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INCENTIVES AND EFFORT IN THE PUBLIC SECTOR:
HAVE U.S. EDUCATION REFORMS INCREASED
TEACHERS' WORK HOURS?

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ABSTRACT

Beyond some contracted minimum, salaried workers' hours are largely chosen at the worker's
discretion and should respond to the strength of contract incentives. Accordingly, we consider the
response of teacher hours to accountability and school choice laws introduced in U.S. public schools
over the past two decades. Total weekly hours of full-time teachers have risen steadily since 1983
by about an hour, and after-school instructional hours have increased 34 percent since 1987. Average
hours and the rate of increase also vary widely across states. However, after accounting for a
common time trend in hours, we find no association between the introduction of accountability
legislation and the change in teacher hours. We conjecture that the weak link between effort and
compensation in most school reforms helps explain the lack of such an association.

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1. Introduction

Among salaried workers, the decision to supply weekly work hours beyond some nominally contracted amount is generally left to the employee's discretion. Thus, salaried workers' weekly hours play a role analogous to that of effort in principal-agent models: an increase in the strength of performance incentives in the employment contract should raise the equilibrium level of hours worked.

In recent years, partly in response to concerns that public schools and their teachers faced inadequate incentives to improve student performance, states have passed a variety of accountability and school choice laws designed to strengthen those incentives. These laws include mandatory testing of all students in at least some grades with scores publicly reported by school, sanctions for schools with low student performance, rewards for schools with high (or improved) student performance, and charter school laws. States introduced these education reforms asynchronously, thus providing a promising "natural experiment" for evaluating their effects. The goal of this paper is to ascertain whether these laws increased the hours worked by full-time public school teachers. Understanding the effects of reforms on teacher hours adds an additional perspective to the burgeoning literature examining their effects on student performance.[1]

Using data from the Current Population Survey (CPS) from 1983 to 1998, and the Schools and Staffing Surveys (SASS, waves 1987 through 1999), we show the following. First, the usual weekly hours worked by full-time teachers, as well as the extra after-school hours they reported in the SASS, increased steadily over this period of expanding educational reform. Second, long-term increases in neither of these variables are well explained by changes in the composition of

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[1] See for example Ladd (1999), Grissmer et al. (2000), Gleww et al. (2003), Murnane and Levy (2001) on the impact of accountability reforms; Hanushek et al. (2001) on the impact of charter schools.

the teacher work force across a variety of dimensions, such as age, gender, race and union status. Third, while pooled regressions across years and states suggest positive effects of accountability and choice reforms, the common time trends in hours and reforms drives these results. After including either year fixed effects or state specific time trends, we find no connection between the observed increase in teachers' work hours and education reforms: hours increases were no greater in states that adopted reforms than in states that did not.

Finally, to help interpret the above findings, we connect our state-level reform measures with information on test scores from the National Assessment of Educational Progress (NAEP). While this may not be the ideal way to study the connection between reforms and student performance, we find that several of the reforms studied *are* associated with improvements in students' test scores in our data. This suggests that the reforms may have increased the efficiency via which teachers transform their work hours into students' test performance.

2. Trends in Teacher Hours

Our analysis focuses on two distinct measures of teacher work hours, taken from different data sets. One measure, taken from the Current Population Survey Outgoing Rotations, is the total number of hours worked in a usual week at a respondent's primary job. This includes both hours spent in the workplace and at home, and (importantly) excludes any hours worked on other jobs.[2] Attractive features of the CPS are that it has annual data on total hours that is consistently reported across the years in our sample[3], it allows for comparisons with non-teachers, and since 1983 it has recorded whether or not an individual is covered by a union contract. A limitation is

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[2] Conveniently, the interviewing instructions explicitly refer to teachers as an example, and state that the hours they spend grading and preparing lessons at home should be counted along with hours at school.
[3] The particular hours question we use was not affected by the 1994 CPS redesign. See Kuhn and Lozano (2002).

small sample sizes in some states and years; for some of our analysis the CPS data is therefore pooled over 4-year intervals.

A distinct indicator of teacher work hours is taken from the Schools and Staffing Survey (SASS). The SASS is a survey of public and private school teachers, with detailed information about personal and school characteristics.[4] The survey was administered in 1987, 1990, 1993, and 1999. Our analysis of SASS data focuses on the number of hours spent by teachers after school *without* students preparing lessons, grading, and in other instructional activities. These extra instructional hours seem more likely to be sensitive to incentives based on students' academic performance than hours spent after school coaching or running the yearbook, or hours that are determined by the length of the school day.[5]

To avoid conflating different levels of teacher effort with the mix of part and full time teachers, our CPS sample is restricted to teachers employed 35 or more hours a week. It is also restricted to salaried individuals aged 22-61. The SASS sample includes only teachers who report a full time appointment. Both samples only include public elementary and secondary school teachers. The CPS sample is also restricted to individuals with no self-employment income, who were not in school, who have at least a bachelor's degree, and to interviews in September through May to avoid typical vacation months. Washington, DC is excluded from the CPS sample because several of the sources for educational reform policies excluded it in their reports.

Trends in teacher work hours are reported in the top row of Table 1 for the CPS and of Table 2 for the SASS. In the CPS, pooling four adjacent sets of years (1983-86, 1987-90, 1991-

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[4] The probability a school is sampled in the SASS is proportional to the square root of the number of teachers in the school. As a result, the SASS oversamples large schools. Sampling weights are however provided to generate means for a nationally representative sample of teachers; these are used throughout this paper whenever means are computed.

[5] The wording of the required (in school) hours question in the SASS changed over time, making it a somewhat less reliable indicator of trends in effort.

94, and 1995-98) yields a sample of between 9 and 11 thousand teachers in each of those four periods. These data show a fairly steady increase from about 43 hours in the early 1980s to about 44 hours in the late 1990s. The SASS, which covers over 19,000 teachers in each of four individual years (1987, 1990, 1993 and 1999) shows that extra instructional hours have risen steadily from 7.18 hours in 1987 to 9.63 hours in 1999.[6]

Both surveys also show that the level and change in hours varied significantly across states, suggesting a possible role for legislative effects. Figure 1 plots the average number of hours worked in the early 1980s in each state against the number of hours worked in the late 1990s as reported in the CPS. A solid line is drawn at 45 degrees: states along this line experienced no change in mean teacher hours over this period. In the states with the highest reported teacher hours in the late 1990s, full time teachers worked at least 5 hours per week longer than in states with the lowest hours.[7] Trends also varied: in four states hours rose by 2.5 or more while in 7 states teacher hours actually declined by half an hour or more.

One potential explanation for the trend in teacher hours is demographic changes in the teaching workforce or changes in school characteristics. For example, if newly hired teachers work longer hours and the share of newly hired teachers increased over this period, changes in the share of new hires may explain some of the trend in hours. To assess the impact of compositional changes, Tables 1 and 2 report average teacher characteristics for our CPS and SASS samples respectively. According to Table 1, the population of teachers in later years was older, included more female teachers, and a smaller proportion who taught in secondary schools. There was little change in the share of teachers who are nonwhite. The fraction of teachers

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[6]As noted the wording of the question about hours spent in school has changed, making it difficult to compare total hours across years, but it appears that most of the increase in total hours is due to an increase in hours spent after school in instructional activities.

[7] In each of the four SASS survey years, the correlation across states between CPS and SASS measures of total teacher hours is between .7 and .8. Clearly, these differences across states in mean teacher hours reflect more than just sampling error.

covered by a union contract eroded over this period, even though there have been few legal changes to affect the status of unions since 1983.[8] According to Table 2, despite the aging of the teacher workforce, there was an increase in the share of newly hired teachers, leading to an erosion of average teacher experience. At the same time there was a rise in the share of minority students and in students receiving free lunches, and a decline in the pupil-teacher ratio.

Tables 3 and 4 report coefficients from teacher work hour regressions in each of the cross sections described in Tables 1 and 2. Because the percent covered by union contracts is a state/year level mean[9], standard errors in these regressions are adjusted for possible dependence of observations within each state/year cell following Moulton (1986). The CPS results indicate that female teachers tend to work fewer total hours, particularly in the early periods, with no statistically significant difference in the late 1990s. In the SASS, female teachers work about 1.7 hours more than male teachers in after-school instructional activities, something that remained unchanged since 1987. Gender differences in after-school hours with students (e.g., coaching) disappear by the later periods, leading to a convergence in total hours.

Both surveys also show that nonwhite teachers tend to work fewer hours, and that new teachers work longer hours. In the SASS, teachers with three or less years of experience work over an hour longer after school than more experienced teachers, and in the CPS younger teachers (ages 22-25) tend to work longer hours than teachers in the middle of their careers, although this effect is not statistically significant. In neither survey does holding an advanced degree appear to affect hours. Secondary school teachers work longer total hours, but this appears to be due to their extra work after school with students in activities like coaching or directing the school play. Extra instructional hours are lower for secondary school teachers.

