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How Much Do People Really Work in the New Economy?

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Abstract

This question is important because average weekly hours are inputs into measures of productivity and hourly wages, which are two key economic indicators. However, the answer to our question is somewhat of a mystery because estimates from the Bureau of Labor Statistics two main sources of hours data tell two very different stories. Between 1973 and 2005 average weekly hours estimated from the BLS's household survey (the Current Population Survey or CPS) indicate that average weekly hours of nonagricultural wage and salary workers decrease slightly from 39.5 to 39.1 hours per week. In contrast, average weekly hours estimated from the establishment survey (the Current Employment Statistics survey or CES) indicate that hours fell from 36.8 to 33.8 hours per week. Thus the discrepancy between the two surveys increased from less than two hours per week to more than five.

Our goal in the current study is to reconcile the differences between the CPS and CES estimates of hours worked and to better understand what these surveys are measuring. We examine a number of possible explanations for the divergence of the two series: differences in workers covered, multiple jobholding, possible overreporting of hours in CPS, changes in the length of CES pay periods, and possible misreporting of hours worked by salaried workers in CES. So far, we have been able to explain only some of the difference.

I. Introduction

The number of hours that people work for pay is an important economic measure. In addition to being a measure of labor utilization, it is a component of other economic statistics such as productivity and hourly earnings.[1] Yet despite its importance, nobody knows how many hours Americans really work because the two principal sources of data on hours worked tell different stories. Figure 1 shows trends in average weekly hours of private non-agricultural workers from the Bureau of Labor Statistics' (BLS) household survey, the Current Population Survey (CPS), and its establishment survey, the Current Employment Statistics survey (CES). We show data from both the March CPS and the CPS Outgoing Rotation Group (ORG) files. The ORG dat are more representative, but the March data have a longer time series. The CPS data indicate that average weekly hours worked declined in the 1960s and early 1970s, increased for most of the 1980s, and leveled off beginning in the late 1980s. The net effect of these changes is that there has been very little change between 1964 and 2005. In contrast, the CES hours series declined between 1964 and the late 1980s, leveled off until the late 1990s, then declined between the late 1990s and 2005.

Because of this divergence, it matters which series is used when estimating trends in hourly wages or productivity. In their examination of alternative hourly wage series, Abraham, Spletzer, and Stewart (1998) found that the different trends in hours account for all of the divergence between hourly wages derived from the National Income and Product Accounts (NIPA), which use hours from the establishment-based Current Employment Statistics program (CES), and estimates from the March CPS. Back-of-the-envelope calculations indicate that the

[1] For a discussion of the importance of hours data for measuring real hourly wages, see Abraham, Spletzer, and Stewart (1998,1999) and for productivity see Eldridge Manser, and Otto (2004).

estimated average annual growth rate in hourly wages is about one-quarter of a percentage point higher between 1973 and 2005 if the CES hours series is used instead of the CPS ORG series.

The goal of this study is to reconcile the differences between the CPS and CES hours series.

II. Why Might the CES and CPS Hours Series Tell Different Stories?

There are several reasons why one might expect estimates of hours worked from the two series to differ. First, the CPS data cover all private nonagricultural workers, whereas the CES data cover only production (in goods-producing industries) and nonsupervisory workers (in services providing industries) within the private nonagricultural sector. Nonproduction and supervisory workers typically work longer hours, so that the CPS's inclusion of these workers leads us to expect weekly hours to be higher in the CPS than in the CES. Second, the CES hours series is a job-based measure, whereas the CPS is a person-based measure. A person working at two jobs would be counted twice in the CES, but only once in the CPS. Third, hours may be overreported in the CPS. The conventional wisdom is that respondents in household surveys such as the CPS tend to overreport their work hours, which is consistent with the observed relationship. Finally, the lengthening of pay periods over time could have caused a decline in CES estimates of average weekly hours apart from any real changes in hours. In what follows, we examine each of these explanations.

Differences in Workers Covered

Differences in workers covered can have a potentially large effect on measured hours if the group that is not covered, non-production and supervisory workers, work different hours than the covered group or if the trend in their hours is different. Anecdotal evidence suggests that differences in sample coverage can at least explain some of the differences in levels. For example production and nonsupervisory workers are much more likely to be working part time. This implies that CES hours should be less than CPS hours, but says nothing about trends.

To examine whether differences in coverage can explain the differences, it is necessary to make the two samples comparable. Because the CES does not collect hours information on non-production and supervisory workers, it is impossible to adjust the CES sample to be comparable to the CPS sample. So we follow the strategy used by Abraham, Spletzer, and Stewart (1998,1999) and replicate the CES sample using CPS ORG data.[2]

The data for this analysis come from the CPS Outgoing Rotation Group (ORG) files for 1979-2005 and from the May Supplement files for 1973-1978. The May Supplements were a test of the earnings questions asked of outgoing rotations beginning in 1979.[3] We restricted the sample to individuals age 16 and older who worked during the CPS reference week and were identified as being either production (in goods-producing industries) or nonsupervisory (in services providing industries) workers using the CPS industry and occupation codes. The distinction between production and nonsupervisory workers is important. Occupations that are classified as nonsupervisory are not necessarily classified as production workers. For example, accountants and attorneys are nonsupervisory workers in service-providing industries, but they are not production workers in goods-producing industries. Therefore it is necessary to distinguish between these two industry groups. The Census industry codes used in the CPS, while not the same as the SIC (and later NAICS) codes used in the CES, are more than adequate for making this distinction. And it is unlikely that changes in these codes over the years had any effect on this distinction.

[2] We did not replicate the CES hours series using the March data, because hourly/salaried status is not available.
[3] Following Abraham, Spletzer, and Stewart (1998,1999), we assume that the May Supplements are comparable to the ORG data.

The classification of workers as production and nonsupervisory workers was more problematic. The CES instructions to respondents contain fairly detailed instructions regarding which types of workers should be counted as production and nonsupervisory workers, but the detailed Census occupation codes used in the CPS do not exactly coincide with the CES instructions. Perhaps more importantly, there were two major changes in the Census occupation codes during the 1973-2005 period covered by our replications (between 1982 and 1983 and between 2002 and 2003). There is not much we can do about this, but the 1982-83 change appears to matter.

A further complication is that employers do not always classify workers according to the instructions on the form. This can occur for a number of reasons. First, respondents may not read the instructions on the form and instead use their own definitions, which may not correspond to BLS's. Second, respondents' recordkeeping systems may not allow workers to be classified using the BLS definitions. For example, the distinction between supervisory and nonsupervisory workers (in services) may not be meaningful. A more meaningful distinction is whether workers are covered by minimum wage/overtime laws. Findings from the BLS's internal Records Analysis Survey (RAS) studies indicate that a large number of establishments reported for workers who are not exempt from minimum wage laws. However, it does appear that the production/non-production worker distinction (in goods-producing industries) is meaningful and that respondents are for the most part reporting for the correct group of workers.

To address the problems with reporting in CES, we replicated the CES sample two ways. The first replication (R1) uses the official CES definition. We classified workers as being production or nonsupervisory workers using the detailed occupation codes within each broad industry group. The second replication (R2) accounts for employers' potential misclassification of employees in services-producing industries. In particular, we assumed that respondents use the exempt/nonexempt distinction rather distinguishing between supervisory and nonsupervisory employees. The CPS does not contain information on whether a worker is exempt or not, so we used information on the worker's detailed occupation and whether the he or she was paid hourly. We assumed that all hourly-paid workers were nonexempt. The remaining workers were classified as exempt if they were supervisors or if their jobs allowed them considerable autonomy as outlined in the minimum wage law.[4] In goods-producing industries, we used CES definition as in R1.

Figure 2 reproduces the CES estimate of average weekly hours along with average weekly hours from the two replications. The first thing to note is that the two replicated series are closer to the actual CES series than the CPS ORG private non-agricultural worker series in Figure 1. In both replications average weekly hours are lower for production and nonsupervisory workers than they are for all private non-agricultural workers. The difference between R1 and ORG private non-agricultural hours per week is about 1.4 hours and does not change much over the 1973-2005 period. The R2 difference is larger and grows over time from 1.6 hours per week to 2.1 hours per week.

However, it appears that the 1982-1983 changes in occupation codes may have contributed to the widening difference between the R2 and ORG private non-agricultural worker series. More than half of the increase in the difference occurred between 1982 and 1983, when the occupation codes changed. Moreover, there is a sharp decline in the fraction of workers covered by the replicated CES sample (the PW ratio). Between 1982 and 1983, the PW ratio fell

[4] Our exempt/nonexempt distinction is rather crude. Determining whether a worker is exempt from minimum wage laws is complicated by the fact that exempt status depends on a number of variables that are not available in the CPS. For example, workers in "mom-and-pop" businesses are generally exempt. Another complicating factor is that the law has changed over time. We could not account for these changes in the CPS data, but the reader should keep this in mind.

from 73.3 to 71.0 in R2, compared with a decrease from 77.1 to 76.4 in R1. The pre-1983 codes are less detailed, but there is no way to know whether the old or the new codes allow for better identification of CES-covered workers.

