than are using pay for performance in the classroom. Our findings suggest that policy effort would be usefully directed towards increasing flexibility in centralized wage setting processes.

REFERENCES

Aaronson, D., L. Barrow, and W. Sander (2007) "Teachers and Student Achievement in the Chicago Public High Schools," Journal of Labor Economics, vol. 25(1), 95–135.

Akerlof, George (1982) "Labor Contracts as Partial Gift Exchange" Quarterly Journal of Economics. 97: 543–69.

Ballou, D., Podgursky, M. (1997) "Teacher Pay and Teacher Quality". W.E. Upjohn Institute for Employment Research, Kalamazoo, MI

Barr, A. and Zeitlin, A. (2010) "Dictator games in the lab and in nature: External validity tested and investigated in Ugandan primary schools", CSAE WPS/2010-11

Barrow, L. and Rouse, C.E. (2005) "Causality, causality, causality: the view of education inputs and outputs from economics", WP-05-15, Federal Reserve Bank of Chicago.

Benton, T., Hutchison, D., Schagen, I. and Scott, E. (2003) "Study of the performance of maintained secondary schools in England", Report for the National Audit Office, London: National Foundation for Educational Research.

Bulman, Joanna (2002) "Patterns of Pay: Results of the 2002 New Earnings Survey." Labor Market Trends 110 (December): 643–55.

Cappelli, P., and Chauvin, K. (1991) "An Inter-plant Test of Efficiency Wage Arguments", Quarterly Journal of Economics 103:769-87.

Dolton, P. (1990) "The economics of UK teacher supply: the graduate's decision", Economic Journal, 100, 400, pp. 91-104.

Dolton, P. and Newson, D. (2003)" The Relationship between Teacher Turnover and Pupil Performance", London Review of Education.

Dolton, P. and van der Klaauw, W. (1995) "Leaving teaching in the UK: A duration analysis", Economic Journal, 105(429), 431-44.

Dolton, Peter (2006). "Teacher supply" in E. Hanushek and F. Welch (eds) The Handbook of Education Economics North Holland: Amsterdam.

Dolton, Peter and Oscar D. Marcenaro-Gutierrez (2011), "If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance", Economic Policy 26 (65), 5–55

Duncombe, William and John Yinger (1998) ,"School Finance Reform: Aid Formulas and Equity Objectives", National Tax Journal, 512: 39-62

Duncombe William and Yinger, John (2008) "Measurement of Cost differentials" in Ladd, H and Edward B Fiske (eds) Handbook of Research in Education Finance and Policy, 238-257.

Duncombe, William and John Yinger (2011) "Making Do: State Constraints and Local Responses in California's Education Finance System", International Tax and Public Finance Vol. 18, No. 3, June 2011, pp. 337-368.

Ehrenberg, R., and Brewer, D. (1994) "Do School and Teacher Characteristics Matter? Evidence from High School and Beyond", Economics of Education Review, Vol. 13, No. 1, pp. 1-17

Eom, Tae Ho , William Duncombe and John Yinger (2007) "The Unintended Consequences of Property Tax Relief: New York State's STAR Program". Syracuse University Working Paper.

Figlio, D. N. (1997). Teacher salaries and teacher quality. Economics Letters, 55(2), 267–271.

Galgóczi, Béla and Glassner, Vera (2008), "Comparative study of teachers' pay in Europe", Brussels: European Commission ETUI-REHS Research Department

Gordon, I.R. and Monastiriotis, V. (2007) "Education, Location, Education: a spatial analysis of secondary school exam results in England", Urban Studies, 44, 1203 – 1228

Hall, E., Propper, C. and van Reenen, J. (2008) "Can Pay Regulation Kill? The Impact of Labor Markets and Skills on Hospital Productivity", Working Paper no. 13776, NBER, Cambridge, MA.

Hanushek, E. (1986) "The Economics of Schooling: Production and Efficiency in Public Schools", Journal of Economic Literature 24 (September 1986), 1141-1147.

