NEW MEASURES OF TEACHERS' WORK HOURS AND IMPLICATIONS FOR WAGE COMPARISONS

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Abstract

Researchers have good data on teachers' annual salaries but a hazy understanding of teachers' hours of work. This makes it difficult to calculate an accurate hourly wage and leads policy makers to default to anecdote rather than fact when debating teacher pay. Using data from the American Time Use Survey, I find that teachers work an average of 34.5 hours per week on an annual basis (38.0 hours per week during the school year and 21.5 hours per week during the summer months). I find that when hours per week are accurately accounted for high school teachers earn in the range of 7–14 percent less than demographically similar workers in other occupations. However, elementary, middle, and special education teachers earn higher wages than demographically similar workers in other occupations.

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1. INTRODUCTION

The efficacy of policies aimed at improving teacher quality depends on a number of important teacher labor supply decisions. Who becomes a teacher, how much and how hard they work, and whether they stay in the profession are all issues requiring an understanding of teachers as labor-market participants. Despite significant amounts of research and money devoted to improving teacher quality, there remain some basic deficits in our knowledge about teacher labor markets. One notable deficit is our lack of clarity on teachers' wages and how they compare with wages in other occupations, which is frustrating to policy makers and voters. Consider the following excerpt from a letter to the editor in the *Minneapolis Star Tribune* (Cavanagh 2011):

> Recent articles about a proposed pay freeze for teachers have contained predictable posturing from the usual suspects—politicians, union leaders, teachers and school administrators—but little information about current teacher pay. [. . .] How many hours per year do teachers work for this pay? How many unemployed teachers are seeking positions at current compensation levels? And how does pay in the public sector compare to pay in the private sector? [. . .] Let's put the relevant facts on the table and let the people decide whether a freeze is unfair or overdue.

Unfortunately, it is not only the popular press that presents unclear and conflicting information about teacher pay—the academic literature on this topic is not much better. At the core of the problem is the fact that the research community has good data on teachers' annual salaries but only limited information about teachers' hours of work. As this frustrated letter writer alludes to, this leads to conflicting estimates of teachers' hourly wages and, hence, very different policy prescriptions.

Basic supply and demand analysis predicts that if wages are too low, there will be a shortage of high-quality teachers. This motivates many to call for increased wages for teachers (Temin 2003; Allegretto, Corcoran, and Mishel 2004). Others counter that teachers' wages are already high in comparison to similarly educated workers and argue that raising wages will only produce a glut of low-quality candidates (Ballou and Podgursky 1995; Podgurksy 2003; Richwine and Biggs 2011). Traditionally, teachers' wages are set by district- or state-mandated salary schedules that decide pay solely on years of service and highest degree. Many have argued this is inefficient and wages should vary by assignment and/or be attached to measures of productivity (Hanushek 2007).[1]

1. A full discussion of the determinants of teachers' wages and the various debates within the literature is beyond the scope of this paper. Those interested might see reviews (Podgursky 2010) and other

Within this debate, there are a number of arguments about whether and how to adjust teachers' wages to account for the length of the school day and year. These arguments often hinge on different assumptions about how much time teachers spend on work-related activities outside of school hours (Nelson and Podgursky 2003; Podgursky and Mishel 2005). At one extreme, economists use administrative data on contract hours such as the National Compensation Survey and assume that teachers do not work at all beyond what is minimally required (Podgursky and Tongrut 2006).[2] More commonly, they use self-reported data from surveys such as the Current Population Survey (CPS), which provides data on weekly wages, and assume that teachers' hours of work are similar to other professionals (Allegretto, Corcoran, and Mishel 2008).[3] I show that neither of these assumptions is correct.

In this study, I offer new measures of hours of work from the American Time Use Survey (ATUS). The time diaries collected by the ATUS are a more reliable way to estimate hours of work than either contract data or surveys.[4] The ATUS provides a unique opportunity to investigate the time teachers spend working and whether teachers are more likely to overestimate their hours in the CPS than other workers. My analysis of the time diary data from the ATUS has the potential to close the debate over whether teachers work more or less than the average worker and allow for a more accurate comparison of teachers' wages to wages in other sectors.

I find that teachers work an average of 34.5 hours per week annually. During the school year, they work an average of 38.0 hours per week and during the summer they work an average of 21.5 hours per week. Teachers work more than they are required to work by contract, but less than self reported hours of work. I find that teachers are more likely to overestimate their hours of work in the CPS than workers in other occupations, and conclude that this is likely because of an uneven work year. Finally, I use time diary data from the ATUS to compare teachers' wages with wages in other sectors. I find that when hours per week are accurately accounted for, high school teachers earn in the range

recent work on topics such as unions (West and Mykerezi 2011) and spacial determinants of wages (Winters 2011).

2. Contract hours are the hours that a teacher is formally required to work as opposed to informal expectations about hours of work.
3. Correcting for different hours of work using the number of weeks worked and hours of work per week, such as in Taylor (2005), assumes the self-reported data are accurate. I argue in this paper that they are not.
4. Juster and Stafford (1991, p. 473) write: "The methodology for collecting time allocation data has been well developed at this point, and the main characteristics of optimum methodology are not in dispute. The only way in which reliable data on time allocation have been obtained is by use of time diaries, administered to a sample of individuals in a population and organized in such a way as to provide a probability sample of all types of days and of the different seasons of the year." The ATUS fits this optimal methodology. The CPS and other surveys, such as the Schools and Staffing Survey (SASS), which also asks about hours of work, do not.

of 7–14 percent less than demographically similar full-time workers in other occupations. Elementary, middle, and special education teachers, however, are paid higher wages than demographically similar full-time workers in other occupations.

The paper proceeds as follows. In the next section I briefly discuss similar work by others. Section 3 describes the data. Section 4 outlines my methodology for constructing time diary measures of hours of work per week by occupation, and presents results that compare teachers' hours of work and propensity to overestimate hours in the CPS to other occupations. Section 5 shows the impact of using time diary measures of hours of work in wage calculations. Section 6 shows the impact of time diary measures of hours of work on the wage gap between teachers and other occupations and further discusses results by assignment, sector, gender, and degree. Section 7 concludes with a brief discussion of the policy implications.

2. PREVIOUS LITERATURE

I am aware of only one other paper that uses ATUS data to examine teachers and their work patterns. Krantz-Kent (2008) provides a short "visual essay" that summarizes teacher work patterns using ATUS data. She finds that teachers' hours of work vary throughout the year. Not surprisingly, teachers are less likely to work during the summer months than during the school year. Almost half of all teachers, however, report some work during the prior week for interviews conducted in July, and over 70 percent report some work during the prior week for interviews conducted in June and August. Krantz-Kent finds that teachers are more likely than others to work at home and to work on Sundays, but teachers work fewer hours during the week and on Saturdays. The net result is that teachers spend, on average, for all days of the week, 18 fewer minutes per day working than other professionals.[5] The analysis stops at summary statistics and does not consider the implications for wages nor compare the diary hours in the ATUS to the self reports in the CPS.

Other than the ATUS, the only other time diary data on teachers was collected and analyzed by Drago et al. (1999). They find the average elementary school teacher works 9.7 hours per day, almost two hours more than what is required by contract. Drago et al. use data from a survey much smaller than the ATUS and do not include nonteachers, therefore it is not possible to compare teachers with other workers. They are also unable to compare diary measures with self-reported hours of work.

5. The definition of "other professionals" in Krantz-Kent (2008) includes health care professionals, business and finance operations professionals, architects and engineers, community and social service professionals, managers, and unspecified "others."

I am not the first researcher to use the ATUS to estimate over-reporting in the CPS. Robinson et al. (2011) find that all workers over-report their hours by 5 to 10 percent. The study most similar to my analysis of over-reporting and its impact on estimating hourly wages is Frazis and Stewart (2004).[6] They compare the "usual hours of work" and "hours of work last week" variables in the CPS to diary data in the ATUS and find that all workers over-report usual hours of work by an average of three hours per week. Frazis and Stewart find that the "hours of work last week" variable in the CPS is much closer to diary data in the ATUS. Here the over-reporting is closer to one hour per week.[7] They also find that women and more educated respondents are more likely to over-report hours in the CPS relative to the diary data in the ATUS. They conclude that accounting for over-reporting increases the college–high school earnings ratio by 4.1 percent and the female–male hourly earnings ratio by 5.4 percent.[8]

Juster and Stafford (1991) note that surveys like the CPS that ask about usual weeks of work are likely to have valid responses only when daily work patterns have regular schedules. Teachers do not have regular work patterns for a number of reasons, most notably because teachers' contracts generally require nine or ten months of work rather than twelve. When asked to recollect a usual day, it is unlikely that teachers will average in their time off during the summer months. This makes teachers more likely than others to over-report their hours of work. Allegretto, Corcoran, and Mishel (2004) cite personal correspondence with the Bureau of Labor Studies urging caution when attempting to interpret usual hours of work data for teachers; they mention flight crews, sales representatives, and truck drivers as other occupations likely suffering from the same estimation challenge. Robinson and Gershuny (2011) examine over-reporting by occupation and find workers in legal, education, and protective services have self-reported hours that are at least four hours per week higher than their average diary hours.