It is not obvious R1 or R2 does a better job of replicating the actual CES data. Replication 2 appears to do a better job of replicating CES hours, but one must keep in mind the apparent break in series between 1982 and 1983. However, R1 comes closer to the replicating the true CES PW ratio, which is fairly constant over this period at about 80 percent.[5]

Accounting for Multiple Jobholding

As noted earlier, the CES measure is job-based whereas the CPS measure is person based. The two measures would be the same if each person held only one job, but about 5-6 percent of the population has more than one job at any one time. We converted the person-based CPS measure to a job-based measure by dividing average weekly hours from the CPS by one plus the multiple jobholding rate. We used published estimates, which are available for 1970-1980, 1985, 1989, 1991, and 1994-2005. We interpolated the multiple jobholding rate for the years with missing data.

We can see in Figure 3 that both replications come closer to duplicating the actual CES hours series. There is virtually no difference between the two replications and the actual CES series between 1973 and about 1984. Over this period, all three series exhibit a downward trend and turn up immediately after the 1982 recession. For the rest of the 1980s, the two replications trend upward slightly (R1) or remain approximately constant (R2), while the actual CES series continues its downward trend. Beginning in 1990, apart from the higher levels, the two

[5] We experimented with an alternative hybrid replication that uses that R1 classification and adds in hourly-paid workers in the services-producing industries. The PW ratio is about 79 percent and does not vary much over the period. Average weekly hours are very close to those in R1.

replications track the CES series fairly well until the late-1990s when the CES and CPS replications diverge further. By 2005 the differences between the CES and the replications were 1.8 and 1.1 hours for R1 and R2.

Our multiple jobholding adjustment is admittedly rather crude. Our simple adjustment ignores the fact that workers' main and second jobs could be in different sectors. The implicit assumption is that individuals whose main jobs are in the CES sample and whose second jobs are outside the CES sample are offset by individuals whose main jobs are outside of CES and whose second jobs are in the CES sample.

The only way to relax this assumption is by recomputing the replicated hours series by counting up the hours on each job using microdata that has industry, occupation, and class of worker information on second jobs. We did this for the post-redesign CPS ORG data (1994-2005). The information on second jobs is identical to the information on main jobs, except that we do not know whether individuals are paid hourly. For this reason, we use the R1 definition for the second job in both recomputed replications.[6] Figure 4 shows the effect of this microdata adjustment. For both R1 and R2, average weekly hours are about one-half of an hour greater than the adjusted replications in Figure 3. The differences between recomputed replicated hours and actual CES hours in 2005 are 2.3 and 1.5 hours per week for R1 and R2 (compared to 1.8 and 1.1 hours per week). On the plus side, the relationship between the adjusted and recomputed replications is fairly constant despite variation in the multiple jobholding rate over this period.[7] This suggests that it may be reasonable to further adjust pre-1994 data using a simple adjustment factor.

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[6] A small fraction, about 5 percent, of multiple jobholders hold more than one job. We experimented with making a further adjustment, similar to our initial multiple jobholding adjustment, to account for these third jobs, but it made virtually no difference.

[7] This finding is consistent with Abraham, Spletzer, and Stewart's (1998) finding that the detailed adjustment did not make much difference when comparing hourly wage series.

Possible Overreporting of Hours Worked in the CPS

The conventional wisdom is that respondents in household surveys such as the CPS tend to overreport their work hours. If this is the case and if the extent of overreporting has increased over time, as some researchers have found, this could explain the divergence of CPS and CES hours.

Research on this issue has taken one of two approaches: comparing reports from household surveys to reports for the same individuals from their employers (Mellow and Sider, 1983; and Rodgers, Brown, and Duncan, 1993); or comparing to household survey responses to time-diary data (Robinson 1985, Robinson and Bostrom 1994, Sundstrom 1999, Williams 2004, and Frazis and Stewart 2004 and 2007). Mellow and Sider found that workers overreported hours compared to their employers' records, and that salaried workers overreported the most. In contrast, Rodgers, Brown, and Duncan found no evidence of overreporting, but their sample was restricted to hourly-paid workers at a large unionized firm. The earlier studies that used time-diary data (Robinson 1984, Robinson and Bostrom 1994, and Sundstrom 1999) found evidence of overreporting in household surveys. The Robinson and Bostrom study found that the extent of overreporting increased between 1965 and 1985. Their findings, if correct, could explain the divergent trends in CES and CPS hours as well as the difference in levels. However, more-recent studies (Williams 2004, and Frazis and Stewart 2004 and 2007) found evidence that household surveys correctly reported, or even underreported, hours. All of these studies found that some groups overreport hours, while others underreport.

There are several reasons why time-diary data might be preferable to data from household surveys that ask respondents to report about hours worked in the previous week. The recall task is generally easier in a time-use survey. The reference period is the previous day, so that respondents need not try to recall over longer periods, and because they are reporting individual episodes of work they do not have to add the lengths of different episodes. Paid work that occurs at home or other locations, which respondents may not report when responding to retrospective questions, is counted in time-diary estimates. Time diaries also have an adding-up constraint that forces the sum of time spent in all activities to equal 24 hours.

In this section we use data from the American Time Use Survey (ATUS) to review and update our earlier research on the accuracy of hours-worked data in CPS (Frazis and Stewart 2004, 2007) and then, replicating the CES sample as above, examine the accuracy of CPS hours reporting on CES jobs (using R1 definitions).

The ATUS sample is a stratified random sample that is drawn from households that have completed their eighth and final month-in-sample in the CPS[8] (hereafter "MIS 8") and is representative of the U.S. civilian population. Interviews were conducted by telephone every day during the year except for a few major holidays.[9] Thus, the data cover the entire year, except for the days before these holidays.[10]

As in other time-use surveys, respondents are asked to sequentially report their activities on the previous day. The diary day starts at 4:00am and goes through 4:00am of the following day (the interview day), so each interview covers a 24-hour period. After the core time diary has been completed, the ATUS asks respondents whether any activities that were not identified as paid work were done as part of their job or business. This question improves identification of paid work activities for self-employed respondents who work at home and others who do not "go

[8] Households are in the CPS sample for four months, out for eight, and then in for another four.
[9] Reference days before major holidays will be missed, as the telephone centers will be closed. The remaining days in the month that fall on the same day of the week as the missing day will have their weights inflated to make up for the missing day, in effect making the assumption (which we make in the absence of other information) that the activities on the missing day are similar to those on other days with the same day of the week.
[10] For details about the ATUS, see Frazis and Stewart (2007) and Hamermesh, Frazis, and Stewart (2005).

to work" in the traditional sense. We can also identify breaks, which allows us to determine how sensitive our results are to alternative definitions of paid work.[11,12] Given these advantages, we will proceed under the assumption that that the time-diary estimates are correct.

The ATUS also contains labor force information about the respondent that was collected using a slightly modified version of the monthly CPS questionnaire. These questions allow us to determine whether the respondent is employed, unemployed, or not in the labor force (NILF). One notable difference between ATUS and CPS employment questions is that the reference period in ATUS is the 7 days prior to the interview--the last day being the diary day--instead of the previous calendar week as in CPS. For respondents who are employed, the ATUS asks about usual hours worked, but does not collect actual hours worked.[13]

For this study, we pooled data from 2003 through 2006.[14] Our previous work used only 2003 data. We restricted our sample to respondents 16 years and older who worked at a job during the seven days prior to their ATUS interview and reported usual hours.

One drawback of using time-diary data is that the reference period is only one day. Previous researchers (for example, Robinson and Bostrom 1994) constructed synthetic workweeks by generating estimates for each day of the week and adding up the estimates. Our

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[11] Hamermesh (1990) is one attempt we have seen to examine the effect of paid breaks on wages.

[12] Interviewers prompt respondents by asking "did you take any breaks of 15 minutes or longer?" whenever a work episode is reported. Beginning in 2004, this prompt was incorporated into the instrument. The prompt automatically pops up whenever work episodes of 4 hours or longer are reported.

[13] Even if it were available, there is a potential problem with using estimates of actual hours worked for the previous week, because the procedure used for contacting respondents in ATUS could impart bias into estimates of actual hours for the previous seven days. Each designated person is assigned an initial calling day. If he or she is not contacted on that day, the interviewer makes the next call one week later, thus preserving the assigned day of the week. Individuals who are unusually busy during a particular week (perhaps because they worked long hours) are less likely to be contacted during that week, making it more likely that they are contacted the following week (and asked to report hours for the busy week). Hence, long work weeks would tend to be oversampled, resulting in a correlation between hours worked during the previous week and the probability that that week is sampled.