Hanushek, Eric and Rivkin, Steven G (2006) Teacher Quality in E. Hanushek and F. Welch (eds) Handbook of the Economics of Education, Vol 2, Pages 1051–1078. North Holland: Amsterdam.

Hoxby, C. (2001), "All School Finance Equalizations are not Created Equal" Quarterly Journal of Economics 116, 4, 1189-1231.

Kane, T. and Staiger, D. (2002) "The Promise and Pitfalls of School Accountability Measures", Journal of Economic Perspectives, Vol. 16, No. 4, Pages 91-114

Loeb, S. and Page, M. (2000) "Examining the link between teacher wages and student outcomes: the importance of alternative labor market opportunities and non-pecuniary variation", The Review of Economics and Statistics, Vol. 82, No. 3

Loeb, S., Kalogrides, D. and Beteille, T. (2011) "Effective Schools: Teacher Hiring, Assignment, Development, and Retention", NBER Working Paper 17177

Lovenheim, Michael F. (2009) "The Effect of Teachers' Unions on Education Production: Evidence from Union Election Certifications in Three Midwestern States", Journal of Labor Economics, Vol. 27, No. 4 (October 2009), pp. 525-587

Ma, A, Battu, H, Elliott, R (2009) "Local Pay Differences and Vacancy Rates for School Teachers in England and Wales: regional differences in teacher's rates of pay and teacher vacancy rates" University of Aberdeen HERU working paper.

Mas, Alex. 2006. "Pay, Reference Points and Police Performance." Quarterly Journal of Economics. 121 (3):783–821.

Murnane, R. J. and Olsen, R. J. (1990) "The effects of salaries and opportunity costs on length of stay in teaching: Evidence from North Carolina", Journal of Human Resources, 25(1), 106- 24.

Nickell, S. and Quintini, G. (2002) "The consequences of the decline in public sector pay in Britain: a little bit of evidence", Economic Journal, 112, F107-F118.

Ondrich, Y., Pas, E. and Yinger, J. (2008) "The Determinants of Teacher Attrition in Upstate New York" Public Finance Review (January 2008) 36: 112-144

Propper, C. and van Reenen, J. (2010) "Can Pay Regulation Kill? Panel Data Evidence on the Effect of Labor Markets on Hospital Performance", Journal of Political Economy, 2010, vol. 118, no. 2

Rivkin, S., Hanushek, E., and Kain, J. (2005) "Teachers, Schools, and Academic Achievement." Econometrica 73:417-458.

Rivkin. S, Hanushek, E. and Kain, J (2004) "Why Public Schools Lose Teachers", Journal of Human Resources 39:326-354.

Rockoff, J. (2004). "The impact of individual teachers on student achievement: Evidence from panel data", American Economic Review 94:247-252.

Ronfeldt, M., Lankford, H., Loeb, S. and Wyckoff, J. (2011) "How Teacher Turnover Harms Student Achievement", NBER Working Paper 17176

Shapiro, C. and Stiglitz, J. (1984) "Equilibrium Unemployment as a Worker Discipline Device." American Economic Review 74 (June): 433-44.

Sianesi, B. (2003), "Returns to Education: A Non-Technical Summary of CEE Work and Policy Discussion," Institute for Fiscal Studies Report, June 2003

Slater, Helen, Davies, Neil and Burgess, Simon (2012) "Do teachers matter? Measuring the variation in teacher effectiveness in England", Oxford Bulletin of Economics and Statistics 74: 629-645

Zabalza, A., Turnbull, P. and Williams, G. (1979) "The Economics of Teacher Supply". Cambridge University Press: Cambridge.