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[8] The only three substantive changes are the introduction of right to work laws in Idaho in 1986, Texas in 1993, and Oklahoma in 2001.
[9] We chose to use the statewide mean of union coverage rather than individual union coverage because of concerns that the effects of union strength in a state were more likely to "spill over" to all public school teachers in the state.

The hours regressions in Tables 3 and 4 also include the percentage of teachers in the respondent's state and year who report that they are union members or are covered by a collective bargaining agreement in the CPS survey. Unions may attempt to raise the number of full time teachers relative to part time teachers, but at the same time may work to reduce the hours of full time teachers. Schools with stronger teachers unions may have difficulty firing teachers that exert less effort. Unions may also be associated with more free periods for preparation[10] or smaller classes, as Caroline Hoxby has argued (1996).

The percentage of teachers who are covered by a union agreement in a state is negatively associated with work hours in the early periods of both surveys. However, in both surveys this negative correlation evaporates by the end of the time period. In the CPS the negative coefficient declines in magnitude and significance over time. In the SASS, the effect of unionization is initially negative, but becomes monotonically larger and more positive in each wave.[11] Even though –as we show below—changes in union coverage cannot explain changes in teacher hours over the last twenty years, this change in the union coefficient suggests that a change in union *policy* towards teacher hours may have played a role. Possible reasons behind such a policy change–in particular, certain forms of parental pressure that are not captured by our school reform measures--are explored in Section 5 of this paper.[12]

The SASS results in Table 4 also indicate that school characteristics affect extra instructional hours. Hours are lower for teachers in rural areas and towns than in cities and suburbs. Hours also tend to be higher in schools with higher pupil teacher ratios. One of the strongest predictors of extra instructional hours is the percentage of students who are eligible for

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[10] This mechanism seems particularly relevant to our SASS measure of hours, since time spent preparing during school hours can substitute for time spent after school hours doing the same thing.

[11] The effect of unions on total hours, as reported in the SASS, is more similar to the CPS results: unions consistently have a negative effect on total hours, and this effect dissipates over time.

free lunches. An additional ten percent of students receiving free lunch is associated with a reduction of 10 to 15 minutes of extra instructional hours each week. This means that teachers in schools one standard deviation below the free-lunch mean (i.e. schools where 3 percent of students receive free lunch) work nearly 40 hours more each year than teachers in schools one standard deviation above the mean share receiving free lunch (50 percent of students receive free lunch). The percentage of students who are minorities does not have an additional impact.

How much of the trend in hours can the compositional changes in teacher and school demographics explain? The Oaxaca decomposition provides bounds for the potential effect of characteristics, using the change in teachers' average characteristics multiplied by either the coefficient vector in the first period ($(\overline{X}_4 - \overline{X}_1)\hat{\beta}_1$) or the final period ($(\overline{X}_4 - \overline{X}_1)\hat{\beta}_4$). Using means from Table 1 and regression coefficients from Table 3, Oaxaca decompositions on the CPS data indicate that the change in teacher characteristics explains at most 4 percent of the increase in hours over this entire period.[13] In large part, this was because teacher characteristics were relatively stable over this period. The decline in teacher unionization generates the largest predicted increase in hours: had all else remained the same, the decline in unionization could account for 12 percent of the actual rise in hours. However, changes in other characteristics offset even this part of the decline. Similar trends are present in the SASS data, where the change in teacher characteristics explains at most 3 percent of the observed hours increase. Overall, therefore, changes in measured teacher and school characteristics do not appear to explain much of the increase in teachers' total hours or after-school hours.

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[12] In an earlier draft of this paper, we examined interaction effects between union coverage and various reform measures. Overall, the change in the effect of unions on hours was *not* correlated with the adoption of education reforms in a state.

[13] Detailed results available on request.

3. Education Reform Policies

The rise in teacher hours raises the question of whether education reforms enacted during this period have resulted in greater workloads for teachers. During this period, a number of reforms were enacted. Four types of reforms seem especially likely to affect teachers' hours: standardized testing with scores publicly reported by school, laws imposing sanctions on schools with low levels of student performance, laws mandating financial rewards for schools where students perform at high levels, and charter school laws. Prior to 2001, these laws were set by states. The federal "No Child Left Behind" Act of 2001 imposes similar accountability reforms on all schools, requiring public test scores reports and school choice for students in persistently "failing" schools.

The underlying premise of these accountability reforms seems to be that reporting, rewarding, and penalizing schools based on results will promote greater effort on the part of teachers and schools. As *Education Week* put it in their 1999 review of accountability plans, "The assumption seems to be that if performance is the problem, what's missing is the will: Find the right combination of carrots and sticks, and effort and achievement will follow."[14]

Proponents of charter school laws also argue that competition from charter schools will increase performance in regular schools as well. If school choice plans do induce competition in the form of increased effort, hours should be one indicator. Charter schools also allow for non-union contracts, and the reduction in the role of unions may also affect hours. Alternatively, choice plans may simply allow parents to satisfy different preferences along other dimensions, and hours might not be sensitive to these policies. Hoxby (2002) claims that teachers work longer hours in areas with greater school choice.

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[14] http://www.edweek.com/sreports/qc99/ac/mc/mc-intro.htm

As noted, most of these reform measures were introduced during the period in which teacher hours rose. Table 5 lists the number of states in each period with standardized test scores that are reported by school, with a law imposing sanctions on schools with low levels of student performance, with a law mandating financial rewards for high student performance, and with a charter school law.[15] The years these measures were introduced in each state are included in the appendix, along with the sources for each.

The trend towards accountability laws is clearly evident in Table 5, with almost universal testing in the late 90s. (Federal law in 1994 required some form of standardized testing.) By the late 1990s, about half of all states went beyond simply reporting scores and could potentially sanction schools with low student performance by taking over schools, reconstituting them or withholding funds. About a third gave financial incentives to schools with high student performance or large improvements. Closer inspection of individual state policies reveals a high degree of diversity in statutes (e.g., states varied in the amount of financial rewards or in the probability that sanctions were actually imposed). Charter school laws were also introduced in the 1990s and quickly gained popularity. By 1998, 34 states had passed such laws. However, most states did not have large proportions of students enrolled in charter schools by the end of the sample period. All of these laws exhibit substantial variation across states, both in the law and the way it is implemented. For example, states vary in the probability that a state would takeover or reconstitute a sanctioned school; they vary in the proportion of student enrolled in

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[15] Information on accountability legislation was compiled using Lexis-Nexis searches for years prior to 1996, corroborated with periodic reports from the Education Commission of the States and "Legislative Updates" reported in Education Week. Education Week's *Quality Counts* report accountability laws beginning in 1997. States are coded as having sanctions if they penalize low performing schools, and are not coded as having sanctions if they simply designate low performers or provide extra funds. Information on charter school laws is from the Center for Education Reform. Details of all sources and dates are in the appendix. In a few states, a reform may be in place in one year only to be removed and then reinstated later. This is often the case when a state changes tests, for example. States are counted as having a reform for the entire period if the change is not permanent. This does not affect the results.

charter schools; and states vary in how permissive or restrictive the charter schools laws are for new starts. We explore some of this policy variation in our results below.

4.   Conceptual Framework

a. Teacher Hours and Teacher Rewards

In order for the education reforms studied in this paper to raise teachers' work hours, they must somehow tighten the connection between a teacher's work hours and an outcome that directly affects his/her utility.[16] In most work environments, the natural outcomes to consider in this context would be the level of pay and the chances of keeping one's job. However, even after most recent reforms, individual merit pay for teachers remains very rare, and job security among public school teachers remains very high.[17] Thus, it seems unlikely that these will be the main channels via which reforms have affected effort to date.[18] For this reason, the framework in which we conceptualize the likely effects of education reforms on teacher hours focuses on two outcomes that are assumed to directly affect teachers' utility: the "quality" of the students with whom they interact, and the physical environment of the classroom and school in which they work. Under student quality, we include behavioral issues –for example the absence of disruptive students (Lazear 2001)—as well as academic ability. Under physical resources, we

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[16] It is of course also possible that education reforms affect teacher hours in a more mechanical fashion, by raising the length of the school day mandated by the school or district. Since teachers can always undo such mandates by putting in fewer hours outside of class, our conceptual framework focuses on choices made voluntarily by teachers. That said, in almost all cases, the reform policies discussed in this section may affect mandated hours in the same way as they would affect individually chosen hours.