[14] The combined sample size from 2003-2006 was 37,035. The response rate for the ATUS varies from about 55 percent to 58 percent. It is also worth noting that interviews with fewer than 5 episodes or more than 3 hours of uncodeable activities are not included in the ATUS public-use file.

approach is equivalent.[15] Thus, we can compare means for specific demographic groups, but we cannot compare the distributions of hours worked between the two surveys.

As noted above, the detailed information in the ATUS allows us to consider alternative definitions of paid work. In keeping with the focus of this paper, we restrict our measure to hours worked on the main job for wage and salary workers. Results for total hours on all jobs and including all workers are similar. We calculate three different measures of hours worked, each of which corresponds to a different concept of hours worked. Going from the most restrictive measure to the least restrictive measure, these are:

(1) Time spent in activities coded as "Working at job."
(2) Definition (1) plus activities identified as breaks and time spent in work-related travel (not commuting).[16]
(3) Definition (2) plus activities that were coded as being done for the respondent's job.

We believe that definition (3) is the most appropriate for comparison, because it includes work-related activities, such as entertaining clients. In practice, there is very little difference between definitions (3) and (2) (0.1 hour per week). The difference between definitions (1) and (2) is somewhat larger, 0.4 hour per week.

We first replicate the analysis in Frazis and Stewart (2007). The first row of Table 1 shows hours estimates from the ATUS and the CPS for the 2003-2006 period. The difference between CPS and ATUS estimates of hours worked varies between 1.4 and 1.9 hours per week, depending on the ATUS definition of work, with CPS estimates being larger.

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[15] For basic comparisons, we reweight observations so that all days of the week receive equal weight. When computing regressions, we generate separate estimates for weekdays and weekends and take a weighted average of the two estimates.

[16] The inclusion of breaks is justified on the grounds that breaks can be productive (see Hamermesh 1990). Work-related travel is defined as travel between work sites, and we identified travel spells as work-related by looking at the surrounding activities.

The response rate for ATUS in 2003-2006 averaged 57 percent, a response rate sufficiently low that there may be a significant difference between ATUS responders and the broader population of CPS responders. Because the sampling frame of ATUS is the CPS sample in MIS 8, we can compare CPS responses given by ATUS sample members with responses from the CPS sample as a whole. We compare actual hours worked reported in CPS MIS 8 for ATUS respondents and hours reported in MIS 8 as a whole, three months before the ATUS interview.[17] We subtract this difference from the difference in reported hours between CPS and ATUS to obtain a measure of the difference between the two surveys adjusted for selection into the ATUS sample:

$$D = E(H_{i,t}^{ATUS}) - E(H_{i,t}^{CPS}) - [E(H_{i,t-3,MIS8}^{CPS} \mid i \text{ in ATUS}) - E(H_{i,t-3,MIS8}^{CPS})] \quad (1)$$

where *i* denotes individual, *t* denotes time period in months, and the third subscript denotes month-in-sample.

Aggregate results are shown in Table 1. Keep in mind that negative values indicate *overreporting* in CPS relative to ATUS. The gross difference in hours per week (ATUS minus CPS hours) ranges from −2.1 hours for Definition 1, the measure excluding breaks, to −1.6 hours for Definition 3. For all three of our measures the sample composition effect is 0.8 hours, which yields an adjusted difference between CPS and ATUS hours of between −1.3 and −0.8 hours per week depending on the definition of paid work used. These results are virtually identical to those using only 2003 data reported in Frazis and Stewart (2007), which range from −1.4 to −0.8.

Note that while the reference periods for the ATUS include almost every day in the calendar, the CPS reference week is virtually always the week of the 12th.[18] This week was

[17] The ATUS interview usually occurs between 2 and 4 months after the CPS MIS 8 interview.
[18] For some Decembers reference week is the week of the 5th to avoid conflicts of the fielding period with Christmas.

chosen to avoid holidays, so there might be a systematic difference between reference and non-reference weeks. We now control for differences in reference periods by restricting the ATUS sample to CPS reference weeks. The results are shown in the third set of rows of Table 1. The difference between ATUS and CPS hours estimates changes dramatically. After adjusting for sample composition, the difference ranges from −0.4 to 0.2 hours per week. (Frazis and Stewart (2007) found a range of −0.3 to 0.3.) Thus, as in our earlier work, we find that the original difference of close to two hours is completely explained by sample composition and the difference between reference and non-reference weeks in CPS.

We now turn to comparing CPS and ATUS measures of hours on jobs covered by the CES. This entails replicating CES coverage in the CPS, as is done above, and looking at hours per job rather than hours of work per person. Our main purpose is to see if differences in reporting of hours over time can account for the divergence between the CPS and CES series. Sample sizes for previous time-use surveys are too small to allow us to do this directly (not to mention issues with comparability). However, we can use demographic and job characteristics associated with under- or overreporting of hours in CPS relative to the 2003-2006 ATUS and estimate the trend in reporting implied by changes in the characteristics of the employed.

As mentioned earlier one complication in replicating the CES sample in the CPS is the lack of information on the characteristics of second jobs, or in earlier data even their existence. We incorporate information on hours for second jobs, but use only those sample members whose main jobs are in the CES sample using the R2 definition.

The first line of table 2 shows that for CES jobs defined as above, CPS reports exceed ATUS hours by 0.8 - 1.3 hours on average after adjustment for sample composition. For reference week, however, ATUS hours match CPS hours for definition 1 and exceed them by a statistically insignificant half an hour for definitions 2 and 3.[19] This close correspondence between ATUS and CPS hours is the sum of three effects, one of which works in the opposite directions from the other two. Hours on main jobs are under-reported for reference weeks by 1.2 - 1.8 hours, significant at the 5 percent level for definition 1 and the 1 percent level for definitions 2 and 3. Hours on second jobs are over-reported for reference weeks by 3.8 - 3.7 hours, significant or close to significant at the 5 percent level. And the proportion of second jobs is higher in ATUS by 3.3 percentage points after adjustment for sample composition. This high proportion of second jobs reported in ATUS relative to that reported in CPS by ATUS sample members reduces relative ATUS hours per job by a full hour.

The under-reporting of hours on main jobs applies only to the CES replication sample. Taking the population of jobs as a whole, the estimated difference in hours on the main job during CPS reference week adjusted for sample composition is −0.3 to 0.2 hours, not statistically significant. Differences between CPS and ATUS in second-job-hours reporting and the proportion of second jobs are similar between the replicated-CES sample and the larger sample. Thus, the implied difference between CPS and ATUS is −1.7 to −1.2 hours per job, which is mostly due to the higher proportion of second jobs in ATUS.

How do these differences vary across subpopulations? Table 2 shows a number of comparisons for replicated-CES jobs (using the R2 definition) for hours during CPS reference weeks. Women appear to over-report hours in CPS relative to men, and under-reporting appears to decrease with education. These results match those found in Frazis and Stewart (2004), who used a sample of individuals who were employed at the time of both their CPS and ATUS interviews and whose reported usual hours had not changed much. Other comparisons in Table

[19] ATUS standard errors are computed using replicate weights that account for survey design effects (BLS 2007). In computing the standard error of CPS-ATUS differences variance in CPS statistics is ignored.

2, by age, parental status, hourly pay, occupation, and industry, are new. Most fail to show significant differences between ATUS and CPS samples. Prime-age respondents (25-54) under-report hours in CPS while both younger and older respondents overreport. Hours are significantly underreported in the CPS for workers in goods-producing industries.

Note that all of the terms in equation (1) can be conditioned on a vector of covariates. That is, rewriting equation (1) so that each term is replaced by predicted values from the appropriately defined regression and arranging terms, one can estimate

$$
\begin{aligned}
D(X) &= (X\beta^{ATUS} - X\beta^{CPS}) - (X\beta^{CPS}_{t-3,MIS8,ATUS} - X\beta^{CPS}_{t-3,MIS8}) \\
&= X(\beta^{ATUS} - \beta^{CPS} - (\beta^{CPS}_{t-3,MIS8,ATUS} - \beta^{CPS}_{t-3,MIS8}))
\end{aligned}
\qquad (2)
$$

where the βs are vectors of regression coefficients corresponding to the samples denoted in the sub- and superscripts. Although the samples for each component of (1) will differ, we can run separate regressions for each component and generate predicted values for differences between ATUS and CPS using equation (2). This allows us to see if some of the results in Table 2 are due to correlations with other variables. It also allows us to "backcast" differences between ATUS and CPS in different years, using regression coefficients to obtain average predicted values of the difference in reported hours.

Regression results for all three definitions of work and for total and reference weeks are shown in table 3. Looking at the reference week results, some differ from Table 2. There is now some evidence that parents overreport hours. The effect of being in a goods-producing industry in one's main job is no longer apparent. Professionals and managers substantially underreport hours in CPS reference weeks.