3. DATA

The data for this paper come from the Current Population Survey (CPS) and the American Time Use Survey (ATUS) extracted via the ATUS-X (Abraham

6. Frazis and Stewart (2009) also compare hours in the CPS and the ATUS. Other discussions of over-reporting that rely on different data sources include Baum-Snow and Neal (2009), who compare hours of work for part-time workers in the CPS and the American Community Survey, and Robinson and Bostrom (1994), who compare hours of work in the CPS with earlier time diary studies conducted by the University of Michigan and the University of Maryland. Podgursky and Tongrut (2006) focus on over-reporting by teachers by comparing the CPS and the National Compensation Survey.
7. Even less when the sample is restricted to respondents interviewed during a CPS reference week.
8. Although it is more common to talk of the male–female ratio, Frazis and Stewart (2004) state their finding in terms of the female–male ratio. Presumably by "increase" they mean the wage gap widens—that is, the female–male ratio becomes more negative.

et al. 2011). The CPS is a probability sample of 60,000 households conducted monthly by the Census Bureau for the Bureau of Labor Studies. The ATUS is a diary survey that has been collected for a subsample of individuals included in the CPS since 2003. Specifically, one-eighth of the households selected by the CPS retire permanently from the CPS sample each month and these households become eligible for the ATUS two months later. Respondents are offered $40 for participating and the response rate is approximately 52 percent.[9]

Only one person in each household is surveyed and he or she is only asked about his or her activities over a 24-hour period beginning at 4 a.m. on the day prior to the interview. Respondents are asked what they did and when, along with who they were with and where they were at the time. They can only indicate one activity at a time. Although time-use information is collected only for the survey respondent, CPS data are available for all members of the household.

The ATUS provides survey weights and replicate weights that I use extensively in my analysis. The weights compensate for three important aspects of the data collection process: (1) the ATUS is a stratified random sample that oversamples some demographic groups, (2) the ATUS sample is not uniformly distributed across days of the week (specifically, weekends are oversampled), and (3) the response rates differ across demographic groups and days of the week (ATUS 2012).

I pool ATUS data from 2003 through 2010. I limit the sample to include only respondents who report being employed at the time of their ATUS interview because the variable of interest—whether the respondent is a teacher—is available only for this group.[10] A respondent is designated as a teacher if his or her primary job is coded as either an elementary, middle, high school, or special education teacher.[11] I further limit the sample to include only full-time workers because time use patterns for full- and part-time workers are very different, and comparisons across occupations would be problematic if more (or fewer) teachers work part time than do workers in other occupations. The CPS and the ATUS do not report weekly earnings for persons who are self-employed so these observations (along with any observation missing weekly

9. Research into nonresponse bias does not suggest any particular problems for this study (Abraham, Maitland, and Bianchi 2006). Additionally, I check nonresponse by occupation and find teachers have a relatively high response rate of 66 percent.

10. To be exact, I do not limit the sample in the sense of dropping observations because this would impact the standard error calculations using the replicate weights provided. Instead, I use the *svy subpop* option in STATA to specify the sample I describe in this paragraph.

11. Preschool, kindergarten, postsecondary, and "other" teachers and instructors are not included as teachers. The decision to group middle school teachers with elementary school teachers is entirely based on the occupation categories provided by the CPS and ATUS. This is also why kindergarten teachers are excluded from the category of elementary school teachers.

Table 1. Teachers by Sector and Assignment

	Assignment			
Sector	**Elementary/Middle**	**Secondary**	**Special Education**	**Total**
Public	1,168	503	170	1,841
Private	170	97	21	288
Total	1,338	600	191	2,129

Notes: The sample includes all ATUS respondents with at least a bachelor's degree who are full-time workers and have reported weekly earnings.

earnings for any other reason) are also dropped from the final sample. Lastly, I include only workers with at least a bachelor's degree.[12] I do this because teaching requires a four-year degree and limiting the sample to college-educated workers provides a better comparison group when estimating the wage gap between teachers and other occupations. This decision assumes that people do not decide between not attending college and attending college to pursue teaching but rather that they decide to attend college and subsequently choose an occupation.[13]

There are 2,129 teachers in the final sample and 16,646 nonteachers (teachers constitute 11.3 percent of the observations). Table 1 shows the breakdown of teachers by sector and assignment. Of the 2,129 teachers in the final sample, 1,841 (86.4 percent) work in the public sector. There are roughly twice as many elementary/middle school teachers as there are high school teachers. Special education teachers constitute a small share of the sample. Table 2 shows summary statistics for teachers and nonteachers. Teachers are slightly more likely to be white than nonteachers. More notably, teachers are much more likely to be female than nonteachers and they are twice as likely to have a master's degree than nonteachers, although they are less likely to have a PhD or professional degree. On average, teachers earn $330 (in 2010 USD) per week less than other full-time workers with at least a bachelor's degree.[14] This yields a naive estimate of the "teacher wage gap" of 23 percent—that is, teachers earn 23 percent less than other college-educated workers ($330/$1,406).

12. As a robustness check, I also produced results that exclude workers with PhDs. This did not impact the findings and these results are available upon request.
13. From a policy perspective, this is in keeping with discussions about how to best recruit high-aptitude college students to teaching. Programs like Teach For America or The New Teacher Project aim to take top college graduates and entice them to join the teaching ranks. It is generally assumed that quality teachers are currently not in the teaching pool because they are engaged in other occupations that require a bachelor's degree, not because they lack a bachelor's degree.
14. All wages are adjusted for inflation using the Consumer Price Index, base year 2010.

Table 2. Summary Statistics

	Teachers ***N* = 2,129**	**Nonteachers** ***N* = 16,646**	
Variable	Mean (SD)	Mean (SD)	Difference
Age, Years	42.2 (10.7)	42.3 (10.6)	−0.1
Female	0.77	0.45	0.32***
White	0.89	0.82	0.07***
Master's Degree	0.48	0.24	0.24***
PhD Degree	0.01	0.05	−0.04***
Professional Degree	0.02	0.05	−0.03***
Weekly Earnings	$1,076 (483)	$1,406 (706)	−330***

Notes: Sample includes ATUS respondents with at least a bachelor's degree who are full-time workers with reported weekly earnings. Teachers include elementary, middle, high school, and special education teachers. Weekly earnings are in 2010 dollars.
***Significant at the 1% level.

Of course, this does not control for demographic characteristics and, as just noted, teachers are different from other college-educated workers in a number of ways. In the Results section I present wage regressions that control for the demographic variables listed in table 2.

When studying teachers, one must be particularly concerned about the summer months. Data for people who are employed but currently absent from work for reasons such as vacation days, illness, and maternity leave are included in the final sample. Teachers who are employed but not at work during summer months should be counted as employed and on vacation. It is possible that during the summer some teachers report being unemployed (and thus are not in the final sample) or they are categorized into another occupation during the summer months (and thus are in the final sample but categorized as nonteachers). For example, a teacher who is a waitress during the summer will be categorized as a waitress rather than a teacher.

Figure 1 shows the weighted share of teachers by month. The weighted share approximates the share of teachers in the total population. The fact that the share of teachers falls during the summer (particularly in July) could be evidence that teachers are missing or miscategorized during the summer. Alternatively, it may be there are fewer teachers during the summer because all job transitions in education happen in the summer. Unlike other occupations where retirements, layoffs, and hiring take place across the calendar year, teachers generally retire, are laid off, or are hired only when classes are not in session. If retirements and layoffs happen early in the summer and hiring takes place later in the summer, this would create a drop in the share of

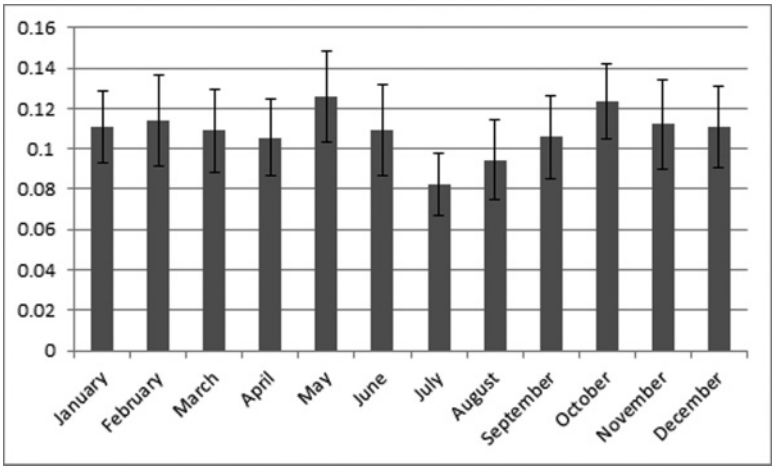

Figure 1. Share of ATUS Respondents Who Are Teachers, by Month. *Notes:* Each bar shows the weighted share of respondents in the ATUS who are teachers by the month of the respondent's ATUS interview. The weights approximate the share of the population who are teachers.

teachers in July. I assume that each of these explanations contributes to the drop in the share of teachers in the summer to some extent.[15]

It seems safe to assume that teachers who are working a different job during the summer or are laid off and hoping to be rehired will not devote any more hours to teaching than teachers who are continuously categorized as such. Thus, my calculations of the average hours devoted to teaching during the summer months will be an upper bound of the true number of hours devoted to teaching during the summer months.