Figure 1

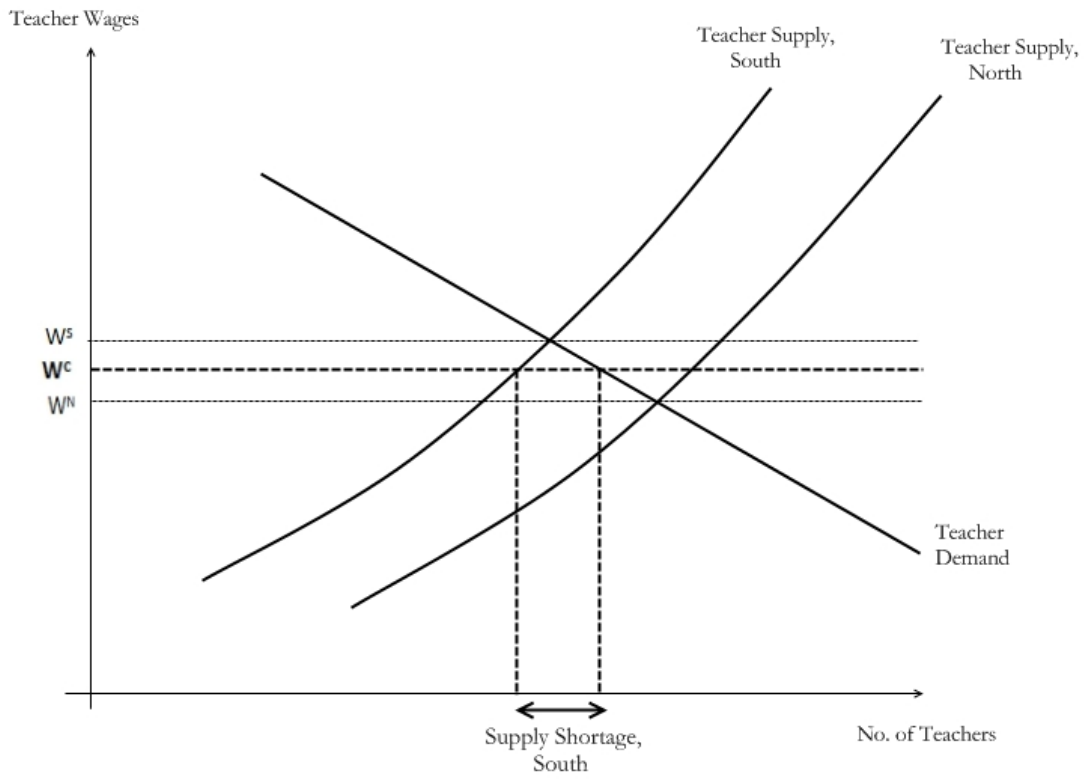
Teacher Wages
Teacher Supply, South
Teacher Supply, North
W^S
W^C
W^N
Teacher Demand
Supply Shortage, South
No. of Teachers