Figure 5 shows the results of our backcasts using the regression coefficients for ATUS Definition 2 in Table 3. The figure shows the amount by which average weekly hours are over-or under-reported for workers whose main jobs are in the CES sample. As before, negative values indicate overreporting. The figure indicates that CPS hours are correctly reported when comparing CPS hours to ATUS hours in all weeks. But when comparing CPS hours to ATUS hours during CPS reference weeks, hours are *under-reported* in CPS. Moreover, there is no trend in this under-reporting. Thus the effect of changes in the demographic composition of the CPS sample on over-/under-reporting does not appear to have contributed to the divergence of the CPS and CES hours series.

These results are not consistent with Robinson and Bostrom's (1994) findings that hours reported from CPS-style questions have increasingly diverged from those reported in time-use surveys. Their findings were cited by Abraham, Spletzer and Stewart (1998) as a potential explanation of the divergence between CPS and CES hours trends alluded to above. Were this the case we would expect to have seen considerable overreporting in CPS, so our evidence casts doubt on this explanation.

The Lengthening of Pay Periods in CES

One feature of the CES that has received little attention is the lengthening of establishments' pay periods. Length of pay period matters for two reasons. The first has to do with the distribution of hours worked over the month. The CES reference period is the pay period that includes the 12th of the month. If workers are paid weekly it coincides with the CPS reference week, while a biweekly payroll will include the CPS reference week plus the either the week before or the week after. Given that workers work less in non-CPS-reference weeks, estimated average weekly hours will be lower in establishments with biweekly payrolls compared to those with weekly payrolls even if actual hours worked are the same in both establishments. Somewhat ironically, the lengthening of pay periods means that CES hours are becoming more representative of the entire month.

The second reason has to do with how employees are counted. All employees who worked at the establishment at any time during the pay period are included in the employee count, regardless of how many hours they worked. Let us suppose that total hours are reported correctly[20] and that turnover is uniformly distributed over the month. Then a longer pay period implies that reported employment will be greater, because employees hired in the second week of the pay period will be included in a biweekly payroll but not in a weekly payroll. Given our assumption that total hours are reported correctly, the denominator is too large and average weekly hours will be underestimated. This effect would also cause measured weekly hours to decline as pay period length increases.

Evidence on length of pay period is scant, but we can get a general idea of how things could have changed by looking at how the distribution of length of pay periods (LP) has changed among CES reporters. The BLS periodically conducts RAS surveys, and tabulates the fraction of reporting establishments that report each LP. The top panel of Table 4 shows the establishment-weighted distribution and mean LP for selected years. There was virtually no change in mean LP between 1981 and 2002. But between 2002 and 2007, there was a significant lengthening of pay periods, due mostly to a shift from weekly to biweekly and semi-monthly pay periods. For our purposes, it is the employee-weighted distribution that we are interested in. The employee-weighted distribution for 2007 in the second panel suggests that there is not that much difference between the establishment-weighted and employee-weighted distributions. The lower portion of Table 4 shows how LP changed between 2002 and 2007 for individual industry groups. Note that most of the changes are smaller than the aggregate change and that LP has become shorter in

[20] Establishments are required to keep records of hours worked for hourly-paid workers.

some industry groups. Thus it appears that most of the aggregate change in LP is due to compositional changes rather than within-industry changes.

The effects that we want to capture with the LP simulations are the effect of expanding the CES reference period to include more non-CPS-reference weeks, and the effect longer pay periods have on reported employment counts. The basic strategy is to hold constant hours worked and the turnover rate (to eliminate any real changes), and allow the LP distribution to vary over time. We estimated weekly hours for the hourly/salaried × reference week/non-reference week × goods-producing/services-providing cells using ATUS data. We assumed that hours worked during the reference week are the same for hourly and salaried workers in goods-producing and services-providing industries (37 hours per week), but used the estimated differentials between reference and non-reference weeks. The assumption that reference week hours are the same is necessary; otherwise the simulation would also capture the effect of the shift of employment from high-hour (goods-producing) industries to low-hour (services-providing) industries. The turnover rate comes from a paper by Fallick and Fleischman (2004) that looks at worker flows (the data are from their Table 4). We assumed that the turnover rate was constant and the same in both industry groups. Finally, we were forced to assume that the LP distribution was constant over time within an industry group. We would have preferred to allow the distribution to vary, but the data are not available. Thus, changes in the LP distribution come about only through changes in the distribution of employment across industry groups. The distributions for the two sectors were generated on an employee-weighted basis using CES microdata for 2006. The main difference between the two distributions is that 71 percent of workers in goods-producing industries are paid weekly, compared with only 22 percent in services-providing industries (the fraction paid monthly is the same in both industries). The average LPs are 1.3 weeks in goods-producing industries and 1.9 in services-providing industries. Finally, we allowed the fraction paid hourly to vary, and used the actual values for each industry. Allowing the fraction paid hourly to vary makes sense, because the difference between reference and non-reference weeks in hours worked differs by pay status and is thus part of what we are trying to capture.

Figure 6 compares the actual CES hours series with a modified series that was generated by adding back the decline in hours due to the changing LP distribution. We can see that the lengthening of pay periods has tended to reduce CES hours estimates, but that the effect is small. It is possible that the effect would be a little larger if we had data on the LP distribution for earlier years, so that the within-industry distributions could be allowed to vary. Given the large changes between 2002 and 2005, it is possible that the decline in hours would have been less gradual and that there might have been an acceleration after 2002. Although this change is small compared to other factors we have examined, it is worth keeping in mind that this change is the result of the interaction of a seemingly innocuous change in the way workers are paid and the CES's way of collecting employment data.

V. Conclusion

We have made some progress in trying to reconcile the differences between the CES and CPS hours series. We found that much of the difference between the two series can be explained by replicating the CES sample using CPS data (i.e., restricting the CPS sample to production and nonsupervisory workers) and making a simple adjustment for multiple jobholding. At first blush, these adjustments appear to have completely eliminated the differences through the early 1980s, and considerably narrowed the differences from the mid-1980s on. The difference between the CPS and CES hours series falls from just over 5 hours to 1.1-1.8 hours depending on which of the two replications is used.

But further analysis undoes some of this narrowing. When we made a more realistic microdata adjustment for multiple jobholding in the CPS and recomputed average weekly hours from the replicated sample, we found that CPS hours were about one-half hour per week higher. We also found that, for workers covered by the CES, respondents underreport hours worked by about 1 hour per week during CPS reference weeks. Both of these findings widen the difference between actual and replicated CES series to between 2.6 and 3.3 hours per week. Thus, we can explain about two-fifths of the difference between CPS and CES hours in 2005.

In the next draft of the paper, we will explore several other differences between the CES and CPS hours series. First, the hours of salaried workers may be misreported in CES. Since establishments are not required to keep records on salaried-workers' hours, it is likely that they report the "standard workweek" for these employees. We can replicate this type of reporting in CPS, and preliminary estimates suggest that they narrow the difference by about one-half an hour. Second, the CES measures hours paid, while the CPS measures hours worked. We can adjust the CPS series to include workers who were employed but not at work, and adjust hours to include hours paid but not worked. Third, we can use recent length-of-pay-period data to incorporate the effect of within-industry changes in the distribution of pay periodicities. Finally, we plan to take a closer look at work done at home and its implication for reporting.

References

Abraham, Katharine G., James R. Spletzer, Jay C. Stewart. 1998. "Divergent Trends in Alternative Wage Series." In *Labor Statistics Measurement Issues*, NBER Studies in Income and Wealth, v. 60, ed. John Haltiwanger, Marilyn E. Manser, and Robert Topel, 293-324. Chicago: University of Chicago Press.

Abraham, Katharine G., James R. Spletzer, Jay C. Stewart. 1999. "Why Do Different Wage Series Tell Different Stories?" *American Economic Review Papers and Proceedings* 89:2, 34-39.

Bailar, Barbara A. 1975. "The Effects of Rotation Group Bias on Estimates from Panel Surveys." *Journal of the American Statistical Association* 70:349, 23-30.

Eldridge, Lucy, P. Marilyn E. Manser, and Phyllis Flohr Otto. 2004. "Hours Data and Their Impact on Measures of Productivity Change." Paper presented to the NBER Productivity Program meeting, (March 2004).

Frazis, Harley and Jay Stewart. 2004. "What Can Time-Use Data Tell Us About Hours of Work?", *Monthly Labor Review* 127:12, 3-9.

Frazis, Harley and Jay Stewart. 2007. "Where Does the Time Go? Concepts and Measurement in the American Time-Use Survey." Forthcoming in *Hard to Measure Goods and Services: Essays in Memory of Zvi Griliches*, ed. by Ernst Berndt and Charles Hulten.

Hamermesh, Daniel. 1990. "Shirking or Productive Schmoozing: Wages and the Allocation of Time at Work." *Industrial and Labor Relations Review* 43:3, 121S-133S.

Hamermesh, Daniel S., Harley Frazis, and Jay Stewart. 2005. "Data Watch—The American Time Use Survey," *Journal of Economic Perspectives* 19(1), Winter 2005, pp.221-232.