Finally, it is important to note that teachers' work during the summer months of June, July, and August is an average of at least three different activities. First, some teachers are working full time either because they teach in year-round districts or because these months include some full weeks of work because most districts' school year stretches into early June and starts again in late August. Second, teachers may be lesson-planning or attending professional development classes. Third, they may be teaching summer school.[16]

15. I attempt to estimate the relative importance of these explanations using teacher turnover data from other sources. The average number of teachers in the ATUS drops 23 percent in the summer. Keigher (2010) uses data from the SASS and finds that 9 percent of teachers exited the profession in 2008. Harris and Adams (2007) find a similar turnover rate using CPS data. Additionally, Keigher (2010) reports that 7 percent of teachers switched jobs within teaching; therefore, approximately 16 percent of teachers are potentially not counted as teachers during the summer due to normal turnover and job transition rates. This suggests that normal turnover rates account for as much as two-thirds of the dip observed in figure 1.
16. For the main analysis, hours of work are limited to work on the respondent's main job, so if a teacher considers summer school a second job, this would not be included. It is not common, however, for teachers to list a second job that is also a teaching job. Additionally, the way the survey

4. RESULTS

Average Hours of Work by Occupation

Because the ATUS collects diary data for a single day, it is impossible to calculate the hours worked over an entire week for any one individual. Instead, I calculate a weighted average of market work across all days of the week for all respondents within an occupational category to create synthetic average work weeks by occupation.[17]

I call this measure "diary hours of work" to distinguish it from the "usual hours of work" or "hours of work last week" variables reported in the CPS. I define weekly diary hours of work, $DHrs_o$, for occupation o as:

$$DHrs_o = \frac{\sum_i^N [(DHrs_{io} * 7)(w_i)]}{N} \quad (1)$$

where $DHrs_{io}$ is hours of work on the respondent's main job reported in the time diary for the N respondents in occupation o.[18] When comparisons between teachers and nonteachers are made, the occupation "teachers" includes elementary, middle, secondary, and special education teachers and "nonteachers" includes all other respondents. In all other instances, I use detailed occupation codes provided by the ATUS. I use weights for each respondent provided by the ATUS, w_i, so that $DHrs_o$ is adjusted for the sampling scheme. Most importantly, these weights adjust for the fact that weekends are oversampled. I calculate standard errors and confidence intervals using replicate weights provided by the ATUS.

The ATUS data include a variety of activities that relate to respondents' work life. I primarily define hours of work using only time coded as "work, main job" (ATUS time use code 050101). The first column of table 3 reports this result. Table 3 also reports results for a more inclusive definition of hours of work that includes "working" (050100–050199) and "work-related activities" (050200–050299).[19] Using the more restrictive definition of work, teachers work 34.5 (SE = 0.7) hours per week annually and nonteachers work 39.8 (SE = 0.3) hours per week annually. Using the more inclusive definition of work, teachers work an average of 36.3 (SE = 0.8) hours per week annually compared to 41.0 (SE = 0.3) hours per week annually for nonteachers.

Not surprisingly, teachers' diary hours of work per week vary across the calendar year. The second panel of table 3 shows hours of work for the school year (all months with the exception of June, July, and August). Teachers work

is worded focuses on what the respondent is *currently* doing so it is unlikely that summer school would be categorized as secondary to a respondent's school-year job unless they were to overlap.

17. This methodology is similar to Robinson and Bostrom (1994) and others who use time diaries to compare time use by demographic characteristics.
18. To be exact, the ATUS reports hours of work in minutes but I divide by 60 and present results in hours.
19. This does not include travel related to work.

Table 3. Weekly Hours of Work, Various Definitions and Measures

	Diary Hours Restrictive	Diary Hours Inclusive	Usual Hours ATUS	Usual Hours CPS	Hours Last Week CPS
Full Sample					
Nonteachers	39.8 (0.3)	41.0 (0.3)	44.7 (0.1)	43.1 (0.1)	42.4 (0.1)
Teachers	34.5 (0.7)	36.3 (0.8)	44.7 (0.2)	42.5 (0.2)	40.4 (0.3)
School Year					
Nonteachers	40.4 (0.3)	41.5 (0.3)	44.7 (0.1)	43.2 (0.1)	42.6 (0.1)
Teachers	38.0 (0.8)	39.8 (0.9)	45.0 (0.3)	42.8 (0.2)	41.7 (0.4)
June, July, August					
Nonteachers	38.1 (0.6)	39.4 (0.6)	44.4 (0.1)	42.9 (0.1)	41.7 (0.2)
Teachers	21.5 (1.7)	23.2 (1.7)	43.6 (0.3)	41.6 (0.5)	33.3 (1.2)

Notes: Mean (SE) for various measures of hours of work. Diary hours are calculated using equation 1. Usual hours and hours of work last week are occupational averages. Teachers include elementary, middle, high school, and special education teachers. Nonteachers include all other occupations. Standard errors are calculated using the replicate weights provided by the ATUS. The sample includes all ATUS respondents with at least a bachelor's degree who are full-time workers and have reported weekly earnings. School year includes all months other than June, July, and August. Interview month is based on the relevant survey for each column.

an average of 38.0 (SE = 0.8) hours per week during the school year. Nonteachers also work slightly more hours during these months, averaging 40.4 (SE = 0.3) hours per week. During the summer, teachers average 21.5 (SE = 1.7) hours per week and nonteachers average 38.1 (SE = 0.6) hours per week.[20]

Figure 2 shows teachers' diary hours of work for each calendar month. In the top panel I compare teachers and nonteachers, in the bottom panel I distinguish between secondary and elementary/middle school teachers. The dip in teachers' hours of work over the summer is evident, as is the fact that secondary teachers are more likely to work during the summer. This is likely because more secondary students attend summer school (Morisi 2010; Smith 2011).

Table 4 presents results by demographic characteristics and teaching assignment. In addition, figure 3 visually summarizes the differences in diary hours of work by demographic characteristics. For each demographic subgroup, nonteachers' hours of work exceeds teachers' hours of work. Demographic differences are potentially very important because teachers are demographically dissimilar from nonteachers. In particular, they are much more likely to be female than non-teachers. To investigate the importance of

20. The school year generally ends in mid-June and begins in mid-August so summer hours are an average of some full work weeks and some vacation weeks. Also, some teachers work summer school and almost all teachers spend at least some time engaged in planning and professional development activities during the summer months. Recall that the estimate of summer hours is likely an upper bound because there may be teachers who are missing or miscategorized during the summer and I assume these teachers spend no more time on activities related to teaching than their peers who are continuously categorized as teachers.

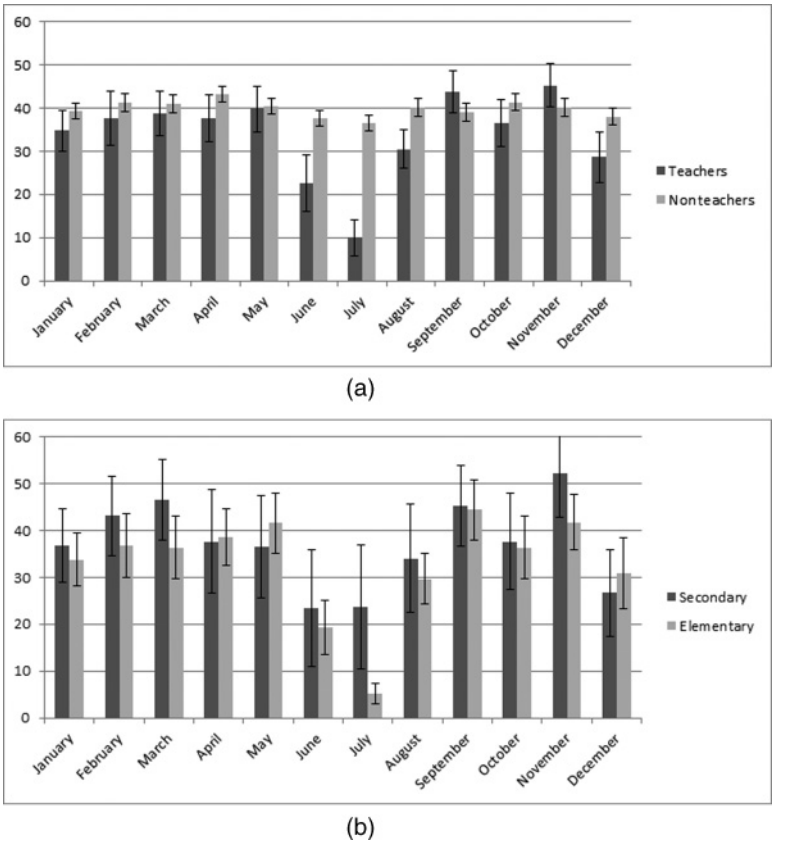

Figure 2. Weekly Diary Hours of Work, by Month. *Notes:* Each bar shows the diary hours of work per week (on the respondent's main job). The first panel shows hours for teachers and nonteachers by the month of their ATUS interview. The second panel shows hours for secondary teachers and elementary/middle school teachers by the month of their ATUS interview. Diary hours are calculated using equation 1. Confidence intervals are calculated using the replicate weights provided by the ATUS. The sample includes all ATUS respondents with at least a bachelor's degree who are full-time workers and have reported weekly earnings.

demographic characteristics, table 5 reports results from ordinary least squares estimates of equation 2

$$DHrs_i = \alpha + \beta' X_i + \gamma Teacher_i + Day_i + \epsilon_i. \quad (2)$$

Respondents are indexed by *i; X* is a set of demographic and geographic characteristics; *Teacher* is an indicator for elementary/middle, secondary, or special education teachers; and *Day* is a set of variables that describe the ATUS diary day.[21] Results are presented in table 5 for three different sets of *X*. The

21. Specifically, I control for the day of the week, month, and year, as well as whether the ATUS interview was conducted on a holiday. Holidays include New Year's Day, Easter, Memorial Day, Independence Day, Thanksgiving, and Christmas. The coefficients on the variables in *Day* are omitted from the table to save space but all are as expected—people work fewer hours on Saturdays, Sundays,