[17] In most "sanctions"-based policies, under-performing schools can be put on probation, which in turn places them at risk of closure or reconstitution. While Jacob (2002) reports that "teachers and administrators in [Chicago] probation schools reported being extremely worried about their job security", both closure and reconstitution remain very rare events, and in any case do necessarily imply job loss: to the extent that unionized teachers in probation schools have effective job protection, they would need to be reassigned to other (and likely better) schools. Our empirical work examines the effect on hours of being in a state where schools or districts have been put under state control or have been reconstituted.

[18] To test the notion that fear of dismissal does not affect teachers, in some specifications (available on request) we enter *local unemployment rates* and *alternative salaries* into the teacher hours regressions. They are never significant.

include instructional materials, funding for "extras" such as class trips, extracurricular activities, etc.

Specifically, let x indicate the quality of students an individual teacher interacts with (both in and out of class); x directly enters a teacher's utility function. Let x be determined by:

$$x = f(p, X) \qquad (1)$$

where X is the mean student quality in the teacher's school and p is a measure of the individual teacher's performance (f_p measures the degree to which principals reward better teachers with more pleasant teaching assignments). Let X be given by:

$$X = X(P) \qquad (2)$$

where P is the school's mean performance. This function summarizes the net flow of good (especially pleasant-to-teach) students into better-performing schools. Assuming that both p and P can be raised by raising teachers' time inputs, combining (1) and (2) and differentiating yields the following connection between individual teacher hours and the outcome (x) that they care about:

$$\frac{dx}{dh} = f_p \frac{dp}{dh} + f_X X_P \frac{dP}{dh} \qquad (3)$$

Denoting r as total physical resources enjoyed by an individual teacher, R as school-level resources, assuming $r = g(p, R)$ and $R = R(P)$ yields the parallel relation:

$$\frac{dr}{dh} = g_p \frac{dp}{dh} + g_R R_P \frac{dP}{dh} \,. \qquad (4)$$

Because these are parallel, in what follows we focus our discussion on student-quality outcomes (3) unless a policy affects resources (4) in a distinct manner.

According to (3) and (4), how are recent education reforms likely to change teachers' work incentives? Consider first X_P and R_P. One of the stated objectives of charter school legislation is to force public schools to compete for students. Thus, charter school legislation

may raise X_P. "Sanctions" policies should also operate most directly on X_P, because parents will wish to avoid sanctioned schools, and sanctions sometimes explicitly include an option for parents to send children to other schools. "Rewards" policies operate directly on R_P, and should raise teacher hours through (4) via a parallel mechanism.[19]

Next consider dp/dh, the sensitivity of a teacher's measured performance to his/her work hours. Clearly, simply by providing performance information to principals that was previously unavailable, mandatory student testing directly raises dp/dh. dP/dh is affected for the same reason at the district level. Since dp/dh and dP/dh multiply X_P and R_P in (3) and (4), this has the further implication that student testing should raise the effectiveness of reforms that act on those other terms. For example, having better, published indicators of school performance will strengthen the migration of good students into better schools (X_P) and hence the effects of both charter and sanctions laws. Testing also makes it easier to identify better-performing schools, thus strengthening the effects of "rewards" policies, R_P. We shall look for these predicted *interaction effects* in our empirical analysis. For example, we can ask whether the remaining three reforms only work when testing is in place, or do an all-or-none specification where we only expect an effect when all four reforms are in place. Finally, we note that, due to the well-known $1/N$ problem affecting team incentives (e.g. Holmstrom 1982), dP/dh will be greater in small schools than large ones.

Finally consider the terms f_p and f_x (and of course their counterparts g_p and g_x). Since these are chosen by principals, none of them are directly affected by the education reforms studied in this paper. However, to the extent that reforms tighten the connection between school-level performance and school-level student quality and resources (i.e. raise either X_P or R_P as discussed above), one might expect f_p and f_x to rise *endogenously* in response to such reforms. In

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[19] Of course, sanctions may affect resources too. We exclude from our definition of sanctions states which respond

other words, to help their school adapt to a more competitive environment, principals may choose to strengthen the incentives their teachers face. This reasoning applies to all reforms.

Where would we expect the endogenous changes in f_p, f_x, g_p, and g_x described above to be strongest? The primary mechanisms via which principals can reward good teachers with better students are (a) by assigning different classes within the school; (b) by requesting a bad teacher be transferred out, or (c) by offering good outside teachers "plum" teaching assignments. Since all of these processes will have the biggest impact on teacher utility in *heterogeneous* schools or districts, we expect larger effects there. Since principals may have greater latitude to assign such rewards and punishments where unions are weak, we also expect these adjustments to be larger where *union coverage* is low. Non-tenured teachers who are at risk of losing their job are also likely to be more sensitive to reforms.

In sum, according to the above framework, we expect the effects of all four reform types on teachers' work hours to be largest for non-tenured teachers, in schools and districts with heterogeneous student quality, and where teacher unions are weak. In addition, we expect positive interaction effects between the reforms. Naturally, we also expect the effect of each reform to increase with measures of its strength and scope (e.g the penetration of charter schools), and when enough time has elapsed for the law to be fully implemented and to impact teacher behavior.

Finally, we note that, at least according to the rhetoric accompanying them, the school reforms studied in this paper seem to be targeted especially at low-performing schools.[20] Thus

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to underperformance *only* by giving additional resources without imposing other sanctions.

[20] Whether this is actually the case is not clear. For example, the availability of charter schools may disproportionately benefit abler and more motivated students. To the extent that rewards target high performance *levels* rather than improvements, rewards will disproportionately benefit schools that are already good. Even sanctions, which explicitly target the worst-performing schools, may create the weakest incentives in the worst schools because any teacher reallocation out of, say, a reconstituted school is likely to be into a better school.

we might expect to find larger effects of reforms on teacher hours in low-performing schools; we test for such differences in our empirical work below.

b. "Leakages"

By assuming a connection (dp/dh) between teacher work hours and measured teacher performance, the above analysis has provided some useful insights into how, and where, we might expect recent education reforms to affect teacher work hours. But how would these insights change if measured teacher performance can be changed by actions *other* than raising total work hours? For example, teachers may raise their measured performance by reallocating a fixed number of work hours towards activities that directly affect test scores (Jacob 2002). Schools may change the distribution of teacher hours over the year (e.g. by starting classes in mid-August) to better prepare students for standardized tests, without changing total teacher hours. Teachers may raise their students' measured performance simply by cheating, rather than working longer hours (Jacob and Levitt 2003).

Relatedly, teachers may simply raise their *effort* rather than hours, thus adjusting on an intensive rather than an extensive margin. Finally, it is possible that reforms simply induce teachers to use a given amount of work time more efficiently. If any of the above factors are important, education reforms could fail to raise teacher hours, even in situations where – according to the above conceptual framework—this is most likely to occur. To distinguish these scenarios (in which students' measured performance improves without an increase in teacher hours) from an alternative scenario in which existing reforms are simply too weak to have had *any* detectable effect on teacher behavior, we briefly examine the correlation between reforms and test scores in this paper as well. We find that reforms do appear to be correlated with higher student test scores, suggesting that teachers may be responding to reforms on the intensive margin.

5. Effect of Reform Policies on Teacher Hours

To assess the effects of state-level programs on teacher hours, Table 6 presents estimates of various regression models that pool data from all years of our CPS data, from 1983 to 1998. The regressions include all the control variables in Table 3 plus an indicator for the presence, in that state and year, of one of the four following types of education reform: charter schools, incentives, sanctions, and testing. Because many states introduced several reforms simultaneously, separate regressions are run for each type of reform.[21] States may have experienced these policies as a comprehensive reform package, and accordingly Row 5 attempts to estimate an overall effect of reform. This specification uses an indicator that assigns a value of .25 to each individual reform, then sums these values. Thus the coefficient on this indicator compares a state with all four reforms in place to one with none.[22]

Accountability reforms and charter schools laws are highly persistent, and teacher hours within a state are also serially correlated over time. As Bertrand, Duflo, and Mullainathan (2004) show, this means that the standard errors in the regressions are likely to be understated in a traditional OLS regression, leading researchers to be likely to incorrectly reject the null of no effect of a law. To account for this serial correlation, the regressions reported in Tables 6 and 7 allow for an arbitrary autocorrelation process, clustering the standard errors by state rather than allowing for state*year random effects. Bertrand, Duflo and Mullainathan (2004) show that this method will lead to more accurate inferences about the effect of the laws.

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[21] Regressions including all three reform measures as separate variables tend to produce results that are even more muted for each measure.

[22] We have also conducted robustness tests, including using various subsets of the reforms, interactions among the reforms, and including a reforms separately and testing their joint significance. In all cases, we find no effects after controlling for year or time effects.