Jacobs, Jerry A. 1998. "Measuring Time at Work: Are Self-Reports Accurate?" *Monthly Labor Review* 121:12, 42-53.

Mellow, Wesley, and Hal Sider. 1983. "Accuracy of Response in Labor Market Surveys: Evidence and Implications." *Journal of Labor Economics*, Vol. 1, No. 4, pp. 331-344.

Robinson, John. 1985. "The Validity and Reliability of Diaries versus Alternative Time Use Measures," in F. Thomas Juster and Frank Stafford, *Time, Goods and Well-Being*. Ann Arbor, MI: Institute for Social Research.

Robinson, John and Ann Bostrom. 1994. "The Overestimated Workweek? What Time Diary Measures Suggest." *Monthly Labor Review* 117:1, 11-23.

Robinson, John P., and Geoffrey Godbey. 1997. *Time for Life: The Surprising Ways Americans Use Their Time*. 2nd ed. State College, PA: Penn State Univ. Press.

Rodgers, Willard L., Charles Brown, and Greg J. Duncan. 1993. “Errors in Survey Reports of Earnings, Hours Worked, and Hourly Wages.” *Journal of the American Statistical Association*, Vol. 22, Issue 424 (December 1993), pp. 1208-1218.

Sundstrom, William. 1999. “Overworked American or the Overestimated Workweek? Trend and Bias in Recent Estimates of Weekly Work Hours in the United States,” unpublished manuscript, Santa Clara University.

Williams, Richard D. 2004. “Investigating Hours Worked Measurements,” *Labour Market Trends*, February 2004, pp. 71-79.

Figure 1: Average Weekly Hours from CPS and CES data

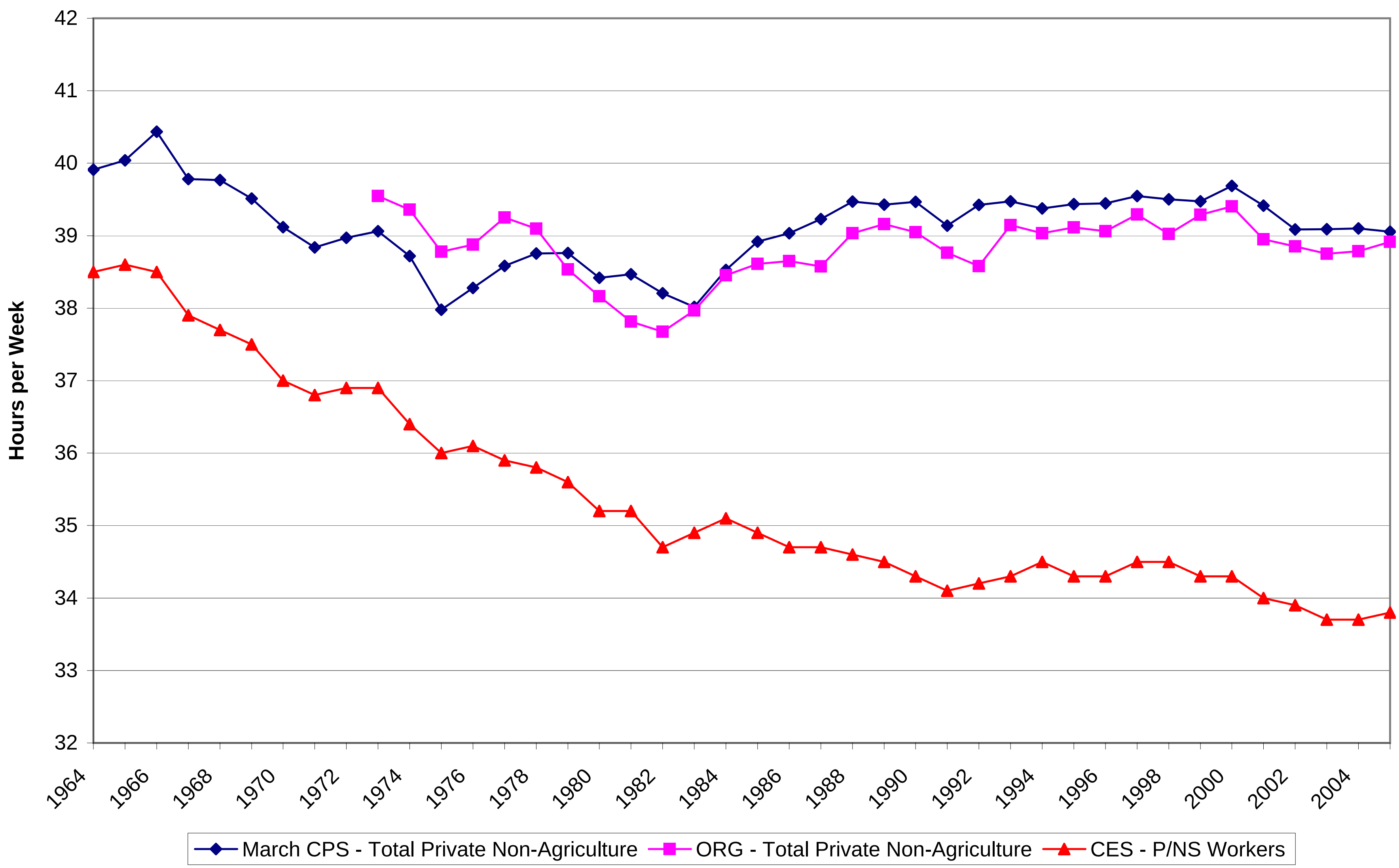


Figure 2: Complarison of CES Weekly Hours to CPS Replications of CES Weekly Hours Not Adjusted for Multiple Jobholding

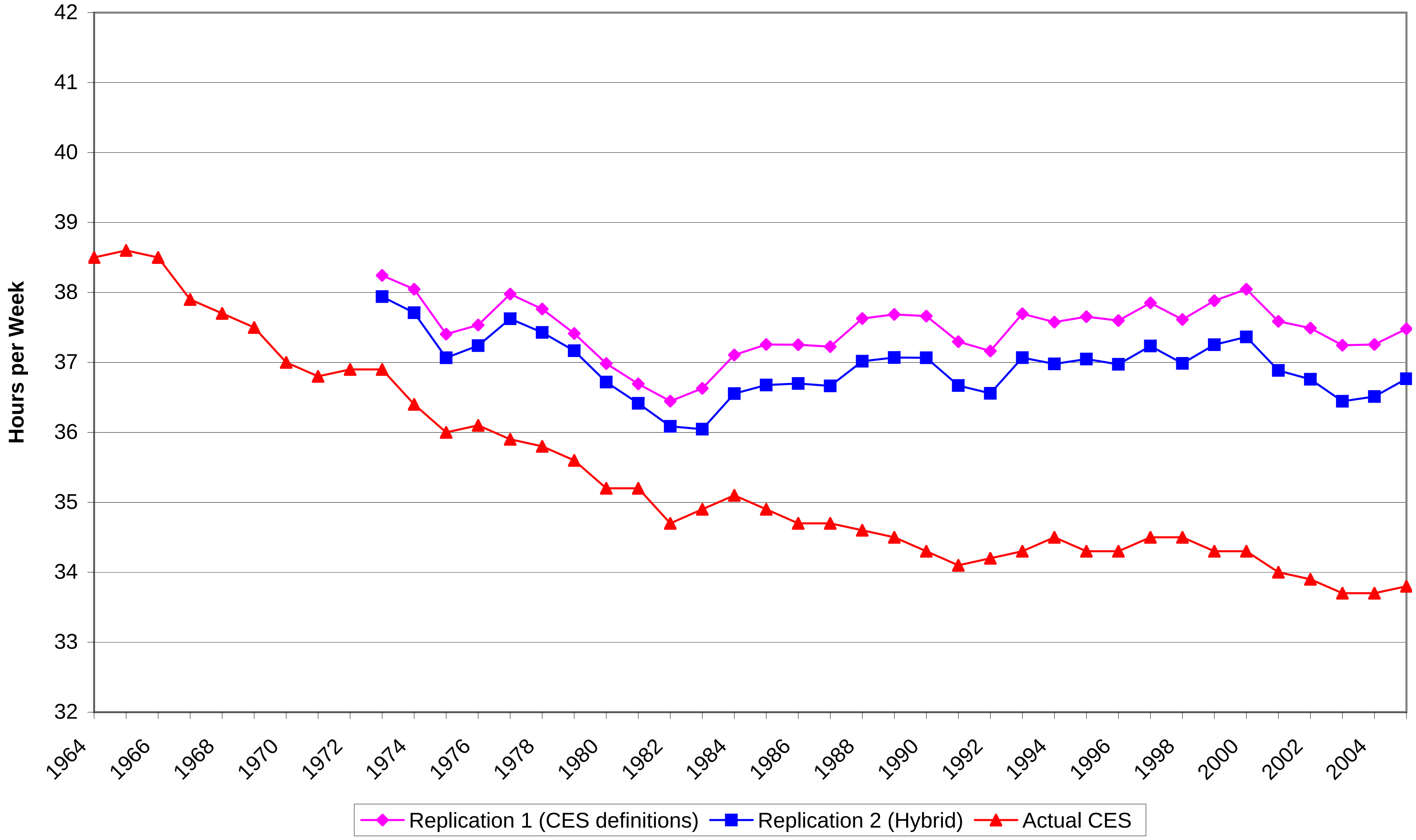


Figure 3: Complarison of CES Weekly Hours to CPS Replications of CES Weekly Hours Adjusted for Multiple Jobholding