Figure 2

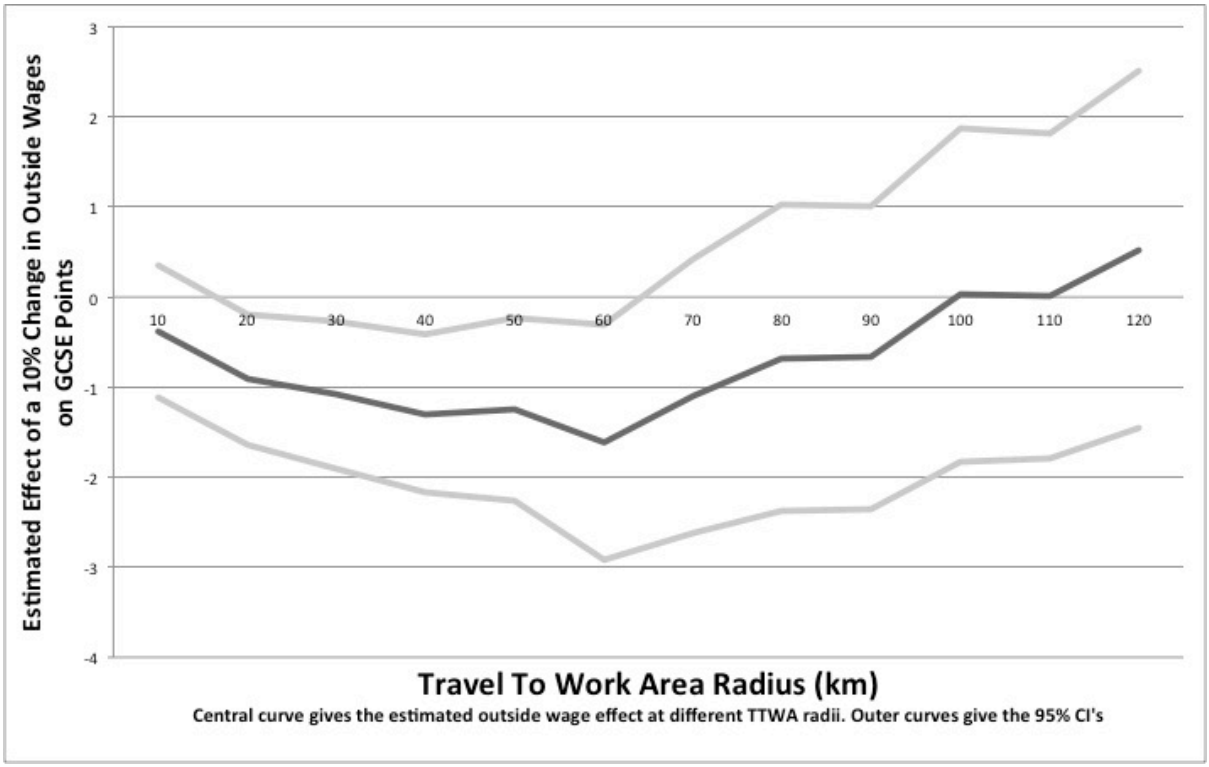
Estimated Effect of a 10% Change in Outside Wages on GCSE Points
3
2
1
0
-1
-2
-3
-4
10
20
30
40
50
60
70
80
90
100
110
120
Travel To Work Area Radius (km)
Central curve gives the estimated outside wage effect at different TTWA radii. Outer curves give the 95% CI's

Table 1: Cross Sectional Associations between outside wages and KS4 performance

Year	2002	2003	2004	2005	2006	2007
Outside wage	-0.357**	-0.193	-0.532**	-0.603**	-0.463*	-0.124
	(0.160)	(0.228)	(0.255)	(0.259)	(0.255)	(0.264)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
LEA dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	2964	2985	2998	3018	3019	3035

Dependent variable is school average KS4 score. Outside TTWA wage lagged by one year. Controls are KS2, %FSM, %Male, %Black African, %Male, Expenditure per pupil. Sample sizes vary by years due to schools opening and closure. Robust standard errors clustered at LEA level in parentheses. * significant at 10% level, ** 5% level, * 1% level.

Table 2: School Productivity

	Key Stage 4				Five or more A*-C	
	OLS		FE		FE	
	[1]	[2]	[3]	[4]	[5]	[6]
Outside Wage	-0.468***	-0.478***	-1.002***	-0.980***	-0.187***	-0.180***
	(0.161)	(0.160)	(0.364)	(0.362)	(0.065)	(0.064)
KS2	0.464***	0.455***	0.218***	0.196***	0.047***	0.042***
	(0.005)	(0.007)	(0.016)	(0.017)	(0.003)	(0.003)
Controls	No	Yes	No	Yes	No	Yes
School FE	No	No	Yes	Yes	Yes	Yes
No. Schools	2949	2949	2949	2949	2949	2949
N	5898	5898	5898	5898	5898	5898

Key Stage 4 mean is the dependent variable for columns [1]-[4], Five A*-C is the dependent variable in columns [5] and [6]. All regressions have 2 observations per school, with the school outcome in 2002 and 2007. Controls for KS2, %FSM, %Male, %Black African, %Male, Expenditure per pupil where indicated. Outside wages are average TTWA wages over five years, lagged by one year (i.e. 1997-2001 and 2002-2006).. Robust standard errors clustered at school level reported in the parentheses. * significant at 10% level, ** 5% level, * 1% level.