The first column of Table 6 shows estimates that do not control for state or year fixed effects; they show generally positive coefficients. Only charter school laws are significant; the charter school coefficient in column 1 indicates that the presence of charter school legislation in a public school teacher's state is associated with .59 more hours of work per week. However, this could also reflect fixed, unobserved differences between states that have little to do with a causal effect of school reform laws. Accordingly, the specification in column 2 includes state fixed effects. Three of the four reforms (and the aggregate reform measure) are now positively and significantly correlated with hours. However, these coefficients could reflect –at least in part-- the common time trend in hours and the introduction of accountability laws. When year fixed effects are added to the specification in column 3, there are no significant effects of any kind of reform legislation on hours: the positive estimated effect of reforms appears to be an artifact of a time trend that is common to *all* states, whether they implement reforms or not.

A remaining possibility is that the introduction of school reform legislation is correlated with unobserved state-specific shocks to teacher hours that are not constant through time. For example, states with deteriorating student achievement or teacher effort may be more likely to enact educational reforms earlier. This could disguise a true, positive causal effect of reforms on hours in our data. Alternatively, socially-conservative states may be most likely to pass school reforms and also have the smallest rate of increase of women's work hours over time. Since teachers are disproportionately women, this, too, could induce a spurious negative correlation between the introduction of education reforms and the increase in teacher work hours. In the final column (number 4) of Table 6 we address this issue by replacing the 15 year effects by a set of state-specific, quadratic time trends (100 variables in all). Again, none of the reforms has a significantly positive effect, the point estimates fall even further, and are in most cases quite close to zero.

While our point estimates in columns 3 and 4 of Table 6 are all relatively close to zero, and in the case of testing are even negative, it is still legitimate to ask whether our estimates can conclusively rule out a positive effect of reforms on teacher hours of substantial magnitude. Previous results showed that total teacher hours increased by about one hour between 1983 and 1998, little of which is explained by changes in teachers' observed characteristics. Between 1983 and 1998, the mean of the row-5 policy variable among teachers in our data increased from .118 to .714. Thus, in order for the policy changes that occurred to explain the one-hour increase in teacher hours that occurred, the coefficient in row 5 would need to be 1/(.714-.118), or 1.68. This figure is clearly outside the 99 percent confidence interval of our preferred point estimates in columns 3 and 4. In fact, *our CPS estimates allow us to reject, with 99% confidence, a rise of 30 or more minutes per week due to all of the measured education reforms enacted between 1983 and 1998.*

However, as noted above, the reforms may have larger impacts on specific groups of teachers. The laws also exhibit substantial heterogeneity across states. The effects may also be largest either after the law has been in place for a while (particularly for a policy like charter schools), or alternatively it may only raise hours initially as teachers adapt to the new provisions. The CPS data do not show any stronger effects on particular subgroups of teachers. A sampling of these regressions are included in the Appendix Table A2, which reports the effects of the reforms on younger teachers (less than 30 years old), non-white teachers, and non-unionized teachers. When state and year fixed effects are included, the policies still show no significant effect on hours.

Table 7 does show that the type of policy and timing may matter, particularly for charter schools. We measure policy strength in several ways. The Center for Education Reform (CER) reports the strength of state charter school laws based on a number of criteria and the number of

students enrolled in charter schools in each year.[23]   To measure the strength of sanction laws, we

create a more restrictive variable that indicated whether or not the state has taken over any

districts or has reconstituted any schools as of that year. We also examine the effect of the

number of years a law has been in place, and the effect of a law that has been in place for three

years or less.   Table 7 shows that the percent of students enrolled in charters and the number of

years a charter law has been in place are associated with longer hours. In one specification, the

number of years incentive laws have been in place also raises hours. As noted, we have also

examined effects of interactions of the laws or subsets of the laws, but again find no effects.

(Results available on request.)

Table 8 reports results parallel to Table 6 using the SASS data set. Since only 4 years of

SASS data are available, column (4) uses only a linear time trend. Overall, the results are

similar, and if anything are less supportive of a positive effect of education reforms on teacher

hours. Again, several of the reforms have significantly positive effects when only state fixed

effects are included. However, these effects are almost entirely due to a common time trend in

hours and charter school legislation. In fact, five of the eight coefficients in the preferred

specifications of columns (3) and (4) are negative. The only law to appear to have any effect is

charter school laws, and this only when linear time trends are not included. Using row 5 to pose

the same question as in the previous table, we note that after-school hours rose by 2.5 over our

sample period. For the policy changes to explain all of this increase, a coefficient of 2.5/(.659-

.282), or 6.63 would be required. We can easily rule this out at a 99% confidence level in both

specifications. More importantly, *our SASS estimates allow us to reject, with 99% confidence,*

any scenario in which the measured education policy changes explained more than 12 minutes (8

percent) of the 2.5 hour increase in after-school teacher hours that took place over this period.

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[23] The include, for example, the number of schools permitted to open each year, the difficulty to charter a school,

We again explore the effect of these laws on subsets of teachers. We examine teachers in schools with more than 50 percent of students who are racial or ethnic minorities, teachers in urban schools, teachers with less than three years experience, and non-unionized teachers. Appendix Table A3 shows that the only policy to have an effect is a strong sanction law. In states where the state has taken over or reconstituted schools, inexperienced (and therefore untenured) and non-unionized teachers raise their work hours. Other teachers with less threat of job loss do not respond to any of the reforms.

Table 9 again explores the strength of the law and the effect of timing on SASS teachers. The SASS also asks if there is a merit plan in individual districts, enabling us to test a "strong" incentive law in addition to the strong charter and sanction laws. Here we find that charter law strength is modestly associated with increased hours and merit pay plans are also associated with increased hours when we use year fixed effects. Neither effect is significant after controlling for linear time trends, but we note that both policies are relatively new and have a shorter period for testing.

Finally, in Tables 6 through 9 it is worth noting that the coefficients of the other, "control" variables –not reported but available on request-- behave much as in the pure cross-section regressions of Tables 3 and 4. The pupil-teacher ratio is significantly positively related to teacher hours in both estimates, with estimates clustering around .2 in the CPS and .03 in the SASS. The effects of teachers' and schools' characteristics are similar to those reported in the cross-sections.

A number of additional checks to ensure the robustness of the findings were conducted. These include testing subsets of the reforms (excluding testing, coding states that have all three of the other reforms, interacting incentives and sanctions with the testing law indicator, including

whether or not charters can hire non-unionized personnel, amount of base funding charter schools receive, etc.

all four reforms simultaneously, or including interactions between incentives and sanctions). We also explored other subsets of teachers (female teachers only, male teachers only, teachers closer to retirement age (>55), teachers in the bottom quintile of the hours distribution), and in no case found noteworthy effects that differ from those presented. We also created a policy variable that was the percentage of *surrounding* states with the reform. None of these additional specifications yielded results substantially different from those reported. All of these results are available on request.

As noted, most individuals appear twice in our CPS Monthly Outgoing Rotation Group sample, with interviews that are one year apart. However, because the CPS does not identify individuals, the standard errors cannot be corrected precisely to account for multiple observations of each person. To place bounds on the possible importance of this issue, we took the extreme approach of dropping all individuals who were being interviewed for the first time, effectively halving the sample but ensuring that no person appeared more than once in our data. Most of the coefficients were not changed dramatically, and standard errors were still low enough to rule out effects of the legislation on hours similar to those ruled out in our discussion of both Tables 6 and 7.

6. What *Does* Explain the Increase in Teacher Work Hours?

It is clear from our data that full-time public school teachers experienced a steady increase in their work hours during the last two decades of the twentieth century. We have also argued, so far, that neither changes in the observed characteristics of teachers, nor the education reform policies enacted during this period, can account for this increase. Why then are teachers now putting in more hours?

While it is not the goal of this paper to provide a final answer to this question, we provide

two pieces of evidence in this section that may shed some light on this issue. First, to put the

time trend in teachers' work hours into context, Figure 2 plots mean teacher hours from our CPS

data against those of three alternative comparison groups: the average hours of workers who are

not teachers; the average hours of female nonteachers; and the average hours of nonteachers with

similar observed characteristics to teachers. In all these cases we restrict attention –as we did

among teachers-- to full-time workers (35 or more hours per week). Details of how the latter

series was constructed are provided in Appendix 2; essentially we construct a "basket" of

nonteachers with a similar age, sex, education, union, etc. mix to teachers, allowing that mix to

change over the years to mirror changes in the mix of the teacher population.

It is clear from Figure 2 that the increase in teacher hours during our sample period was

similar to that experienced by most other workers. In fact, relative to nonteachers, teachers'

hours increased more slowly, and certainly more slowly than the hours of nonteaching women.