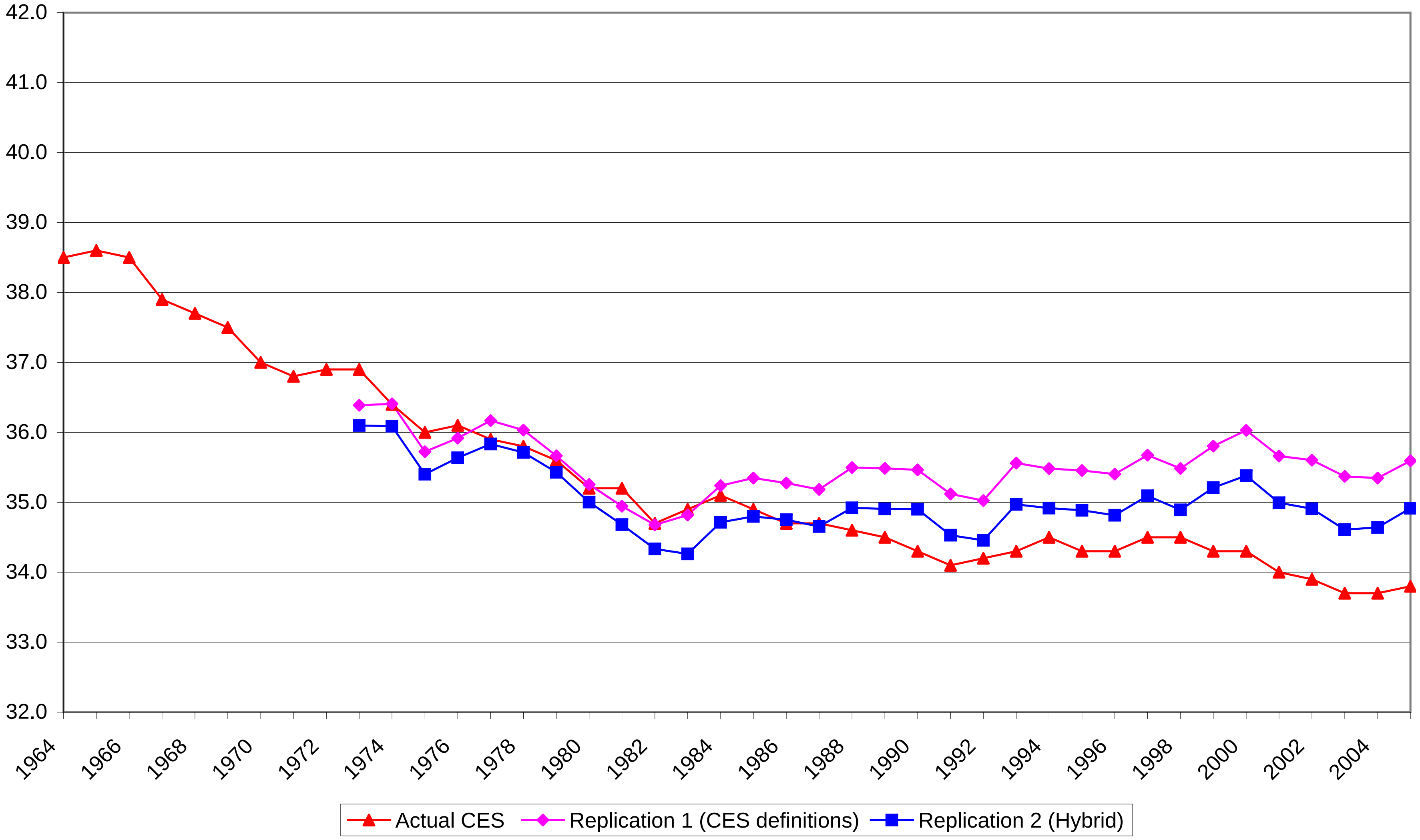


Figure 4: Complarison of CES Weekly Hours to CPS Replications of CES Weekly Hours Adjusted for Multiple Jobholding

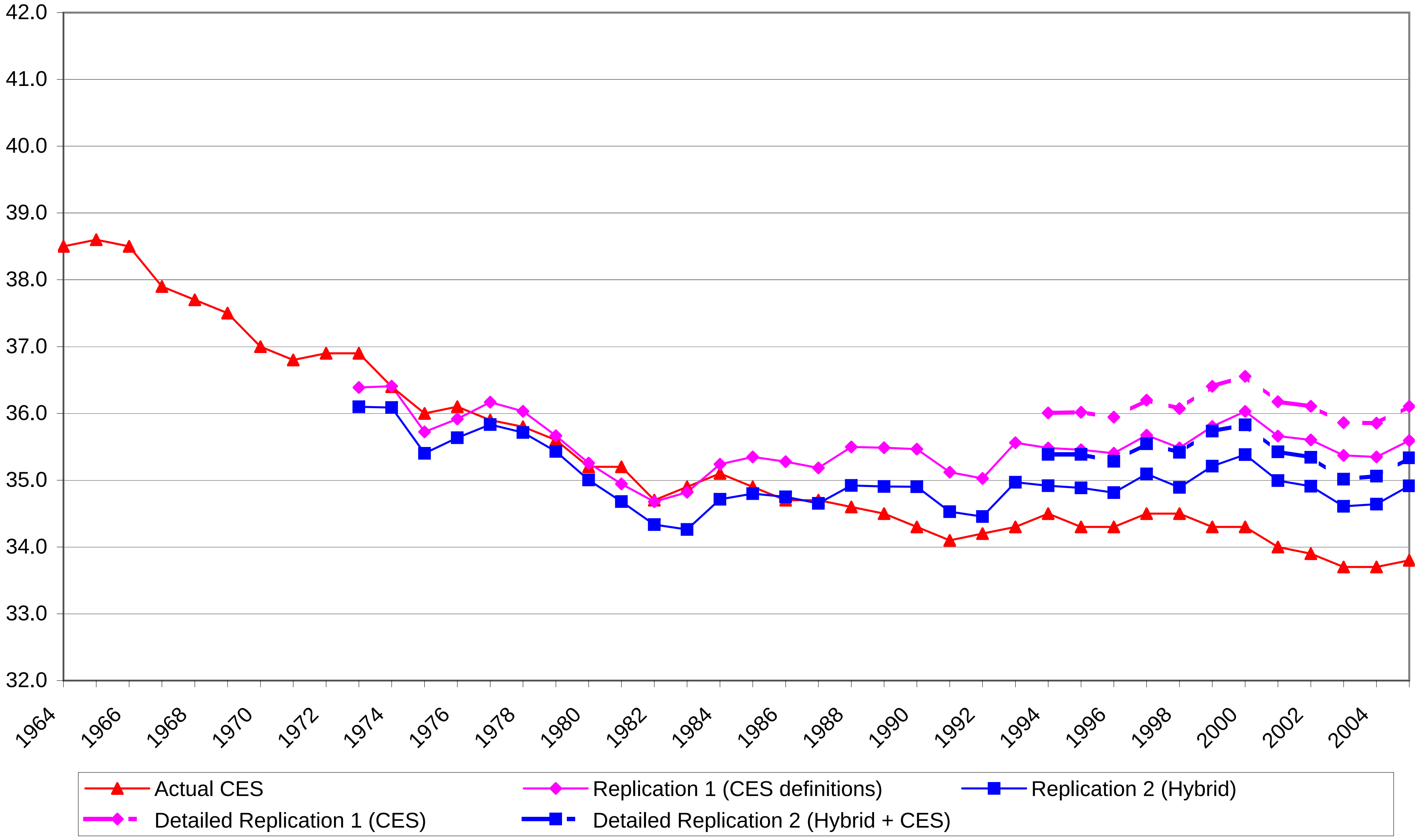
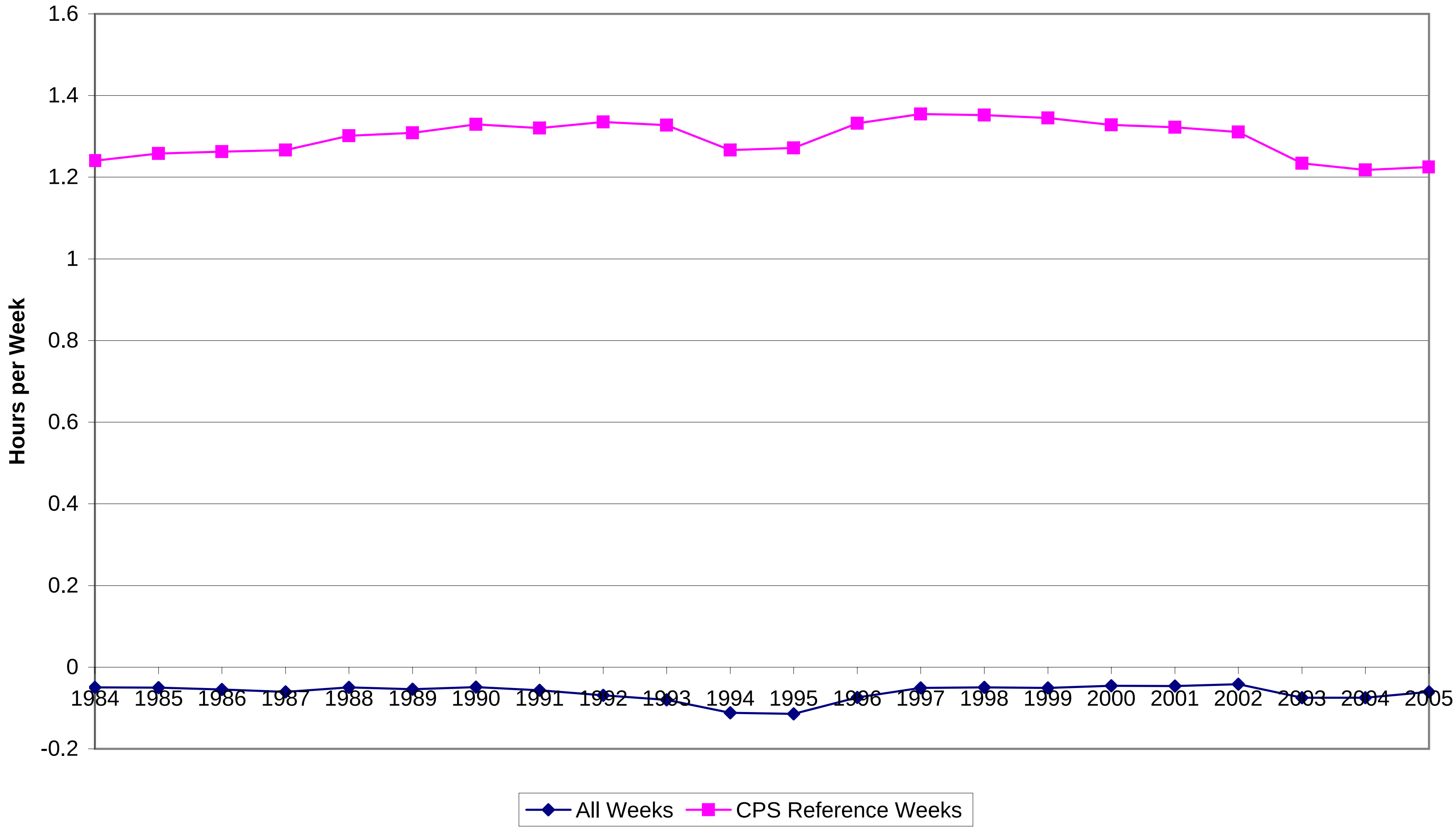