Table 3: Robustness Checks

			FE estimate on wage (se)	
[1]	Baseline Estimate		-0.980***	5898
			(0.362)	
Tests of identification				
[2]	Stable group composition		-0.752**	5898
			(0.362)	
		F test on interaction	11.91***	
[3]	Placebo test (wages t+1)		0.219	17960
			(0.308)	
[4]	Placebo test (wages t+2)		0.101	14920
			(0.325)	
Wage and labour market tests				
[5]	Manual wage		-0.455	5898
			(0.431)	
[6]	Outside wage		-0.921**	5898
			(0.361)	
		+ Employment of 16-25 year olds	0.678	5898
			(0.472)	
[7]	Including inside wages		-0.873**	5612
			(0.376)	
[8]	Wage gap		-0.801**	5612
			(0.371)	
[9]	Wage corrected for teacher composition		-0.940***	5898
			(0.276)	
[10]	Standard errors clustered at TTWA level		-0.980*	5898
			(0.512)	
[11]	Standard errors clustered at LA level		-0.980*	5898
			(0.529)	
[12]	Bootstrapped Standard Errors		-0.980**	5898
			(0.486)	
School gaming				
[13]	Exclusions as dependent variable		0.124	60
			(0.474)	
[14]	Number of exams taken as dependent variable		-0.195***	5760
			(0.070)	
[15]	Without KS2 control		-1.058***	5898
			(0.369)	
[16]	Value Added as the dependent variable		-0.972***	5898
			(0.370)	

KS4 school performance is dependent variable unless stated otherwise. Controls are KS2, %FSM, %Male, %Black African, %Male, Expenditure per pupil in all regressions. Row [13] estimated at GOR level, and is estimated with GOR fixed effects. Robust standard errors clustered at school level (unless stated otherwise) in parentheses. * significant at 10% level, ** 5% level, * 1% level.

Table 4: Tests of salience of research design

	Regional Heterogeneity			Excluding London	Only Schools Facing High Local Competition	Only Schools with No Control over Wages
	[1]	[2]	[3]	[4]	[5]	[6]
Outside Wage	-0.860**	-0.851**		-1.070***	-1.370***	-1.598***
	(0.363)	(0.360)		(0.373)	(0.515)	(0.483)
HW*Outsidewage	-0.248**		-0.737**			
	(0.112)		(0.372)			
MW*Outsidewage			-0.758**			
			(0.361)			
LW*Outsidewage		0.574***	-0.175			
		(0.107)	(0.387)			
Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. Schools	2949	2949	2949	2585	2144	1825
N	5898	5898	5898	5170	4288	3650

All regressions have 2 observations per school, with the school outcome in 2002 and 2008. Outside wages are the average wages over five years, lagged by one year (i.e. 1997-2001 and 2002-2006). Controls are KS2, %FSM, %Male, %Black African, %Male, Expenditure per pupil in all regressions. The results are robust to alternative definitions of the wage regions. The exclusion of London excludes all schools in inner or outer London. Schools are defined as facing high local competition if more than 8 schools within a 10km radius. Schools with no control over wages are 'Community' secondary schools. Standard errors robust and clustered at the school level, and are given in the parentheses.* indicates significant at 10% level, ** 5% level, * 1% level.