However, in a comparison not included in Figure 2, other public sector workers appeared to have

even slower rates of increase. In sum, the recent increase in teacher work hours is not at all

exceptional when seen in the context of changes in work hours among comparable groups in the

labor market.[24] The increase in teacher work hours over this period may therefore be driven by

the same unmeasured factors that led to a general, secular increase in hours. Factors such as the

increased ease of substituting market inputs for nonmarket inputs to home production come to

mind. Alternatively, increases in nonteacher hours may have been driven by changes in private-

sector work incentives that were *stronger* or more effective than those associated with education

reform (see Kuhn and Lozano 2005 for recent evidence on this point). In this view, salaried

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[24] The discussion of hours changes relative to different groups of nonteachers raises the possibility of using them more formally as a control group in a double- or triple-difference estimation strategy. We considered, then rejected this approach on the grounds that teachers in other states (but with different reform provisions) seemed a more natural control than private-sector workers, or even police or firemen, in one's own state.

workers' hours *do* respond to greater performance incentives; it is simply the case that, even with

reform, the education sector has lagged behind the private sector in the growth of performance-

related pay.

Because teachers are disproportionately women, it is also possible that the increase in teacher

hours is driven by secular changes in labor force commitment common to women specifically.

To explore this hypothesis more closely, we conducted a series of regressions of the long-term

change in teacher hours on long-term changes in the hours of various comparison groups across

the 50 states over this period. These are reported in Table 10, separately for male teachers

(columns 1-3) and female teachers (columns 4-6). To understand this table, note that column 1

regresses the change in the hours of male teachers on those of male nonteachers. The coefficient

is -.67, indicating a negative but statistically insignificant correlation. Hours changes of female

teachers are also negatively and insignficantly correlated with hours changes of male nonteachers

(column 4). In contrast, looking across states the secular change in the hours of both male *and*

female teachers is positively correlated with changes in female nonteachers' hours (columns 2

and 5). The fact that this correlation also applies to *male* teachers rules out the simple hypothesis

that the increase in teacher hours is driven by changes in the labor force commitment of all

women.[25]

An example of a hypothesis that would be more consistent with the results in Table 10 would

be a "parental pressure" story. In such a hypothesis, mothers working longer hours would insist

on harder-working teachers, regardless of the teacher's gender. For instance, the increase in

mother's work hours may decrease the number of hours they spend in the home production of

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[25] Note that hours increased among *both* male and female teachers over our sample period. Disaggregating row 1 of
Table 1 by gender shows an increase in total hours of 0.55 hours for men, versus 1.13 hours for women.
Disaggregating row 1 of Table 2 yields essentially identical increases in after-school instructional hours of 2.3 for
both male and female teachers.

education, which in turn raises their demand for "school production" as a substitute.[26] To explore this hypothesis a little further, columns 3 and 6 restricts the comparison group of female nonteachers to women between the ages of 35 and 50, when they are most likely to have school aged children.[27] The correlation between the hours of this group and those of both male and female teachers is now positive and statistically significant.

6. Teacher Hours, State Reforms, and Student Test Scores

Our results indicate very muted effects of education reform on teacher work hours. We have noted, however, that teachers may still be responding to laws in dimensions other than hours of effort. Teachers may be teaching "smarter" instead of "harder," adjusting behavior on the intensive margin. Accountability laws accompanied by detailed state content standards may also reduce lesson preparation time if the standards are highly prescriptive. Critics of accountability reforms also argue that the link between student performance and teacher effort may itself be weak. Some argue that teachers may simply "teach to the test" and omit more challenging material. Additionally, accountability laws may only affect teachers on the critical margins. Teachers whose school's performance levels are close to the critical values that trigger sanctions or incentives may alter their behavior, but teachers farther from the margins may have no real incentive to change. Teachers may also reallocate their attention to focus on students near critical thresholds, but not increase their effort overall. Jacob (2002) and Figlio and Getzler (2002) provide evidence that suggests these types of responses. Thus, it may be that the very structure of the reforms implemented to date makes a positive effect on total teacher effort unlikely, without necessarily ruling out an effect on students' test scores.

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[26] Flyer and Rosen (1997) present a similar argument in explaining the rise in the number of teachers per student.
[27] In the 1990 Census, about 63 percent of women in this age group who work at least 35 hours per week have children over the age of 5 living with them.

To explore this issue, we present some evidence on the relationship between our state-level education reform measures and student performance based on the NAEP state assessments of 4th grade math scores.[28] While this is probably not the ideal data or design for a study of the effects of education reform on student performance, it can shed additional light on potential explanations for our findings. The results are shown in Table 11.

Table 11 shows the effect of a number of the policy measures on student 4th grade math scores. We find that a number of the laws are important. Charter school laws are associated with higher scores, and strong charter laws are particularly important. Incentives also appear to increase measured student performance. Sanctions by themselves do not, but states that have taken over districts and/or schools have higher performance. Of course, it is not clear from this exercise if *teachers* have increased student performance in these policy states through some mechanism other than hours or effort, or if other factors are important. For example, greater reporting of succeeding or failing schools may also increase *parental* effort and involvement. However, the results are also consistent with increased performance without requiring additional teacher time.

7. Conclusion

The average weekly work hours of teachers have risen steadily since 1983, with an overall increase of about an hour per week. The hours teachers spend after school without students increased even more, rising about two and a half hours per week—a 34 percent increase. Considering these trends in the light of the recent explosion of education reforms across U.S. states, it is tempting to conjecture that greater "incentivization" in teachers' employment

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[28] Means of the NAEP data are included in Appendix Table A4.

contracts induced by these reforms has, at least in part, induced America's teachers to put in a few extra hours, especially grading papers or preparing better lessons after school.

According to the results in this paper, succumbing to the above temptation would lead a researcher astray. Once we adjust for a common time trend in teacher hours across *all* states, we can detect no association between the adoption of any of four distinct types of reforms –charter schools, incentives, sanctions, and testing—and changes in teacher work hours. Further, our CPS estimates allow us to reject with 99 percent confidence a total effect of all the reforms adopted between 1983 and 1998 on the teacher work week in excess of (plus) 30 minutes. In the SASS data, we can say with 99 percent confidence that reforms account for less than 12 minutes of the 2.5-hour increase in teachers' mean after-school instructional hours.

We conjecture that the lack of an effect of education reforms on teacher hours may be due to the weak connection between individual teacher effort and rewards that characterize most of the reforms that have been implemented: when examined closely one would not necessarily *expect* these reforms to have much of an effect on individual teachers. While reforms with more high-powered incentives might of course be more successful in increasing teacher effort, it is of course also worth noting that high-powered incentives may have other disadvantages that would need to be considered when adopting such policies.[29]

Finally, it is of course possible that U.S. education reforms have caused changes in teacher behavior that are beneficial to students, or at least raise school performance indicators, without affecting teachers' work hours. Teachers could have intensified their work effort per hour without increasing the number of hours worked, or –again without increasing total hours-- could have changed the mix of activities during their day towards activities that are rewarded. Indeed, we find some preliminary evidence that student test scores does appear to have increased in

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[29] See Jacob (2002), Figlio and Getxer (2002) Jacob and Levitt (2003) for examples.

states that adopted reforms despite the lack of an effect of reforms on hours. Understanding exactly what this means for the quality of education experienced by students requires further research on the precise ways in which teachers, students, and parents allocate their time, and on how this is affected by school reform policies.

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Appendix 1: Education Reform Policies

Table 1A : Year Reform Measure Enacted

	Testing	Incentives	Sanctions	Charter School
Alabama	1983		1995	
Alaska	1989			1995
Arizona	1983			1994
Arkansas	1991		1983	1995
California	1983			1992
Colorado	1996			1993
Connecticut	1983	1996	1997	1996
Delaware	1983			1995
Florida	1983	1997	1996	1996
Georgia	1983	1985	1985	1993
Hawaii	1983			1994
Idaho	1984			1998
Illinois	1986		1995	1996
Indiana	1986	1987		2001
Iowa				
Kansas	1983			1994
Kentucky	1996	1990	1984	
Louisiana	1987		1996	1995
Maine	1985			
Maryland	1983	1996	1990	
Massachusetts	1996		1993	1993
Michigan	1983		1993	1993
Minnesota	1996			1991
Mississippi	1983			1997
Missouri	1995		1996	1998
Montana	1992			
Nebraska				
Nevada	1983		1997	1997
New Hampshire	1993			1995
New Jersey	1983	1996	1988	1996
New Mexico	1983	1996	1996	1993
New York	1983		1996	1998
North Carolina	1983	1997	1995	1996
North Dakota	1990			
Ohio	1989		1989	1997
Oklahoma	1986		1990	1999
Oregon	1984		1996	1999
Pennsylvania	1991	1997		1997
Rhode Island	1987		1997	1995
South Carolina	1983	1984	1984	1996
South Dakota	1985			
Tennessee	1983		1992	
Texas	1990	1994	1989	1995
Utah	1990			1998
Vermont			1997	
Virginia	1988		1997	1998
Washington	1983	1997	1997	
West Virginia	1983			

| **Wisconsin** | 1989 | | | 1993 |
| **Wyoming** | 1998 | | | 1995 |

Indicates policy as of 1999. A date of 1983 indicates the policy was in place as of 1983.