Figure 5: Backcasting of Over/Under-reporting of Weekly Hours - Hours on All Jobs for Replicated CES Sample



Note: Negative values indicate overreporting.

Figure 6: Complarison of CES Weekly Hours (with and without LP adjustment) to CPS Replications of CES Weekly Hours Adjusted for Multiple Jobholding

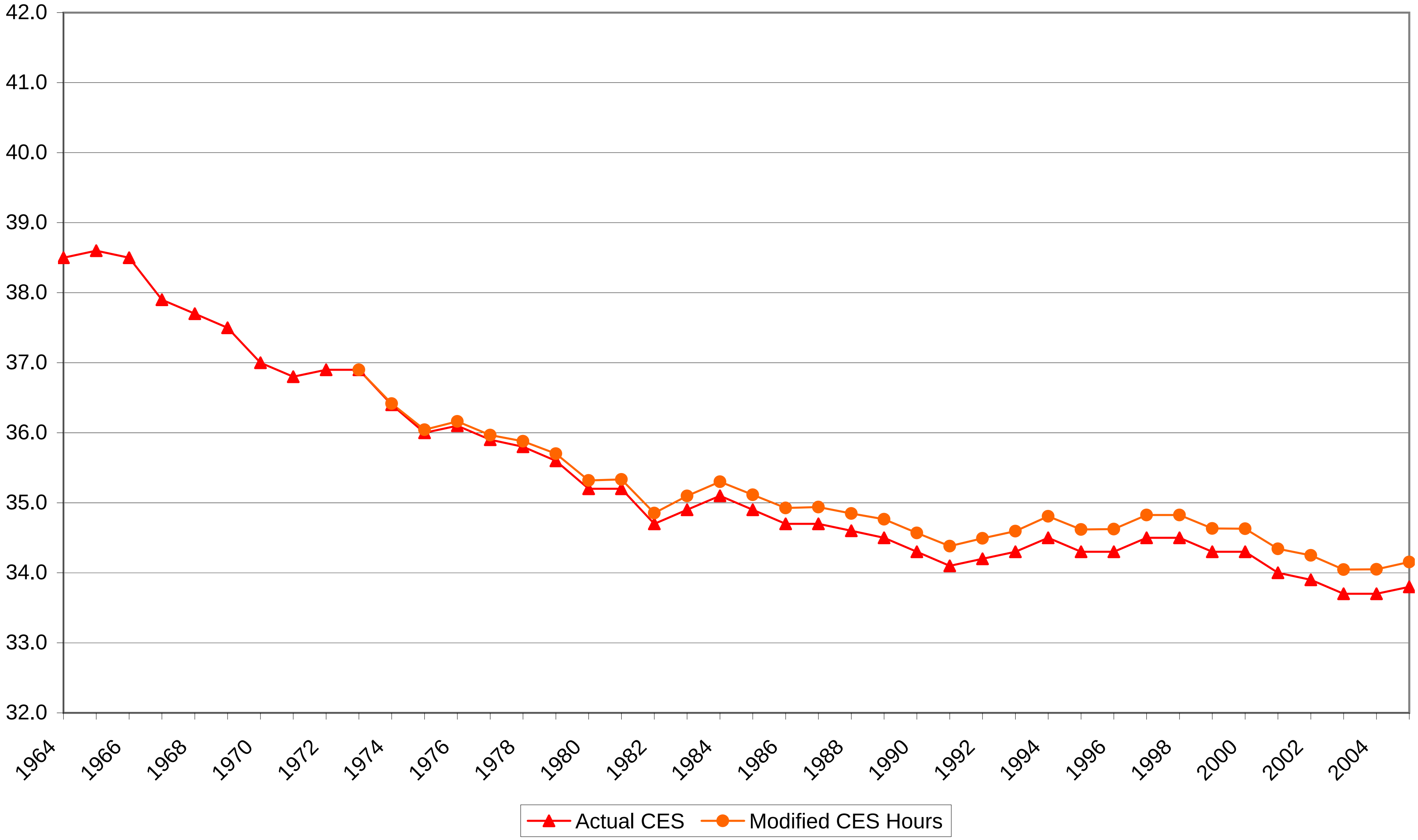


Table 1: Hours of paid work in ATUS and CPS

Time Period	Jan. 2003 - Dec. 2006			October 2002-September 2006		Jan. 2003 - Dec. 2006
Survey - Hours response from…	ATUS			CPS	CPS	CPS
Sample - Respondents participated in…	ATUS			ATUS	CPS MIS 8	CPS
Hours Measure	Definition 1	Definition 2	Definition 3	Actual CPS	Actual CPS	Actual CPS
Average Weekly Hours	37.4	37.8	37.9	38.4	39.2	39.5
Difference from CPS actual hours	-2.1	-1.7	-1.6			
Adjusted difference from CPS actual hours	-1.3	-0.9	-0.8			
Average Weekly Hours in CPS Reference Weeks	38.3	38.7	38.8	38.4	39.2	39.5
Difference from CPS actual hours	-1.2	-0.8	-0.7			
Adjusted difference from CPS actual hours	-0.4	0.0	0.2			

Table 2
Difference in Hours of Paid Work for CES-replicate jobs, CPS − ATUS 2003-2006 (adjusted for ATUS sample composition).