Table 4. Weekly Diary Hours of Work, by Subgroups

	Nonteachers	All Teachers	Secondary Teachers	Elem/Middle Teachers
	N = 16,646	*N* = 2,129	*N* = 600	*N* = 1,338
Full Sample	39.8 (0.3)	34.5 (0.7)	37.6 (1.6)	33.3 (1.0)
Female	37.8 (0.4)	33.9 (0.9)	35.6 (2.2)	33.9 (1.0)
Male	41.3 (0.3)	36.4 (1.7)	39.8 (2.3)	30.4 (2.7)
Age 20–40 Years	39.4 (0.4)	34.0 (1.1)	36.3 (2.1)	34.3 (1.3)
Age 40–60 Years	40.1 (0.4)	35.1 (1.2)	39.5 (2.2)	32.4 (1.5)
White	39.8 (0.3)	34.7 (0.8)	37.3 (1.6)	33.5 (1.1)
Nonwhite	39.8 (0.7)	32.8 (2.4)	36.7 (5.1)	31.7 (3.0)
Bachelor's	39.4 (0.3)	33.8 (1.1)	35.0 (2.3)	33.4 (1.4)
Master's	40.0 (0.6)	35.1 (1.2)	40.7 (2.2)	32.9 (1.4)
Has Kids	38.9 (0.4)	33.8 (1.0)	35.1 (1.9)	33.5 (1.3)
No Kids	40.4 (0.4)	35.1 (1.1)	39.3 (2.2)	33.2 (1.5)
Public Sector	37.3 (0.6)	34.5 (0.8)	37.6 (1.7)	33.5 (1.0)
Private Sector	40.5 (0.3)	34.5 (2.2)	37.8 (3.8)	32.4 (2.7)

Notes: Mean (SE) of diary hours of work calculated using equation 1. Sample includes ATUS respondents with at least a bachelor's degree who are full-time workers with reported weekly earnings. "All teachers" includes elementary, middle, high school, and special education teachers. "Nonteachers" includes all other occupations. The *N* counts refer to the full sample, there are fewer observations in each subgroup (i.e., 77% of teachers are female so there are 1,640 female teachers [2,219 × 0.77]).

first column shows results with no demographic controls. In this specification, teachers work an average of 5.37 (SE = 0.7) hours per week less than nonteachers. This drops to 4.31 (SE = 0.7) hours per week in the second column when gender is controlled for and 3.94 (SE = 0.7) hours per week in the third column when a full set of demographic and geographic controls is included.[22]

Secondary school teachers differ from elementary/middle and special education teachers in their work patterns, as well as their demographic makeup. Thus the final three columns of table 5 repeat the analysis, breaking *Teacher* into the three different teaching assignments. In each specification, secondary school teachers are much closer to nonteachers (the omitted group). When a

Mondays, Fridays, and holidays. The coefficients on the indicators for year are not statistically different from zero. One might worry that the years included, 2003–10, include the recent Great Recession and this could impact hours worked systematically. To this point, it is reassuring that none of the coefficients on the indicators for interview year are statistically significant. To further investigate this concern, I also tested a single indicator for 2008–2010 as well as an interaction between that indicator and *Teacher*, neither of which was statistically significant. Lastly, I include figure 4, which shows $DHrs_0$ for teachers and nonteachers by year and does not reveal any time trends.

22. The full set of controls includes gender, age (and age squared), indicators for degrees beyond a bachelor's, and indicators for race, multiple jobs, own children in the house, metro area, state, and census region (coefficients for state and region are omitted from the table to save space).

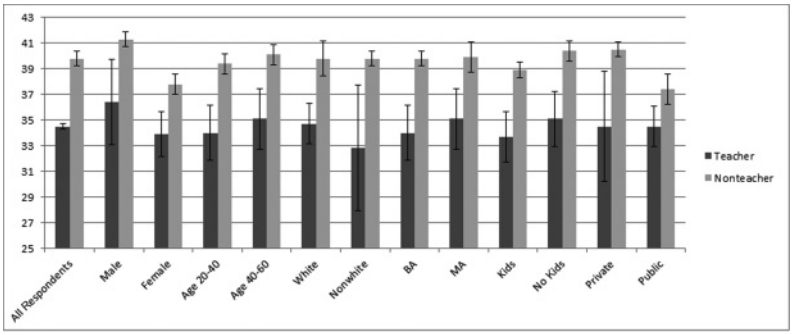

Figure 3. Weekly Diary Hours of Work, by Subgroups. *Notes:* Each bar shows the diary hours of work per week (on the respondent's main job) for teachers and nonteachers for various demographic groups. Diary hours are calculated using equation 1. Confidence intervals are calculated using the replicate weights provided by the ATUS. The sample includes all ATUS respondents with at least a bachelor's degree who are full-time workers and have reported weekly earnings.

full set of demographic and geographic controls is included, I find that secondary school teachers work an average of 2.33 ($SE = 1.3$) hours per week less than nonteachers and elementary/middle school and special education teachers work an average of 4.43 ($SE = 0.9$) and 5.93 ($SE = 2.2$) hours per week less than nonteachers, respectively.

Over-reporting

Recall that all ATUS respondents are also CPS respondents and CPS respondents are asked about both their usual hours of work per week and their hours of work last week.[23] ATUS respondents are asked about their usual hours of work again at the time of their ATUS interview. Figure 5 shows the distribution of usual hours and hours of work last week for teachers and nonteachers.[24] The modal response for questions about usual hours and hours of work last week is 40 hours per week for both teachers and nonteachers. The most noteworthy point made by this figure is how incredibly similar teachers and nonteachers are in their self-reported hours of work.[25]

23. These questions were revised in 1994. Prior to 1994, respondents were only asked about their work last week and the CPS attempted to correct for time off and overtime to figure out a usual work week.
24. For this figure I use the responses from the final CPS interview because the "hours of work last week" question is not asked as part of the ATUS. A few respondents switch between teacher and nonteacher but otherwise the sample is identical to the one described in the data section.
25. For usual hours of work, respondents can report that their hours vary. CPS documentation indicates that if the respondent asks for a definition of "usual," interviewers are instructed to define the term as more than half the weeks worked during the past four or five months. Interestingly, despite the fact that teachers' work weeks look very different in the summer than during the school year, teachers are *less* likely than others to report that their hours vary: 4 percent of teachers report that their hours vary compared with 5 percent of nonteachers. This is calculated from responses in the final CPS interview and the difference is statistically significant at the 1 percent level. When asked about their usual hours of work per week in the ATUS, only 2.5 percent of teachers report that their

Table 5. The Teacher Hours Gap: Results for Diary Hours of Work

	(1)	(2)	(3)	(4)	(5)	(6)
Teacher	−5.373***	−4.314***	−3.942***			
	(0.705)	(0.721)	(0.741)			
Elem/Middle				−6.152***	−4.826***	−4.426***
				(0.838)	(0.873)	(0.891)
Secondary				−3.088**	−2.759**	−2.331*
				(1.322)	(1.307)	(1.306)
Special Ed				−7.312***	−5.959***	−5.930***
				(2.272)	(2.231)	(2.21)
Female		−3.395***	−3.458***		−3.329***	−3.390***
		(0.4)	(0.4)		(0.402)	(0.403)
Age			0.14			0.146
			(0.142)			(0.142)
Age^2			−0.002			−0.002
			(0.002)			(0.002)
Master's			0.687			0.69
			(0.564)			(0.56)
PhD			3.268***			3.277***
			(1.148)			(1.15)
Professional			2.630**			2.607**
			(1.234)			(1.233)
White			−0.333			−0.337
			(0.622)			(0.623)
Mult Jobs			−1.897**			−1.916**
			(0.759)			(0.76)
Has Kids			−1.973***			−1.975***
			(0.463)			(0.464)
Metro			0.736			0.747
			(0.775)			(0.775)
Month	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
State	No	No	Yes	No	No	Yes
Region	No	No	Yes	No	No	Yes
Obs.	18,775	18,775	18,775	18,775	18,775	18,775
R^2	0.449	0.452	0.458	0.45	0.453	0.458

Notes: Dependent variable is diary hours of work. Each observation is weighted using the weights provided by the ATUS and standard errors are calculated with successive difference replication (SDR) variance estimation using the replicate weights provided by the ATUS. Sample includes ATUS respondents with at least a bachelor's degree who are full-time workers with reported weekly earnings. *Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

hours vary and only 2.7 percent of nonteachers report that their hours vary. This difference is not statistically significant.

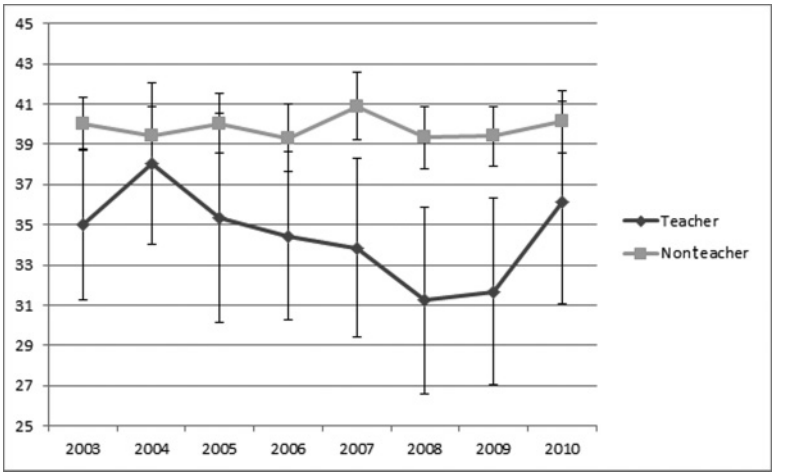

Figure 4. Weekly Diary Hours of Work, by Year. *Notes:* This figure shows diary hours of work per week (on the respondent's main job) for teachers and nonteachers disaggregated by year of the respondents ATUS interview. Diary hours are calculated using equation 1. The sample includes all ATUS respondents with at least a bachelor's degree who are full-time workers and have reported weekly earnings.