Sources for date reform policy was enacted:

Charter school laws:

- Center for Education Reform (www.edreform.com/charterschools/) lists year charter schools were permitted for each state. CER's *National Charter School Directory* reports and index for the strength of the charter school law and the number of students enrolled in charter schools.

Incentives and Sanctions:

- Todd Ziebarth, *Rewards and Sanctions for Schools and School Districts*, Education Commission of the States, (1999 and 2001) and Education Commission of the States*, Education Accountability Systems in 50 States*, (1997) list statutes, public bills, and legislative acts for accountability laws.
- Todd Ziebarth, *State Takeovers and Reconstitutions*, Education Commission of the States, (2004) lists instances and dates when states or districts have taken over or reconstituted schools and/or districts.
- The original date was for the law was taken from the legal history given in a Lexis-Nexis search for the current code or act.
- Laws that preceded currently enacted legislation were taken from the history of the law or when unavailable from searches of monthly "Legislative Updates" in *Education Week* or from Education Week Quality Counts (1997) descriptions of state accountability laws.

Testing:

- Education Week , *Quality Counts* (1997-2001) lists states with criterion or norm referenced tests;
- Council of Chief State School Officers, *Annual Survey of State Student Assessment Programs*, (1994-2001). This also reports if results are used to takeover or dissolve schools.

  Historical information from

- Kino, Mary, *The State of Assessment Program: What are State Wide Assessment Programs Doing*? Paper presented at the Annual Meeting of the National Council on Measurement in Education (Boston, MA, April 17-19, 1990).
- Bond, Linda, *Surveying the Landscape of State Educational Assessment Programs*, Council for Educational Development and research, Washington D.C., 1993.

Appendix Table A2: Estimates of the Effect of Selected Education Reforms for Specific Teacher Subgroups: CPS data

	Specification		
	Age<30	Nonwhite	Non-unionized
Reform:			
Charter	-.107	.119	.913
	(.558)	(.837)	(.723)
Incentives	.427	-.244	.129
	(.532)	(.625)	(.657)
Sanctions	.246	.204	-.565
	(.366)	(.430)	(.566)
Testing	.168	-1.362	.084
	(.357)	(.458)	(.457)
Number of reforms/4			
State and year Fixed Effects	Yes	Yes	Yes

Appendix Table A3: Estimates of the Effect of Selected Education Reforms for Specific Teacher Subgroups: SASS data

	Specification			
Reform:	Teaching in a school with >50% minority students	Urban	<3 yrs Teaching Experience	Non-unionized
Charter	.1935 (.3467)	-.1309 (.3196)	.25002 (.4702)	-.2167 (.4006)
Incentives	-.5228 (.3370)	-.8793 (.5525)	-.7918* (.4276)	-.2850 (.3979)
Sanctions	.1422 (.2824)	-.0799 (.3941)	.5548 (.3816)	.4264 (.3248)
Takeover	.2690 (.2779)	.1974 (.5146)	.9819** (.3864)	1.0481** (.4418)
Number of reforms/4	-.7078 (.5189)	-1.4237 (.8797)	-.0693 (.7460)	-.1579 (.7469)
State and year Fixed Effects	Yes	Yes	Yes	Yes

Standard Errors in Parentheses. Clustered on state cells.
** significant at p=.05
* significant at p =.10
Each cell represents the results of a *separate* regression using the one policy measure indicated.

All regressions also include controls for total years of experience, indicators for secondary school teacher, 0-3 years of experience, female, nonwhite, advanced degree, school in city, town/rural, percent students minority and receiving free lunch, school pupil teacher ratio, state unionization level from CPS, and school enrollment.

Appendix A4 Average Individual Characteristics, Math NAEP

	1992	2000
Math score	221.609 (30.776)	225.4056 (29.768)
Female	.494 (.500)	.494 (.499)
White	.647 (.478)	.611 (.487)
IEP	.080 (.271)	.104 (.306)
LEP	.030 (.169)	.045 (.208)
Parents ed less than HS*	.048 (.215)	
Parents ed HS*	.143 (.350)	
Parents ed some college*	.084 (.278)	
Female teacher	.126 (.331)	.126 (.331)
White teacher	.915 (.279)	1.0 (0)
Teacher experience, 0-2 yrs	.086 (.281)	.104 (.305)
Teacher experience, 3-5 yrs	.123 (.328)	.134 (.341)
Teacher high certificate	.381 (.486)	.186 (.389)
Teacher MA plus	.422 (.494)	.433 (.495)
City	.245 (.430)	.323 (.467)
Urban fringe	.236 (.424)	.305 (.460)
Town	.182 (.386)	.178 (.382)
Num students in class	22.989 (5.612)	21.867 (5.583)
Teacher total hours*	35.996 (9.064)	
Teacher preparation hours*	7.680 (5.878)	

*Only available in 1992 wave.

Appendix 2: Derivation of Nonteacher Hours Series

This appendix describes the creation of the fourth comparison series to teacher hours presented in Figure 2. This series estimates mean hours worked for a group of nonteachers with observed characteristics to teachers in each year. We began by estimating the following regression for all full-time employed persons (working 35 or more hours per week) who are not teachers in the entire pooled 1983-1998 CPS data:

$$H_i^N = a^N + bX_i^N + c^N S_i Y_i \qquad (A1)$$

where H_i^N is the work hours of an individual nonteacher I; X includes indicators for ages 22-25 and 51-65, female, nonwhite, an advanced degree, and month of interview; and $S_i Y_i$ is a full set of interactions between 49 state fixed effects and 15 year effects (799 year x state effects in all).

Then we used the estimated coefficients from this regression to calculate:

$$\overline{H}_i^{NT} = a^N + b\overline{X}_i^T + c^N S_i Y_i \qquad (A2)$$

$\overline{H}_i^{NT}$ is the predicted mean hours of nonteachers with the characteristics of teachers in teacher i's state and year. It is calculated using the nonteacher regression coefficients, the state x year effects, monthly indicators, and teachers' mean characterisitcs $\overline{X}_i^T$, which gives the mean values of the age, gender, nonwhite and education dummies for teachers in that year (but not that state). To be clear, $\overline{X}_i^T$ takes 16 distinct values, one for each of the 16 years (1983-98) of data.

Note that the specification in (A1) and (A2) restricts the state-by-year effects to be the independent of the level of observed characteristics, *X*. To relax this assumption we constructed several alternative measures (some regression-based, some nonparametric) that allow hours trends to be different for nonteachers with *X*'s more similar to teachers (e.g. a college-educated, predominantly female population) than for other nonteachers. The results were very similar.

Table 1: Average Weighted Teacher Characteristics, CPS Sample

	1983-86	1987-90	1991-94	1995-98
Weekly Work hours	42.88	43.47	43.83	43.80
	(.065)	(.072)	(.078)	(.084)
Age 22-25	.053	.051	.054	.051
	(.002)	(.002)	(.002)	(.003)
Age 51-65	.158	.161	.171	.210
	(.004)	(.004)	(.004)	(.005)
Female	.664	.684	.709	.719
	(.005)	(.005)	(.005)	(.005)
Nonwhite	.104	.102	.094	.107
	(.003)	(.003)	(.003	(.004)
Teacher has Advanced Degree*	.546	.57	.503	.463
	(.005)	(.005)	(.005)	(.006)
Teaches in a Secondary School	.484	.459	.43	.413
	(.005)	(.005)	(.005)	(.005)
Covered by Union Agreement	.790	.775	.759	.751
	(.004)	(.005)	(.005)	(.005)
N	11,822	11,101	10,877	9,027

Standard Deviations in Parentheses. All means calculated using CPS individual weights.

* Prior to 1991, schooling is reported as number of years, so individuals with more than 4 years of college are designated as having more than a BA. After 1991, the CPS records an individual's highest degree, and this category includes those with MA's or higher.

Weekly Work hours refers to usual hours of work in main job; main job is the job with highest usual hours.