	Job 1			Job 2			All Jobs		
	Definition 1	Definition 2	Definition 3	Definition 1	Definition 2	Definition 3	Definition 1	Definition 2	Definition 3
All	1.20**	1.72***	1.78***	-3.78**	-3.72*	-3.72*	0.00	0.48	0.53
	(0.59)	(0.59)	(0.59)	(1.91)	(1.95)	(1.95)	(0.54)	(0.54)	(0.54)
Men	4.41***	5.00***	5.06***	-3.81	-3.74	-3.74	2.74***	3.29***	3.33***
	(0.99)	(1.00)	(1.00)	(2.56)	(2.60)	(2.60)	(0.85)	(0.86)	(0.86)
Women	-1.99***	-1.54**	-1.48**	-4.16***	-4.13***	-4.13***	-2.77***	-2.36***	-2.31***
	(0.65)	(0.65)	(0.65)	(1.58)	(1.58)	(1.58)	(0.62)	(0.62)	(0.62)
High School Dropouts	3.71*	4.34**	4.43**	-6.35	-6.35	-6.35	3.52	4.11*	4.20*
	(1.94)	(1.97)	(1.96)	(5.18)	(5.18)	(5.18)	(2.20)	(2.24)	(2.23)
High School Grads	3.75***	4.33***	4.38***	-1.02	-0.96	-0.96	3.30***	3.85***	3.89***
	(1.01)	(1.02)	(1.02)	(2.58)	(2.59)	(2.59)	(1.15)	(1.16)	(1.16)
Some College	2.15**	2.71**	2.78**	-4.87**	-4.86**	-4.86**	0.24	0.75	0.81
	(1.07)	(1.09)	(1.09)	(1.98)	(1.98)	(1.98)	(1.09)	(1.11)	(1.11)
College Grad	0.62	1.01	1.11	-2.21	-2.07	-2.07	-2.44	-2.08	-1.99
	(1.66)	(1.68)	(1.68)	(4.00)	(4.14)	(4.14)	(1.49)	(1.50)	(1.50)
Parents	1.49*	2.05**	2.10**	-0.81	-0.75	-0.75	0.30	0.81	0.86
	(0.85)	(0.87)	(0.87)	(1.92)	(1.95)	(1.95)	(0.78)	(0.79)	(0.80)

Table 2 (continued)

	Job 1			Job 2			All Jobs		
	Definition 1	Definition 2	Definition 3	Definition 1	Definition 2	Definition 3	Definition 1	Definition 2	Definition 3
Non-parents	0.80	1.31*	1.37*	-5.14*	-5.08*	-5.08*	-0.36	0.11	0.16
	(0.72)	(0.73)	(0.73)	(2.65)	(2.71)	(2.71)	(0.70)	(0.71)	(0.71)
Hourly	0.73	1.30*	1.35**	-3.95**	-3.90**	-3.90**	-0.03	0.50	0.54
	(0.66)	(0.67)	(0.67)	(1.91)	(1.95)	(1.95)	(0.63)	(0.63)	(0.64)
Non-hourly	2.52	2.86*	2.96*	-4.14	-4.12	-4.12	-0.67	-0.36	-0.27
	(1.58)	(1.60)	(1.61)	(3.35)	(3.36)	(3.36)	(1.48)	(1.50)	(1.51)
Mgr./Professional	3.39***	3.80***	3.84***	-3.95*	-3.93*	-3.93*	-0.23	0.13	0.16
	(1.18)	(1.18)	(1.19)	(2.06)	(2.06)	(2.06)	(0.98)	(0.99)	(0.99)
Other Occ.	0.73	1.28*	1.34**	-3.94*	-3.88*	-3.88*	-0.03	0.48	0.53
	(0.66)	(0.67)	(0.67)	(2.11)	(2.15)	(2.15)	(0.61)	(0.61)	(0.61)
Goods producing	5.66***	6.58***	6.61***	-5.58**	-5.57**	-5.57**	3.53***	4.37***	4.41***
	(1.26)	(1.27)	(1.27)	(2.73)	(2.73)	(2.73)	(1.28)	(1.29)	(1.29)
Non-Goods producing	0.41	0.89	0.94	-3.48	-3.42	-3.42	-0.54	-0.11	-0.05
	(0.64)	(0.65)	(0.65)	(2.23)	(2.27)	(2.27)	(0.59)	(0.59)	(0.60)
Age 16-24	-5.08***	-4.63***	-4.62***	-7.13**	-7.11**	-7.11**	-5.75***	-5.35***	-5.34***
	(1.40)	(1.41)	(1.41)	(2.92)	(2.92)	(2.92)	(1.28)	(1.29)	(1.29)
Age 25-54	3.94***	4.50***	4.57***	-2.33	-2.25	-2.25	2.43***	2.95***	3.01***
	(0.60)	(0.60)	(0.60)	(1.99)	(2.04)	(2.04)	(0.60)	(0.61)	(0.61)

Table 2 (continued)

	Job 1			Job 2			All Jobs		
	Definition 1	Definition 2	Definition 3	Definition 1	Definition 2	Definition 3	Definition 1	Definition 2	Definition 3
Age 55+	-2.62**	-2.14*	-2.07*	-6.86***	-6.83***	-6.83***	-3.31***	-2.86***	-2.80***
	(1.15)	(1.16)	(1.17)	(2.00)	(2.01)	(2.01)	(1.08)	(1.09)	(1.10)

* Significantly different from zero at .10 level.
** Significantly different from zero at .05 level.
*** Significantly different from zero at .01 level.

Table 3

Estimated Effects of Covariates on Sample-adjusted Difference in CPS and ATUS Hours worked per Job, CES replicate sample

	Definition 1		Definition 2		Definition 3	
Total	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Parent	-0.81	0.61	-0.84	0.61	-0.84	0.61
Female	-1.76***	0.55	-1.80***	0.56	-1.83***	0.56
HS Grad	-0.24	0.75	-0.12	0.76	-0.12	0.76
Some Clg	-1.47*	0.86	-1.44	0.88	-1.45*	0.88
Clg Grad	-0.58	0.99	-0.60	1.00	-0.56	1.00
Age	0.09	0.11	0.12	0.11	0.12	0.11
Age Sq.	-0.0011	0.0012	-0.0013	0.0013	-0.0013	0.0013
Mgr/Prof.	2.00**	0.90	1.85**	0.91	1.84**	0.91
Goods Producing	0.03	0.93	0.27	0.94	0.24	0.95
Hourly	-1.23	0.77	-1.03	0.78	-1.08	0.78
Constant	0.18	2.01	-0.06	2.08	-0.01	2.09
Reference Week						
Parent	-1.78*	1.02	-1.78*	1.05	-1.72*	1.05
Female	-2.22**	1.06	-2.32**	1.09	-2.37**	1.10
HS Grad	0.11	1.59	0.18	1.64	0.22	1.63
Some Clg	-1.17	2.20	-1.18	2.26	-1.17	2.26
Clg Grad	-3.13	2.82	-3.24	2.87	-3.18	2.85
Age	0.32*	0.19	0.35*	0.19	0.34*	0.20
Age Sq.	-0.0045**	0.0022	-0.0048**	0.0023	-0.0047**	0.0023
Mgr/Prof.	4.57***	1.65	4.48***	1.66	4.45***	1.65
Goods Producing	-0.41	1.37	-0.19	1.39	-0.25	1.39
Hourly	-0.35	1.51	-0.10	1.53	-0.11	1.55
Constant	-1.86	3.79	-2.12	3.86	-1.96	3.89

* Significantly different from zero at .10 level.
** Significantly different from zero at .05 level.
*** Significantly different from zero at .01 level.

Table 4: Changes in the Distribution of Length of Pay Period

	Weekly	Biweekly	Semi-monthly	Monthly	Mean LP
Total Private					
1981	53	23	20	4	1.6
1999	53	33	9	5	1.6
2002	48	34	12	5	1.6
2007	32	46	19	3	1.8
Employee-Weighted Distribution - Total Private					
2007	33	50	15	3	1.8
Establishment-Weighted Distributions					
2002 - Major Industry Group					
Natural resources & mining	53	30	11	6	1.6
Construction	78	14	4	4	1.3
Manufacturing	64	25	7	3	1.4
Wholesale trade	37	39	13	11	1.9
Retail trade	61	27	9	4	1.5
Transportation & warehousing	61	24	10	5	1.5
Utilities	27	53	7	13	2.0
Information	16	61	12	11	2.1
Financial acitivities	46	27	21	5	1.7
Professional & business services	40	35	16	8	1.8
Private education & health	17	57	17	9	2.1
Leisure & hospitality	39	47	10	3	1.7
Other services	37	41	15	7	1.8
2007 - Major Industry Group					
Natural resources & mining	56	27	15	2	1.5
Construction	79	14	4	3	1.3
Manufacturing	64	25	9	2	1.4
Wholesale trade	30	45	18	7	1.9
Retail trade	34	52	13	1	1.7
Transportation & warehousing	49	33	15	3	1.6
Utilities	27	62	10	1	1.8
Information	12	75	11	2	1.9
Financial acitivities	4	54	40	2	2.1
Professional & business services	37	36	21	6	1.8
Private education & health	13	65	19	3	2.0
Leisure & hospitality	27	55	16	2	1.8
Other services	42	35	17	5	1.7