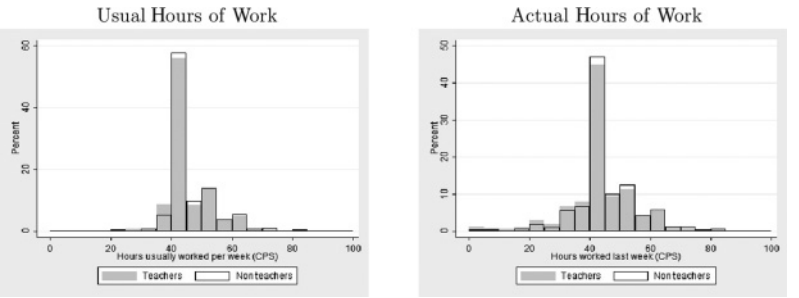

Figure 5. Self Reported Hours of Work, Teachers and Nonteachers. *Notes:* This figure shows the distribution of responses to the questions about respondents' usual hours of work per week and hours of work last week. Data for both are from the final CPS interview. The sample includes all ATUS respondents with at least a bachelor's degree who are full-time workers and have reported weekly earnings. Additionally, respondents who changed occupations between the time of their final CPS interview and their ATUS interview are excluded. Teachers include elementary, middle, high school, and special education teachers. Nonteachers include all other occupations.

The third and fourth columns of table 3 report the average "usual hours of work" for teachers and nonteachers. The final column reports the average "hours of work last week" for teachers and nonteachers. For both teachers and nonteachers, responses for usual hours of work exceed responses for hours of work last week, which in turn exceed estimates of diary hours. Specifically, usual hours and hours last week appear to be overestimates of work when compared with the more restrictive diary measure that includes only time spent working on the respondent's main job. When the more inclusive definition

of work—one that includes other work related activities—is used, the self-reported data appear slightly more accurate.

The average over-report across all full-time workers with at least a bachelor's degree is about five hours per week when comparing usual hours of work in the ATUS with time diary hours and about two and a half hours per week when comparing hours of work last week in the CPS with time diary hours. These magnitudes are larger than those found by Frazis and Stewart (2004). They find that among all workers, the average over-reporting for usual hours of work is three hours per week and the average over-reporting for hours of work last week is one hour per week. They also report that education is positively related to over-reporting, however, which may explain why my sample of only college-educated workers shows more pronounced over-reporting.[26]

The key point made by table 3 is that teachers differ very little from non-teachers in their self-reported hours of work but they differ considerably in their diary hours of work. Both teachers and nonteachers report usual hours of work in excess of 40 hours per week (even during the summer months). When asked about their hours of work last week, teachers report an average of 41.7 (SE = 0.4) hours per week during the school year and 33.3 (SE = 1.2) hours per week during the summer. These estimates are 3.7 and 11.8 hours more than their diary hours, respectively. Nonteachers report hours of work last week that average 42.6 (SE = 0.1) during the school year and 41.7 (SE = 0.2) during the summer. These are only 2.2 and 3.6 hours more than their diary hours, respectively.[27]

In what follows, I define over-reporting OR_o in occupation o as:

$$OR_o = \frac{\sum_{i=1}^{N}[UHrs_{io} - (DHrs_{io} * 7)](w_i)}{N} \tag{3}$$

where $UHrs_{io}$ is the usual hours of work reported by the N respondents in occupation o. For this analysis, teachers are split into secondary, elementary/

26. In support of this assertion, when I calculate over-reporting for all workers with at least a high school diploma, I find that usual hours are 4.4 hours per week larger than diary hours, and hours of work last week are 2.1 hours per week larger than diary hours. This sample is still more educated than the full population because it excludes workers with less than a high school diploma and part-time workers. It is likely that the fact that education is positively associated with over-reporting is driven by the fact that more education is positively associated with being a salaried employee rather than an hourly employee and salaried workers are more likely to over-report than hourly workers. It is also likely that because I did not limit the sample to respondents interviewed on a reference week that I am slightly overestimating the discrepancy between hours of work last week and diary hours.

27. Frazis and Stewart (2004) argue that diary hours and hours of work last week are much closer when the sample is limited to ATUS respondents who are interviewed on a CPS reference week. I replicate this analysis, although the sample size is much reduced (there are only 411 teachers interviewed on a CPS reference week) so I prefer the estimates presented here. Restricting the sample does not change the main result, namely, that teachers are more likely to overestimate their hours of work than are nonteachers.

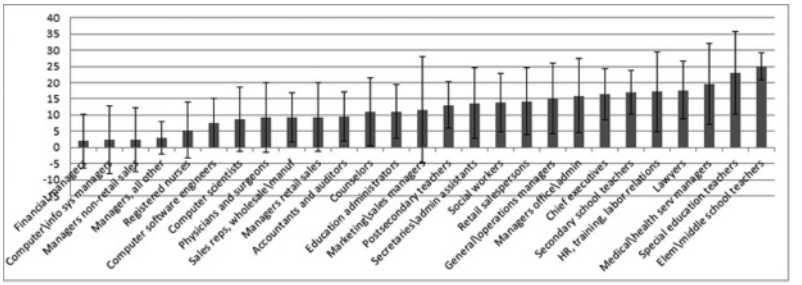

Figure 6. Over-reporting of Usual Hours of Work, by Occupation. *Notes:* Each bar shows over-reporting from equation 4; confidence intervals are calculated using replicate weights provided by the ATUS. The occupations included are the most common in the final sample.

middle, and special education. As before, $DHrs_{io}$ is the diary hours for each respondent and w_i are weights provided by the ATUS. I focus on usual hours of work rather than hours of work last week because usual hours are re-asked at the time of the ATUS interview. Unfortunately, hours of work last week is only asked at the time of the final CPS interview and this is separated from the ATUS interview by two to four months.[28]

It is more interesting to look at over-reporting as a percent of total hours so next I modify the definition of over-reporting to:

$$ORpercent_o = \frac{\sum_{i=1}^{N}\left[\frac{UHrs_{io}-(DHrs_{io}*7)}{UHrs_{io}}(w_i)\right]}{N} * 100. \quad (4)$$

Figure 6 shows $ORpercent_o$ by occupation. The occupations shown are the most common in the final sample, that is, they are common occupations for full-time workers with at least a bachelor's degree.[29] Over-reporting is quite common, although teachers over-report their usual hours of work more dramatically. Secondary, elementary/middle, and special education teachers over-report their usual hours of work in the ATUS by 17 percent ($SE = 3$), 25 percent ($SE = 2$), and 23 percent ($SE = 6$), respectively. The average across all teachers is 22 percent ($SE = 1.6$), whereas the average across all other occupations is 10 percent ($SE = 0.6$).

In sum, teachers are more likely than others to over-report their usual hours of work and hours of work last week. It is unlikely that teachers are, on average, more dishonest or forgetful than other workers. Instead, I suspect that teachers have a more difficult time answering questions about their usual hours of work because their work weeks vary across the calendar year. For

28. I attempted to match ATUS weeks and CPS reference weeks so that I could compare teachers who were interviewed at the same point in time (rather than the sample respondent interviewed at different points in time). As noted in the previous footnote, however, the sample was severely impacted.
29. Each occupation has at least 190 respondents in the final sample.

instance, if a teacher is asked in November about her usual hours of work, she likely thinks about her usual hours of work for the last month or so rather than rolling her summer hours into the calculation. For hours of work last week, the CPS practice of choosing a reference week to avoid holidays may make it more likely that teachers are interviewed for the CPS after a full week of work whereas their ATUS interview falls on a week with time off. If teachers have more time off than other workers, this would bias the hours of work last week variable without any malfeasance on the part of teachers.

5. IMPLICATIONS FOR WAGE CALCULATIONS

This analysis has important implications for researchers and policy makers interested in wage comparisons. Consider a researcher using CPS data to compare wages across occupations. The CPS reports weekly earnings $Earn_i$ for each worker i. Most researchers will use this and the usual hours of work variable or hours of work last week to calculate an hourly wage, $Wage_i$, according to the simple formula:

$$Wage_i = \frac{Earn_i}{Hrs_i}. \tag{5}$$

I have shown that over-reporting of hours of work is systematically biased by occupation and that the usual hours of work variable is particularly problematic for workers, such as teachers, whose hours vary throughout the calendar year. If the weekly earnings data for teachers (and other workers with uneven schedules) already accounts for the variable hours, however, equation 5 will yield an accurate hourly wage. For example, consider a hypothetical worker who works 40 hours/week *every other week* for 52 weeks and earns $52,000. If he reports that he usually works 40 hours/week and earns $1,000 weekly his hourly wage will be $25/hour, half what it should be. If, on the other hand, he reports that he usually works 40 hours but adjusts his weekly earnings to $500, then the hourly wage will accurately reflect $50/hour. If teachers do the mental arithmetic needed to adjust their weekly earnings to account for variable hours, or if the CPS makes this adjustment to the data after the interview, then the over-reporting of usual hours of work is of little concern to labor economists interested in calculating an hourly wage. I show, however, that the weekly earnings data does not properly account for teachers' variable work hours and thus equation 5 is measured with error.