Table 2: Average Weighted Teacher Characteristics: SASS Sample

	1987	1990	1993	1999
After school hours without students	7.18 (.142)	8.28 (.188)	9.04 (.223)	9.63 (.262)
Total experience (years)	15.24 (.332)	15.69 (.392)	15.80 (.395)	14.93 (.330)
New Teacher (1-3 yrs experience)	.090 (.006)	.102 (.008)	.115 (.008)	.161 (.005)
Female	.675 (.013)	.685 (.014)	.696 (.012)	.748 (.011)
Nonwhite	.130 (.013)	.126 (.013)	.130 (.014)	.146 (.019)
Teacher has Advanced degree	.470 (.024)	.448 (.027)	.465 (.028)	.446 (.028)
Teaches in a Secondary School	.517 (.005)	.494 (.007)	.551 (.009)	.483 (.012)
Union Coverage[*]	.717 (.037)	.704 (.043)	.700 (.043)	.680 (.043)
City	.265 (.023)	.254 (.020)	.258 (.025)	.241 (.021)
Town/rural	.455 (.031)	.471 (.030)	.459 (.030)	.256 (.030)
Pupil-teacher ratio (schoolwide)	16.18 (.562)	16.05 (.602)	16.54 (.636)	15.45 (.543)
Share of students receiving free lunch (schoolwide)	.276 (.012)	.307 (.015)	.322 (.014)	.360 (.018)
Share of minority students (schoolwide)	.271 (.027)	.278 (.030)	.293 (.032)	.326 (.037)
K-12 Enrollment (total for school)	790 (35.36)	771 (33.81)	798 (30.73)	810 (37.81)
N	25,506	30,116	28,436	19,415

Standard Errors in Parentheses. All means calculated using SASS-supplied teacher weights.

*The mean coverage rate of teachers in the individual's state, taken from the CPS.

Table 3: Teacher Hours and Personal Characteristics: Cross-Section Regression Coefficients, CPS Sample.

	1983-86	1987-90	1991-94	1995-98
Age 22-25	.2602	.7634**	.0978	.6508
	(.2459)	(.3648)	(.3978)	(.4288)
Age 50-65	.3422*	.5168**	.8877**	.6405**
	(.1678)	(.1922)	(.2373)	(.2378)
Female	-.8760**	-.9388**	-.2268	-.2786
	(.1841)	(.2732)	(.2181)	(.2169)
Nonwhite	-1.4162**	-2.2351**	-2.2489**	-2.6416**
	(.3357)	(.2296)	(.4927)	(.4227)
Teacher has Advanced degree	.1928	.0857	-.3678	-.1768
	(.1814)	(.2837)	(.2507)	(.2886)
Teaches in a Secondary School	.6188**	.4384**	.7521**	.3807
	(.1504)	(.1458)	(.2312)	(.2422)
Share covered by union agreement (statewide)	-2.8995**	-3.5384**	-2.2878	-1.2269
	(1.1799)	(1.1797)	(1.3052)	(1.1958)
R^2	.02	.02	.03	.02
Number of observations	11,822	11,101	10,877	9,027

Dependent Variable: Total Usual Weekly Hours at Main Job.

Robust Standard Errors in Parentheses.

All regressions include a full set of interview month and year dummies. Data from the June, July and August CPS interviews were not used.

Table 4: Teacher Hours and Personal Characteristics: Cross-Section Regression Coefficients, SASS Sample.

	1987	1990	1993	1999
Experience	-.0021	.0179**	.0027	.0264**
	(.0038)	(.0066)	(.0081)	(.0081)
New Teacher	1.2259**	1.2894**	1.6900**	1.3851**
	(.2588)	(.2729)	(.2328)	(.2741)
Female	1.8008**	1.7619**	1.8830**	1.6633**
	(.1031)	(.1234)	(.1029)	(.1232)
Nonwhite	-.5049**	-1.1220**	-1.0880**	-1.0476**
	(.2095)	(.2078)	(.2305)	(.2480)
Teacher has	.1580	.0228	.2435	.1349
Advanced Degree	(.1174)	(.1589)	(.1487)	(.1984)
Teaches in a	-.2032	-.9105**	-1.0782**	-.9737**
Secondary School	(.1473)	(.1763)	(.1952)	(.2020)
% Covered by Union	-.0621	1.4697**	1.7876**	3.6171**
(statewide)	(.5041)	(.6052)	(.6832)	(.8566)
City	.1844	-.2003	-.3243	.2907
	(.2036)	(.1421)	(.1989)	(.1976)
Town or rural	-.1628	-.4527**	-.5059**	-.7061**
	(.1511)	(.1646)	(.1773)	(.1666)
Pupil-Teacher Ratio	.0945**	.0918**	.0961**	.0044
	(.0284)	(.0223)	(.0388)	(.0281)
Share of Students with	-1.8295**	-1.9537**	-1.8358**	-2.2290**
Free lunch (schoolwide)	(.2412)	.3997	(.4741)	(.5906)
Share Minority	-.3633	.8429**	.6380	.6404
(schoolwide)	(.2814)	(.4031)	(.4655)	(.4667)
Enrollment/100	-.0195	-.0125	.0092	.0264
	(.0101)	.0156	(.0164)	(.0162)
R^2	.04	.05	.05	.06
N	25,506	30,116	28,436	19,415

Robust Standard Errors in Parentheses

Table 5: Number of States with Reform Policy

	1983-86	1987-90	1991-94	1995-98
Test all students in at least one grade, report results by school	28	37	42	48
Impose sanctions on schools with low performance	4	9	12	27
Give monetary rewards to schools with high performance	2	4	5	13
Charter schools permitted	0	0	11	34

Table 6: Estimates of the Effect of Selected Education Reforms on Total Teacher Hours: CPS data.

Standard Errors in Parentheses. Clustered on state cells.

	Specification			
Reform:	Pooled Cross Sections	Adding State Fixed Effects	Adding State and Year Fixed Effects	Adding State Effects, plus State-specific Quadratic Time trends
Charter	.5946**	.5327**	.2406	.0947
	(.1915)	(.1935)	(.2019)	(.2372)
Incentives	.5445	.3626*	.0864	.1858
	(.3850)	(.2026)	(.1882)	(.1928)
Sanctions	.4528	.4354**	.0593	.2342
	(.4319)	(.1814)	(.1913)	(.2002)
Testing	-.3558	.2090	-.1104	-.2174
	(.3827)	(.2107)	(.1645)	(.1581)
Number of reforms/4	.5978	.9345**	.1877	.1787
	(.4765)	(.2164)	(.3168)	(.4872)

Sample size for all regressions: 42,827

** significant at p=.05
* significant at p =.10

Each cell represents the results of a *separate* regression using the one policy measure indicated.

All regressions also include dummies for teachers aged 22-25 and 50-65, indicators for female, nonwhite, secondary school teacher, advanced degree, state pupil teacher ratio, and month of interview.

Table 7: Effect of Strength and Timing of Laws on Total Teacher Hours: CPS data.

Reform:	Specification	
	Includes State and Year Fixed Effects	Includes State Effects, plus State-specific Quadratic Time trends
Charter law strength	.006	.002
	(.005)	(.007)
Percent students in charter	16.750*	20.625 *
	(8.813)	(12.43)
Within 3 years of charter law passage	.037	-.082
	(.192)	(.239)
Number of years charter law in effect	.108**	-.019
	(.048)	(.100)
State has taken over districts/schools	-.166	-.035
	(.194)	(.196)
Within 3 years of sanction law passage	-.296**	-.252
	(.151)	(.161)
Number of years sanction law in effect	.035*	.178
	(.020)	(.171)
Within 3 years of incentive law passage	.035	-.085
	(.178)	(.220)
Number of years incentive law in effect	.001	.235**
	(.020)	(.074)

Standard Errors in Parentheses. Clustered on state cells.
Sample size for all regressions: 42,827

** significant at p=.05
* significant at p =.10

Each cell represents the results of a *separate* regression using the one policy measure indicated.

All regressions also include dummies for teachers aged 22-25 and 50-65, indicators for female, nonwhite, secondary school teacher, advanced degree, state pupil teacher ratio, and month of interview.

Table 8: Estimates of the Effect of Selected Education Reforms on After-School Teacher Hours: SASS data.

	Specification			
Reform:	Pooled Cross Sections	Adding State Fixed Effects	Adding State and Year Fixed Effects	Adding State Effects, plus State-specific Linear Time trends
Charter	1.4979**	1.4205**	.3854*	-.4242
	(.2429)	(.2322)	(.2105)	(.3663)
Incentives	.2287	.8223**	-.4132	-.1.334**
	(.2004)	(.3311)	(.3444)	(.3880)
Sanctions	.6824**	1.4939**	.1916	.3064
	(.2418)	(.2354)	(.2152)	(.2586)
Testing	.2914	.8082*	-.3219*	-.1348
	(.2985)	(.4530)	(.1870)	(.4632)
Number of reforms/4	1.7836**	2.5350**	-.0757	-.8664
	(.3892)	(.4920)	(.5106)	(.5501)

Sample size for all regressions: 103,473

Standard Errors in Parentheses. Clustered on state cells.

Each cell represents the results of a *separate* regression using the one policy measure indicated.

All regressions also include controls for total years of experience, indicators for secondary school teacher, 0-3 years of experience, female, nonwhite, advanced degree, school in city, town/rural, percent students minority and receiving free lunch, school pupil teacher ratio, state unionization level from CPS, and school enrollment.