Table 5: Analysis of Pathways

	REGULATOR ASSESSMENT		STAFF TENURE		YP WAGES	YP UNEMP
	[1]	[2]	[3]	[4]	[5]	[6]
Dependent var:	Overall School Rating	Teaching Quality Rating	Proportion of Teachers <1 Year	Proportion of Teachers >10 Years	School KS4 Score	School KS4 Score
Outside Wage	0.607**	1.369***	0.300***	-0.339**		
	(0.275)	(0.165)	(0.116)	(0.138)		
Local 16-25 Wages					-0.035	
					(0.027)	
Local 16-25 Unemployment						0.204
						(0.228)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	No	No	No	Yes	Yes
LEA dummies	Yes	Yes	Yes	Yes	No	No
School dummies	No	No	No	No	Yes	Yes
Years (dep var)	2003-2008	2003-2008	2010	2010	2004-2008	2004-2008
N	4567	3181	2680	2680	11904	11420

In Columns [1] and [2] dependent variable is OFSTED rating and outside wage is lagged five year averages. In Columns [3] and [4] the dependent variable is the proportion of teachers in a school with tenure <1 year, and >10 years respectively. Due to ASHE data limitations, outside wages are constructed from the LFS between 2005 and 2009, using full time wages of 22-60 year olds at Local Authority level. Controls variables from PLASC for 2008. In columns [5] and [6], the dependent variable is school performance, with wages and unemployment rates of 16-24 year olds at Local Authority level taken from LFS. Controls in all regressions for KS2, %FSM, %Male, %Black African, %SEN and Expenditure per pupil. Robust standard errors in parentheses. * indicates significant at 10% level, ** 5% level, * 1% level.

Table 6: Cost Benefit Analysis

		Costs of Policy Change		Benefits of Policy Change			
		Increased Teacher Wage Bill (£m)	Increased Deadweight Loss from Taxation (£m)	Increased Number of Pupils Attaining 5 A*-C GCSEs	Discounted total increase in Lifetime Earnings (£m)	Financial Cost Per Pupil Obtaining 5A*-C (£) ((1))÷ (3)]	Net Social Benefit (£m) [(4) -(2)]
		[1]	[2]	[3]	[4]	[5]	[6]
1	Baseline Case	102.4	30.7	2041	77	50,179	46
2	60% DW Loss	102.4	61.4	2041	77	50,179	16
3	6 % increase in earnings	102.4	30.7	2041	39	50,179	8
4	Beta +1SE	102.4	30.7	2921	110	35,061	80
5	Beta -1SE	102.4	30.7	1161	44	88,216	13
6	CF Wage - 10%	-614.7	-184.4	-3466	-131	177,354	54
7	CF Wage +10%	819.6	245.9	7548	285	108,581	39

Change in teacher wage bill estimated from the number of teachers in each region (source: DfE), multiplied by the difference between the counterfactual and actual teacher wage in each region (estimated from the LFS). This is £3082, -£23 and -£1058 in the high, medium and low wage regions respectively. Change in proportion of individuals attaining 5A*-C estimated at regional level using same specification as Table 4, Column [3], with 5A*-C proportion as the dependent variable. Increase in lifetime earnings calculated using the 12% wage premium from obtaining 5A*-C GCSE grades estimated by Sianesi (2003).

APPENDIX A

Table A1: Data Sources

Data	Source	Years
School Value Added, KS4 and KS2 Grades, Case Mix Controls, School Type, 5A*-C %	PLASC	2002-2008
Outside Wages	ASHE	1997-2006
Exclusions	Dept. for Education	2002-2007
OFSTED	Dept. for Education	2003-2008
LEA 5 A*-C Proportion (1997)	Dept. for Education	1997
YP Wages	LFS	2004-2007
YP Unemployment	LFS	2004-2007
25-49 Unemployment	NOMIS	2003-2007
Inside Wages	Teacher Pay & Conditions Handbook	2002 & 2007
Outside Wages, Tenure Regressions	LFS	2005-2009
Teacher Tenure	School Workforce Census	2010
No. Exams Taken	NPD	2002-2007