CPS respondents are asked to report earnings in the time period they prefer, for example, hourly, weekly, biweekly, monthly, or annually. Over 70 percent of teachers elect to report annual earnings. Allowing respondents to report in a periodicity with which they were most comfortable was added to the CPS in 1994. This improved on the previous procedure which only gave respondents the option to report hourly wages or weekly earnings and was

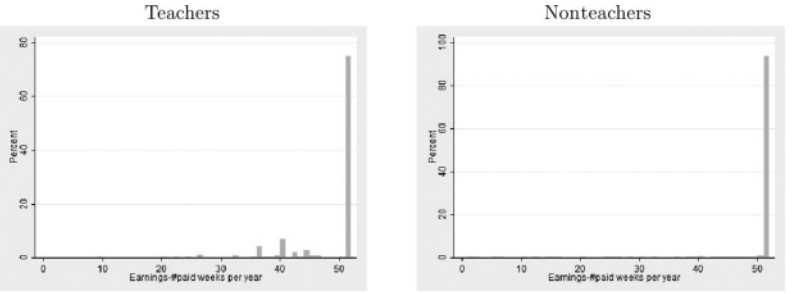

Figure 7. Weeks Worked. *Notes:* This figure shows the distribution of responses to the question about how many weeks the respondent worked. This question is only asked of respondents who report earnings annually. The ATUS extract builder that I used to obtain ATUS data does not include the number of weeks worked data so this figure is based on data from the 2010 CPS which I downloaded separately for this analysis. The sample includes all full-time college-educated workers in the January 2010 CPS. Teachers include elementary, middle, high school, and special education teachers. Nonteachers include all other occupations.

introduced to give the CPS a better chance at calculating accurate weekly earnings since they do not rely on respondents to do the necessary mental arithmetic. Despite this improvement, I show that problems remain.

Respondents who elect to report annual earnings are then asked how many weeks they worked for this salary. Using this information, the CPS converts the annual salaries into weekly earnings. Looking at the final earnings per week variable reported in the CPS, I find that teachers who report weekly earnings average $1,036.3 (in 2010 USD) per week and teachers who report annual salaries average $1,131.6 (in 2010 USD) per week.[30] It is unclear in either case, however, whether this refers to weekly earnings for the school year or weekly earnings for the entire calendar year. That is, are teachers and/or the CPS accounting for summers off? I find evidence that they are not.

Figure 7 shows the distribution of responses for the number of weeks worked for teachers and nonteachers who report annual earnings.[31] The modal response for both teachers and nonteachers is 52 weeks. This indicates that most teachers view summers as time working. A minority of teachers report between 36 and 44 weeks. These responses more accurately reflect the school year. One reason most teachers report working 52 weeks may be that most teachers are given the option to receive their pay spread over the school year or the calendar year and anecdotal evidence suggests the majority choose the

30. These are statistically identical, $Prob(>t) = 0.9180$.

31. The ATUS extract builder that I used to obtain ATUS data does not include the number of weeks worked variable so these figures are based on data from the 2010 CPS, which I downloaded separately for this analysis. The sample includes all full-time, college-educated workers in the January 2010 CPS.

latter.[32] I suspect most teachers are reporting weeks paid rather than weeks worked. A simple back of the envelope calculation supports this assertion. The average salary for teachers in 2009–10 was $55,350 (National Center for Education Statistics) which is 53 weeks at $1,036.6 per week and 49 weeks at $1,131.6 per week.

Because the vast majority of teachers report working 52 weeks, if researchers calculate a wage using equation 5, they are implicitly (and erroneously) assuming that hours per week are consistent across all weeks during the calendar year. Instead of using equation 5 to calculate hourly wages, I use:

$$Wage_i = \frac{Earn_i}{DHrs_o} \tag{6}$$

where $Earn_i$ is the CPS weekly earnings variable adjusted to account for inflation using the Consumer Price Index and base year 2010. $DHrs_o$ is the time diary measures of hours of work described in equation 1 for occupation o. This replaces the individual's estimate of his or her hours of work with the estimate I obtain using the ATUS time diaries for all workers within a given occupation.[33]

Figure 8 compares the distribution of hourly wages calculated using diary hours and usual or actual hours of work for all full-time college-educated workers. The distributions are not that different. The mean hourly wage is slightly higher when calculated using diary hours of work. This reflects the fact that almost all workers over-report their hours of work. In the next section I show that, although the overall distribution of hourly wages is not dramatically impacted by substituting $DHrs_o$ for Hrs_i, systematic biases by occupation make this adjustment very important when calculating the teacher wage gap. To preview this result, figure 9 shows the same distributions for teachers. Notice that the shift in the distribution is much more evident for teachers.

6. THE TEACHER WAGE GAP REVISITED

I estimate a simple Mincer style wage equation controlling for a vector of demographic and geographic variables, X_i. The demographic variables are a quadratic in age, additional education beyond a bachelor's degree (a set of

32. This may surprise some economists because spreading pay over the calendar year delays receipt of the final pay checks and thus decreases the net present value of the salary. Teachers may receive a benefit from spreading pay over the summer because they do not have to plan for uneven cash flows. Choosing to spread pay over the calendar year is rational if this benefit outweighs the small loss of potential interest income.

33. As previously noted, this includes zero hours during the summer for many teachers but positive hours during the summer if the teachers are working summer school or engaged in planning and so on.

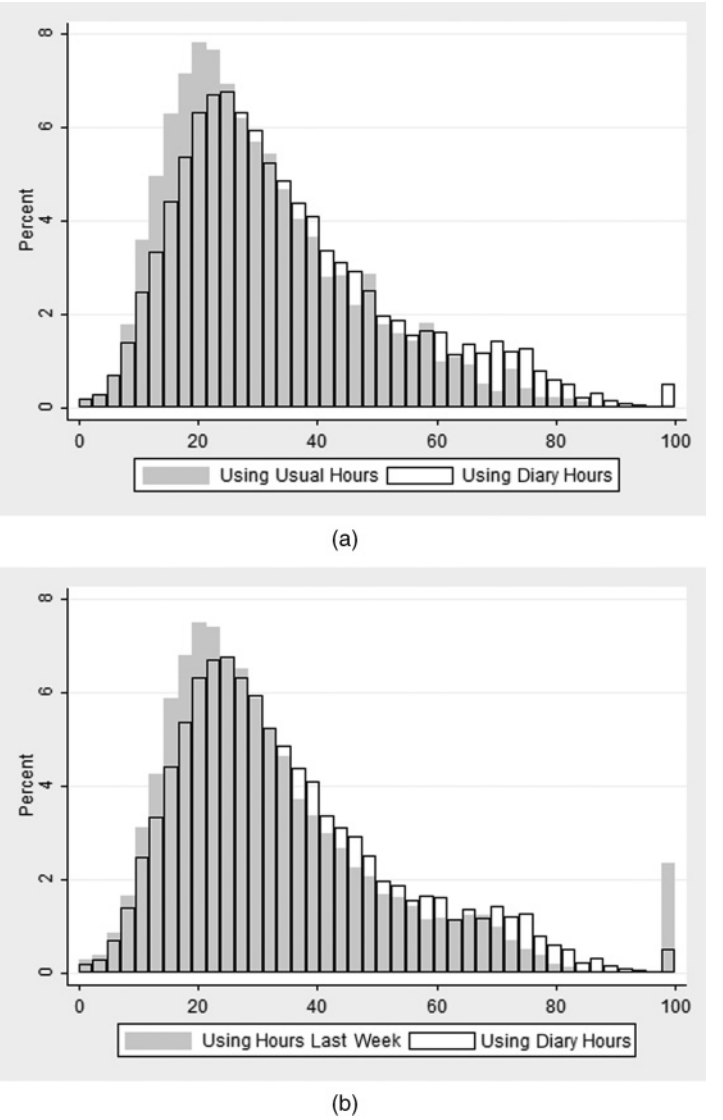

Figure 8. Hourly Wages, Comparing Usual Hours, and Hours Last Week to Diary Hours. *Notes:* This figure compares the distribution of hourly wages calculated using usual hours of work and hours of work last week to hourly wages calculated using diary hours of work for all full-time workers with at least a bachelor's degree and reported weekly earnings. I top code wages at $100/hour.

indicator variables for master's, PhD, and professional degrees), and indicators for white and female.[34] The geographic variables are state and census-region indicators. I include an indicator variable, $Teacher_i$, to calculate the teacher