Table 9: Effect of Strength and Timing of Laws on Total Teacher Hours: SASS data.

Sample size for all regressions: 103,473

	Specification	
Reform:	Adding State and Year Fixed Effects	Adding State Effects, plus State-specific Linear Time trends
Charter law strength	.012*	-.009
	(.006)	(.011)
Percent students in charter in state	10.323	7.167
	(11.976)	(24.965)
Within 3 years of charter law passage	.345*	.361
	(.209)	(.297)
Number of years charter law in effect	.014	-.353**
	(.052)	(.047)
State has taken over districts/schools	.340	.072
	(.295)	(.498)
Within 3 years of sanction law passage	.231	-.054
	(.205)	(.204)
Number of years sanction law in effect	-.060	-.321**
	(.034)	(.056)
District has merit pay plan	.220*	.072
	(.117)	(.089)
Within 3 years of incentive law passage	.198	-.454
	(.178)	(.326)
Number of years incentive law in effect	-.074	-.455**
	(.048)	(.042)

Standard Errors in Parentheses. Clustered on state cells.

** significant at p=.05
* significant at p =.10

Each cell represents the results of a *separate* regression using the one policy measure indicated.
All regressions also include dummies for teachers aged 22-25 and 50-65, indicators for female, nonwhite, secondary school teacher, advanced degree, state pupil teacher ratio, and month of interview.

Table 10: Long-Change Regressions Across 50 States: Estimated Effect of Changes in the Mean Hours of Selected Comparison Groups on the Mean Hours of Full-Time Teachers.

Independent Variable:	Dependent Variable:					
1983-1998 State-Level Change in Mean Hours of:	1983-1998 State-Level Change in Mean Hours of Male Teachers			1983-1998 State-Level Change in Mean Hours of Female Teachers		
	(1)	(2)	(3)	(4)	(5)	(6)
Male Nonteachers	-.6728 (.4228)			-.1347 (.2675)		
Female Nonteachers		.6489 (.4055)			.7777 (.2316)	
Female Nonteachers, Age 35-50			.6596 (.2650)			.5847 (.1523)
R^2	.12	.12	.11	.01	.19	.23

Dependent variable is the change in mean hours of teachers from 1983-1985 period to 1995-1998 period.

Sample size for all regressions: 50

Standard Errors in Parentheses.

Each column represents the results of a *separate* regression.

Table 11: Estimates of the Effect of Selected Education Reforms on Student Test Scores

	4th Grade math NAEP scores
Charter law	2.380*
	(1.322)
Strength of charter law (no law=0)	.1023**
	(.0374)
Percent students in charter schools in state	95.191
	(84.347)
Incentive law	4.309**
	(2.034)
Sanction law	2.527
	(1.531)
State has taken over or reconstituted districts/schools	3.953**
	(1.414)

Sample size for all regressions: 139,486
Standard Errors in Parentheses. Clustered on state cells.

** significant at p=.05
* significant at p =.10

Each row represents results from a separate regression

Regressions also include indicators for student characteristics (female, white, IEP, LEP), indicators for teacher characteristics (female, white, teach 0-2 years, teacher 3-5 years, high certificate, MA plus), indicators for locale (city, fringe, town), number of students in class, and state and year fixed effects.
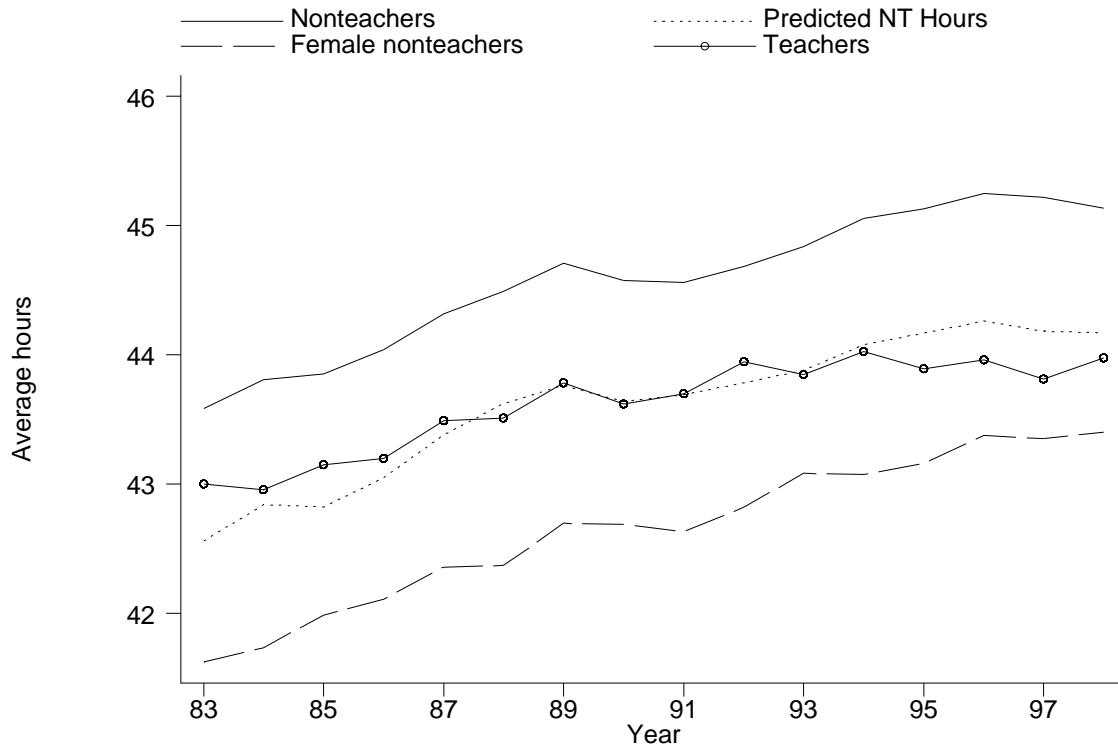
Figure 1: Teacher Hours Across States in Early 1980's and Late 1990's
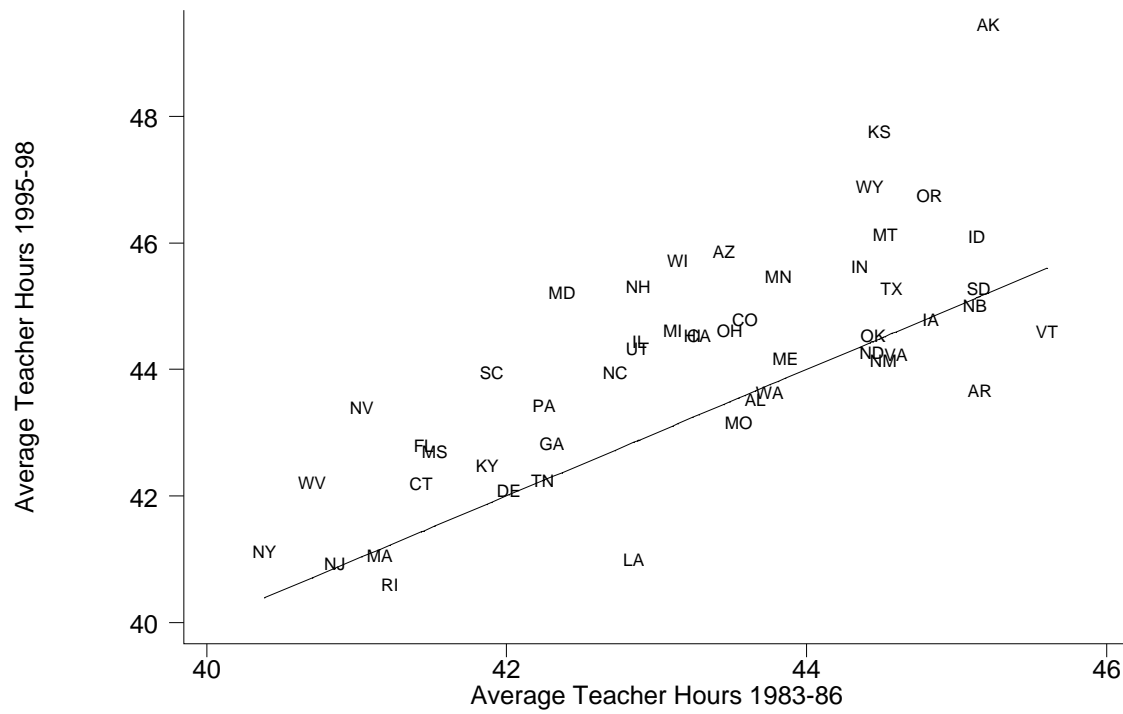
Source: CPS Outgoing Rotations

Figure 2: Trends in the Average Hours of Teachers and Other Comparison Groups

Source: CPS Outgoing Rotations