Table A2: Outside Wage Regions

Panel A: High, Medium and Low Outside Wage Regions		
Government Office Region (GOR)	Average Wage, 2006 (£)	Wage Region
North East	29,092	Low
Yorkshire & the Humber	30,043	Low
West Midlands	30,724	Low
East Midlands	30,809	Low
North West	30,941	Medium
South West	31,330	Medium
East	34,105	Medium
South East	37,223	High
Inner London	37,248	High
Outer London	49,484	High

Panel B: Wage Growth By Regions (£)			
Growth Period	HW region	MW Region	LW Region
1997 – 2001	5,220	3,569	2,327
	(3,568)	(2,298)	(2,864)
2002 – 2006	4,381	3,510	3,716
	(4,420)	(1,980)	(2,154)
1997 – 2006	12,208	9,490	8,399
	(4,711)	(2,849)	(2,588)

Source: ASHE. Standard deviations of wage growth are given in the parentheses. The top two rows of Panel B do not sum to the bottom row due to wage growth between 2001 and 2002.

TABLE A3: Descriptive Statistics

Variable		Mean	Standard Deviation	Minimum	Maximum	N
Variables Used in Main Regressions						
Key Stage 4	Overall	44.08	10.18	14.86	99.01	5898
	Between		9.120	18.87	85.47	
	Within		4.530	25.52	62.65	
Key Stage 2	Overall	26.68	1.930	19.69	33.42	5898
	Between		1.700	21.26	32.73	
	Within		0.920	24.23	29.13	
Five A*-C %	Overall	0.565	0.192	0.048	1	5898
	Between		0.175	0.126	1	
	Within		0.079	0.248	0.881	
Average Outside Wage (5 Years, log)	Overall	7.134	0.161	6.651	7.615	5898
	Between		0.113	6.845	7.489	
	Within		0.115	6.940	7.328	
Expenditure Per Pupil (EPP)	Overall	4.102	1.059	1.375	20.75	5898
	Between		0.639	2.686	12.21	
	Within		0.844	-4.442	12.65	
Free School Meals (FSM) %	Overall	0.132	0.126	0	0.89	5898
	Between		0.123	0	0.875	
	Within		0.029	-0.052	0.317	
Male %	Overall	0.506	0.189	0	1	5898
	Between		0.186	0	1	
	Within		0.030	0.271	0.740	
Black African %	Overall	0.015	0.045	0	0.508	5898
	Between		0.043	0	0.438	
	Within		0.012	-0.467	0.146	
Special Educational Needs (SEN) %	Overall	0.023	0.020	0	0.394	5898
	Between		0.018	0	0.307	
	Within		0.010	-0.080	0.127	
Variables Used in Robustness Checks						
Inside Wages	Overall	6.290	0.079	6.204	6.481	5612
	Between		0.037	6.271	6.399	
	Within		0.070	6.207	6.373	
Average Number of Exams taken	Overall	9.132	1.071	1	15.04	5760
	Between		0.896	5.252	12.89	
	Within		0.587	4.399	13.87	
LA 16-25 Unemployment	Overall	0.078	0.021	0	0.207	14825
	Between		0.014	0.025	0.129	
	Within		0.015	0.006	0.169	
LA 16-25 Wages	Overall	17738	2809	9240	30000	15445
	Between		2215	13218	22265	
	Within		1729	10680	26180	
LA 25-49 Employment	Overall	0.810	0.060	0.555	0.947	39224
	Between		0.052	0.628	0.901	
	Within		0.029	0.696	0.910	
OFSTED Overall School Rating	Overall	2.646	0.876	1	4	4919
	Between		0.781	1	4	
	Within		0.500	0.851	4.146	
OFSTED Teaching Quality Rating	Overall	2.663	0.782	1	4	3397
	Between		0.734	1	4	
	Within		0.383	1.597	3.996	
Variables with no within school variation						
LFS Av. Wage (05-09)	Overall	29,338	4,396	21,369	53,368	3089
Tenure <1 yr	Overall	0.113	0.083	0	1	2646
Tenure >10 yrs	Overall	0.217	0.111	0	0.792	2646