34. The omitted category is nonwhite males with no more than a bachelor's degree.

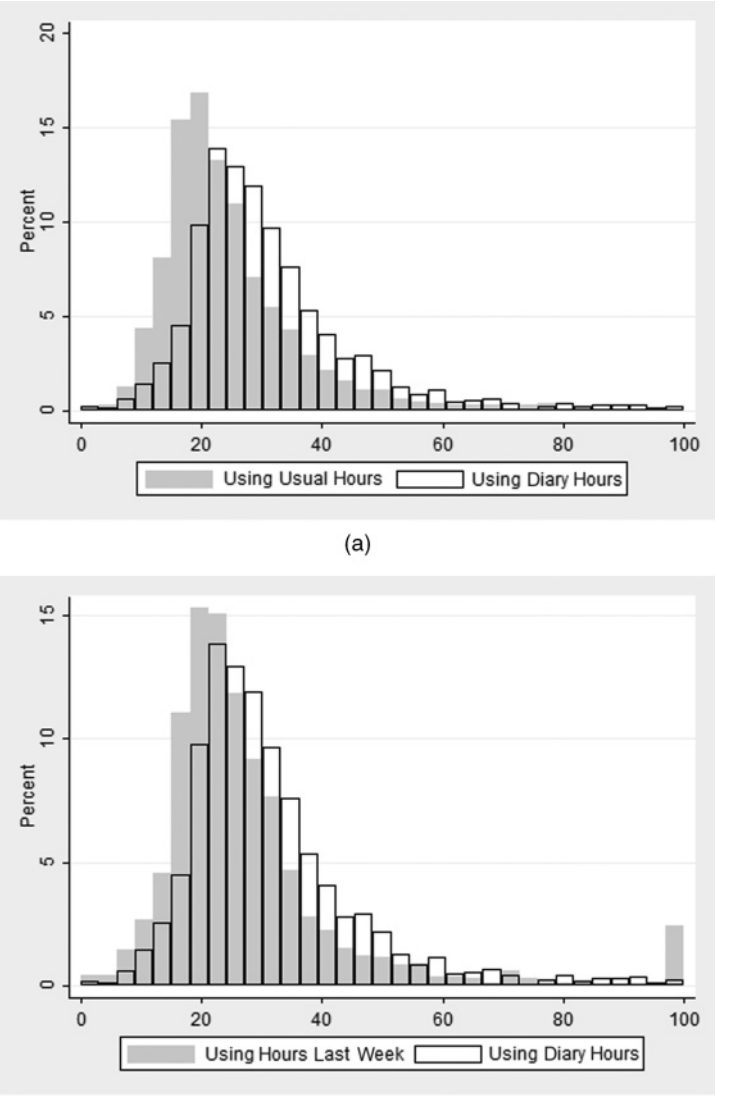

Figure 9. Hourly Wages, Comparing Teachers' Usual Hours and Hours Last Week with Diary Hours. *Notes:* This figure compares the distribution of hourly wages for teachers calculated using usual hours of work and hours of work last week to hourly wages calculated using diary hours of work for all full-time workers with at least a bachelor's degree and reported weekly earnings who are categorized as teachers at the time of their ATUS interview. I top code wages at $100/hour.

wage gap, which equals 1 if the respondent is an elementary/middle, secondary, or special education teacher:

$$\ln(Wage_i) = \alpha + \beta' X_i + \gamma Teacher_i + \epsilon_i. \quad (7)$$

The coefficient of interest is γ, the difference in wages between teachers and other demographically similar workers. The semilogarithmic nature of equation 7 necessitates a transformation of γ in order to discuss the difference between teachers' wages and nonteachers' wages in percentage terms, that is, the teacher wage gap. Specifically, in the text I transform the results using equation 8:

$$Teacher\ Wage\ Gap = e^{\gamma} - 1. \tag{8}$$

I compare estimates of the teacher wage gap when $Wage_i$ is calculated using usual hours of work or hours of work last week to estimates of the teacher wage gap when $Wage_i$ is calculated using diary hours of work. Each observation is weighted using the weights provided by the ATUS and standard errors are calculated using the replicate weights provided by the ATUS.

Results are presented in columns (1), (2), and (3) of table 6. I find that when I use usual hours of work to calculate hourly wages, the teacher wage gap is 13.0 pecent (SE = 1.6), that is, teachers earn 13.0 percent less than demographically similar workers in other occupations. When hours of work last week are used, this drops to 7.1 percent (SE = 1.6). When I use diary hours of work to calculate hourly wages I do not find a significant difference between teachers and nonteachers. That is, the teacher wage gap disappears.

I also report the teacher wage gap separately for elementary/middle school, secondary school, and special education teachers, in columns (4), (5), and (6). I do this because secondary school teachers are less likely to over-report their usual hours of work than are elementary/middle school or special education teachers. From a policy perspective, differentiating between secondary school, elementary/middle school, and special education teachers is important because the license and training requirements differ for these groups, and the alternative labor market opportunities differ because most secondary school teachers have subject-specific training that is more applicable to other sectors. When I use diary hours of work to calculate hourly wages, secondary school teachers earn an hourly wage that is 13.6 percent (SE = 2.3) less than demographically similar workers. Elementary/middle school and special education teachers, on the other hand, do not earn hourly wages that are less than demographically similar workers. In fact, elementary/middle school and special education teachers appear to earn higher hourly wages than demographically similar workers.[35]

35. Special education teachers often need advanced certification which may not be captured by the educational controls included in this model. As an additional robustness test, I treat all special education teachers as if they have a master's degree. In this specification, the statistically significant coefficient on special education disappears.

Table 6. The Teacher Wage Gap: Results for Hourly Wages Using Usual Hours, Hours Last Week, and Diary Hours of Work—ATUS sample

	(1) Usual	(2) Last Week	(3) Diary	(4) Usual	(5) Last Week	(6) Diary
Teacher	−0.122***	−0.069***	0.016			
	(0.016)	(0.016)	(0.016)			
Elem/Middle				−0.111***	−0.082***	0.065***
				(0.019)	(0.019)	(0.018)
Secondary				−0.188***	−0.081***	−0.128***
				(0.024)	(0.029)	(0.023)
Special Ed				0.008	0.04	0.145***
				(0.036)	(0.053)	(0.039)
Age	0.063***	0.061***	0.068***	0.063***	0.061***	0.067***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)
Age^2	−0.0006***	−0.0006***	−0.0007***	−0.0006***	−0.0006***	−0.0007***
	(0.00005)	(0.00005)	(0.00005)	(0.00005)	(0.00005)	(0.00005)
Master's	0.143***	0.127***	0.165***	0.143***	0.127***	0.165***
	(0.014)	(0.016)	(0.014)	(0.014)	(0.016)	(0.015)
PhD	0.227***	0.24***	0.277***	0.226***	0.239***	0.276***
	(0.027)	(0.029)	(0.027)	(0.027)	(0.029)	(0.027)
Professional	0.321***	0.238***	0.371***	0.321***	0.238***	0.374***
	(0.028)	(0.026)	(0.027)	(0.028)	(0.026)	(0.027)
White	0.054***	0.089***	0.075***	0.054***	0.089***	0.075***
	(0.013)	(0.019)	(0.014)	(0.013)	(0.019)	(0.014)
Female	−0.153***	−0.196***	−0.170***	−0.156***	−0.197***	−0.176***
	(0.011)	(0.013)	(0.012)	(0.011)	(0.013)	(0.012)
Month	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	17,734	17,734	17,734	17,734	17,734	17,734
R^2	0.149	0.118	0.15	0.15	0.119	0.152

Notes: Dependent variable is ln(hourly wage) calculated from equation 5 using usual hours of work or equation 6 using hours of work last week or diary hours of work. Each observation is weighted using the weights provided by the ATUS and standard errors are calculated with successive difference replication (SDR) variance estimation using the replicate weights provided by the ATUS. Sample includes ATUS respondents with at least a bachelor's degree who are full-time workers with reported weekly earnings.
***Significant at the 1% level.

Table 7 applies my estimates of diary hours to all respondents in the CPS outgoing rotations (CPS-ORG) for 2003–10 rather than only those who were selected for and responded to the ATUS. This (much) larger sample (N = 308,538), yields very similar results. It is again that case when using usual hours of work or hours of work last week, teachers appear to be paid less

Table 7. The Teacher Wage Gap: Results for Hourly Wages Using Usual Hours, Hours Last Week, and Diary Hours of Work—CPS-ORG sample

	(1) Usual	(2) Last Week	(3) Diary	(4) Usual	(5) Last Week	(6) Diary
Teacher	−0.100***	−0.077***	0.013***			
	(0.004)	(0.004)	(0.004)			
Elem/Middle				−0.098***	−0.074***	0.048***
				(0.005)	(0.005)	(0.005)
Secondary				−0.113***	−0.089***	−0.073***
				(0.006)	(0.006)	(0.006)
Special Ed				−0.075***	−0.053***	0.055***
				(0.012)	(0.012)	(0.012)
Age	0.064***	0.068***	0.068***	0.064***	0.068***	0.068***
	(0.0008)	(0.0009)	(0.0009)	(0.0008)	(0.0009)	(0.0009)
Age^2	−0.0007***	−0.0007***	−0.0007***	−0.0007***	−0.0007***	−0.0007***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Master's	0.145***	0.156***	0.162***	0.145***	0.156***	0.162***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
PhD	0.22***	0.248***	0.259***	0.22***	0.248***	0.26***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Professional	0.222***	0.231***	0.277***	0.222***	0.231***	0.277***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
White	0.088***	0.111***	0.113***	0.088***	0.112***	0.113***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Female	−0.177***	−0.194***	−0.179***	−0.177***	−0.194***	−0.182***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Month	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	308,538	308,538	308,538	308,538	308,538	308,538
R^2	0.121	0.129	0.121	0.121	0.129	0.121

Notes: Dependent variable is ln(hourly wage) calculated using usual hours of work, hours of work last week, or diary hours of work. Each observation is weighted using the weights provided by the CPS and standard errors are calculated with successive difference replication (SDR) variance estimation using the replicate weights provided by the CPS. Sample includes CPS-ORG respondents with at least a bachelor's degree who are full-time workers with reported weekly earnings.
***Significant at the 1% level.

than demographically similar workers. When diary hours are used, however, teachers' wages are actually 1.3 percent (SE = 0.4) *higher* than wages for demographically similar workers. When I disaggregate teachers into secondary, elementary/middle, and special education, I again find that this result is driven by elementary/middle and special education teachers. The teacher wage gap persists for secondary teachers. In this sample, I find secondary teachers are

paid 7.6 percent ($SE = 0.6$) less than demographically similar workers when hourly wages are calculated using diary hours of work.

Table 8 disaggregates the result into demographic subgroups.[36] The first column reproduces column (3) from table 6 for comparison. The second and third columns limit the sample to female and male respondents, respectively. I find that, on average, female teachers are paid hourly wages that are slightly more than demographically similar females in other occupations, but male teachers are paid 12.5 percent ($SE = 3.1$) less than demographically similar males in other occupations. The fourth and fifth columns limit the sample to respondents whose highest degree is a bachelor's or master's. Teachers whose highest degree is a bachelor's degree earn slightly more than workers whose highest degree is a bachelor's in other occupations, whereas teachers with a master's degree appear to be paid on par with workers with a master's degree in other occupations. Finally, the sixth column disaggregates teachers into public and private sector workers. Here I find that in contrast to public school teachers, private school teachers are paid hourly wages that are 9.4 percent ($SE = 3.6$) less than demographically similar workers in other occupations when hourly wages are calculated using diary hours of work.

Lastly, table 9 reproduces the subgroup analysis for public sector teachers only because their wages are determined by public policy. On average, public sector teachers earn 3.5 percent ($SE = 1.6$) more than demographically similar workers when hourly wages are calculated using diary hours of work. The difference between female and male teachers is more pronounced in this sample. As was the case with the full sample, public sector teachers whose highest degree is a bachelor's are paid slightly more than workers with only a bachelor's degree in other occupations, whereas those with a master's degree are paid wages similar to workers with a master's degree in other occupations. Perhaps most importantly, I again find that secondary school teachers are paid less, in this sample 11.8 percent ($SE = 2.6$) less, than demographically similar workers in other occupations and elementary/middle and special education teachers are paid more than demographically similar workers in other occupations when hourly wages are calculated using diary hours of work.

These subgroup results provide a slightly more nuanced story to complement the main result of this paper. The fact that a wage gap exists for male teachers is likely because male nonteachers are concentrated in higher paying occupations than female nonteachers. It suggests that lower wages for teachers are, at least in part, due to occupational segregation. The results by degree suggest that teaching is a relatively attractive option for recent

36. I calculate $DHrs_0$ separately by subgroup, although the sample size on which the estimates are based falls and more measurement error is introduced. Noting this caveat, I reestimate equation 6 using subgroup specific $DHrs_0$ to calculate $Wage_i$.

Table 8. The Teacher Wage Gap, Results for Hourly Wages Using Diary Hours of Work, by Subgroup

	(1) Full Sample	(2) Female	(3) Male	(4) Bachelor's	(5) Master's	(6) By Sector
Teacher	0.016	0.044**	−0.118***	0.041**	−0.019	
	(0.016)	(0.018)	(0.031)	(0.02)	(0.026)	
Public Teacher						0.033**
						(0.016)
Private Teacher						−0.090**
						(0.035)
Age	0.068***	0.063***	0.071***	0.074***	0.059***	0.067***
	(0.004)	(0.007)	(0.005)	(0.005)	(0.009)	(0.004)
Age^2	−0.0007***	−0.0007***	−0.0007***	−0.0008***	−0.0006***	−0.0007***
	(0.00005)	(0.00008)	(0.00006)	(0.00006)	(0.0001)	(0.00005)
Master's	0.165***	0.211***	0.121***			0.165***
	(0.014)	(0.017)	(0.024)			(0.014)
PhD	0.277***	0.295***	0.254***			0.276***
	(0.027)	(0.055)	(0.028)			(0.027)
Professional	0.371***	0.372***	0.351***			0.373***
	(0.027)	(0.05)	(0.03)			(0.027)
White	0.075***	0.031*	0.101***	0.086***	0.045	0.075***
	(0.014)	(0.018)	(0.023)	(0.017)	(0.028)	(0.014)
Female	−0.170***			−0.192***	−0.113***	−0.174***
	(0.012)			(0.015)	(0.024)	(0.012)
Month	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	17,734	8,721	9,013	11,252	4,758	17,734
R^2	0.15	0.142	0.115	0.127	0.094	0.151

Notes: Dependent variable is ln(hourly wage) calculated from equation 6 using diary hours of work. Each observation is weighted using the weights provided by the ATUS and standard errors are calculated with successive difference replication (SDR) variance estimation using the replicate weights provided by the ATUS. Column (1) replicates the result from table 6 for comparison. Columns (2)–(5) limit the sample to only female, male, highest degree is a bachelor's, highest degree is a master's, respectively. Column (6) repeats column (1) disaggregating teachers into public and private sector workers.
**Significant at the 5% level; ***significant at the 1% level.

graduates with only a bachelor's degree. Most salary schedules are structured with strong incentives for teachers to pursue a master's degree mid-career. For teachers with master's degrees, wages are on par with nonteachers with master's degrees. The fact that a wage gap persists for private school teachers provides evidence that private school wages are below the market wage. Private school wages that are below the market wage may be easily explained, however, by compensating differentials.

Table 9. The Teacher Wage Gap, Results for Hourly Wages Using Diary Hours of Work, by Subgroup—Public Sector Teachers Only

	(1) Full Sample	(2) Female	(3) Male	(4) Bachelor's	(5) Master's	(6) By Assignment
Public Teacher	0.034**	0.157***	−0.224***	0.069***	0.036	
	(0.016)	(0.019)	(0.029)	(0.02)	(0.027)	
Public Elem/Middle						0.085***
						(0.018)
Public Secondary						−0.112***
						(0.026)
Public Special Ed						0.151***
						(0.043)
Age	0.068***	0.063***	0.07***	0.073***	0.06***	0.067***
	(0.004)	(0.007)	(0.005)	(0.005)	(0.009)	(0.004)
Age^2	−0.0007***	−0.0006***	−0.0007***	−0.0008***	−0.0006***	−0.0007***
	(0.00005)	(0.00008)	(0.00006)	(0.00006)	(0.0001)	(0.00005)
Master's	0.164***	0.211***	0.121***			0.164***
	(0.014)	(0.017)	(0.024)			(0.014)
PhD	0.277***	0.3***	0.254***			0.277***
	(0.027)	(0.056)	(0.028)			(0.027)
Professional	0.372***	0.373***	0.357***			0.374***
	(0.027)	(0.05)	(0.03)			(0.027)
White	0.074***	0.03	0.102***	0.087***	0.043	0.075***
	(0.014)	(0.018)	(0.022)	(0.017)	(0.028)	(0.014)
Female	−0.172***			−0.194***	−0.110***	−0.177***
	(0.012)			(0.015)	(0.025)	(0.012)
Month	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	17,734	8,721	9,013	11,252	4,758	17,734
R^2	0.15	0.149	0.119	0.127	0.092	0.152

Notes: Dependent variable is ln(hourly wage) calculated from equation 6 using diary hours of work. Each observation is weighted using the weights provided by the ATUS and standard errors are calculated with successive difference replication (SDR) variance estimation using the replicate weights provided by the ATUS. Column (1) includes the entire sample. Columns (2)–(5) limit the sample to only female, male, highest degree is a bachelor's, highest degree is a master's, respectively. Column (6) repeats column (1) disaggregating teachers into elementary/middle, secondary, and special education teachers.
**Significant at the 5% level; ***significant at the 1% level.

7. CONCLUSION

Teachers, like all workers, make labor market decisions based on a complex set of information. They consider each job as a bundle of characteristics including amenities, such as location, work schedule, and level of personal satisfaction. Nonpecuniary factors certainly play a role in a college graduate's decision to

pursue and subsequently remain in teaching. To ignore the obvious impact that wages have on the number and quality of potential teachers would be a mistake, however. If teaching pays less than other occupations, schools will be left with a small pool of low-quality candidates from which to choose. If teaching pays more than other occupations, there will be a surplus of potential teachers.

To properly compare wages for teachers to wages in other occupations, researchers must take care to properly account for hours of work. The time diary data in the ATUS provide a unique opportunity to move beyond warring anecdotes about teachers who work short contract days/years and teachers who work extraordinary hours staying late to provide extra help, taking work home to grade, and planning and attending extracurricular activities on the weekend. Time diaries provide a clearer picture of hours of work for teachers and nonteachers than either administrative data or recall data from surveys. Using the ATUS, I find that teachers work more than is contractually required. They bring work home, and work on the weekends and during the summer months. However, teachers work less than they self-report when asked to recollect a usual week of work. Indeed, all workers work less than they self-report when asked to recollect a usual week, but teachers are more likely to overestimate their hours than are workers in other occupations.

I construct measures of diary hours per week by occupation and find that teachers work an average of 38.0 hours/week during the school year and 21.5 hours/week during the summer. When I use this measure, rather than a measure of usual hours of work per week or hours of work last week, I find that teachers' hourly wages are no more or less than workers in other occupations. In many ways, this is exactly as economists would predict and is confirmation of the power of market forces to set wages across occupations.

I find that averaging across all teachers obscures some interesting details, however. Secondary school teachers appear to have notably different work schedules and are less likely to overestimate their usual hours of work than elementary/middle school and special education teachers. When diary measures of hours of work are used to calculate hourly wages, secondary school teachers earn in the range of 7–14 percent less than similar workers in other occupations, whereas elementary, middle, and special education teachers are paid on par with or more than similar workers in other occupations.[37] I take this as evidence that policy makers should consider abandoning the single salary schedule that forces districts to pay all teachers the same regardless of the grade and subject they teach. Licensing and alternative labor market opportunities differ for these categories of teachers and I have shown that

37. Male elementary school teachers earn hourly wages that are less than other demographically similar men. If occupational segregation accounts for the teacher wage gap, then this indicates that elementary teachers are also underpaid relative to other occupations.

work schedules differ as well. With the current system, it is likely that schools face a surplus of elementary school teachers and a shortage of high-quality secondary school teachers. Raising secondary school teacher wages could help alleviate this problem. Disaggregating by subject may be important as well. Unfortunately, ATUS data only allow for disaggregation by elementary/middle, secondary, and special education, so this is left for future research.

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