Hours Data and Their Impact on Measures of Productivity Change

by

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I. Introduction

The Bureau of Labor Statistics (BLS) collects data on labor hours in both household and establishment (business) surveys. These data are of interest for a variety of reasons, including comparing the situation of workers over time or in different countries. In addition, hours data are used together with measures of earnings in constructing average hourly earnings or other types of hourly compensation and unit labor costs measures. Another major use of hours data is in measuring productivity, which is a technical relationship between output and inputs in the production process. The present paper focuses on the hours data that are available in the U.S. and how these data are integrated to arrive at a measure of hours worked appropriate for productivity measurement.

As measured U.S. productivity grew strongly in the latter half of the 1990s, some concern was raised about the measurement of hours. For example, Steven Roach of Morgan Stanley Dean Witter argued that the government may be undercounting the number of hours people are working. He believes that many white collar workers are in fact working longer workdays than the official U.S. data show, as a result of the new portable technologies of the information age—laptops, cellular telephones, home fax machines, and beepers; see Roach (1998, p.6). It is important to note, however, that even if there were an undercount of hours worked, it would affect productivity growth only if the undercount were growing differently than measured hours. And even then, it would affect it significantly only if it affects more than a small part of the working population.

In this paper we consider alternative concepts, data sources, and estimation procedures for measuring hours worked and discuss the major advantages and disadvantages of alternative types of hours measures. In addition, we show that using labor force survey data on average weekly hours to construct a total hours series provides a somewhat different picture of the growth of hours in the U.S. than does the hours series used to construct the official productivity measures, which is based primarily on the monthly establishment payroll survey. The paper also discusses ongoing research in the productivity program to improve the estimates of hours worked for nonproduction and supervisory workers, for whom business survey data are lacking at present.

II. Major Sources of Hours Data for the U.S.[1]

The Current Employment Statistics survey (CES) is a monthly payroll survey of nonfarm establishments. The CES collects data on employment for all employees from a sample of nonfarm business establishments. These data refer to persons who worked during, or received pay for, any part of the pay period that includes the 12th of the month. Proprietors (unincorporated self-employed persons) and unpaid family workers are not included. The CES also collects employment, earnings and hours **paid** for production workers in goods-producing

[1] Additional information on each of these data sources is available at http://www.bls.gov.

industries and nonsupervisory workers in service-producing industries.[2] The CES, however, does not collect hours data for nonproduction and supervisory workers.[3] The CES sample is very large—approximately 400,000 establishments—as a result, the data are published for detailed industries and areas.

The Current Population Survey (CPS) is the U.S. labor force survey. CPS data are collected monthly for individuals in a sample of about 60,000 households. Data from the survey are used to construct the official measure of unemployment. The CPS provides information on employment, hours worked, and demographics. Employment- and unemployment-related information refers to the week including the 12th of the month. Hours information refers to hours **worked**, not hours paid. Information is collected monthly on actual hours worked, separately for the primary job and the secondary job. This permits constructing hours worked by industry or occupation, adjusted to a jobs basis.[4] Information also is collected for total hours on all jobs, and for usual hours worked. Households are in the survey for four months, out for eight months, and back in for four months. Certain information is collected only from the outgoing rotation groups, that is, from households currently in their fourth or eighth month in sample. Data on special topics are gathered in periodic supplements.

The American Time Use Survey (ATUS), which began collecting data in 2003, is a survey of how people living in the United States spend their time. The ATUS sample is a subset of households completing their final month of interviews for the CPS, which currently yields about 1,850 completed interviews per month. Beginning in January, 2004, the sample size will be reduced so that the number of completed interviews is expected to be approximately 1,200 per month. Separate estimates for how people spend weekdays and weekends will be developed. ATUS collects a diary of the activities that a respondent was engaged in over the last 24 hours. These activities will include information on hours worked such as time at work, time spent on work activities at home, and interruptions of 15 minutes or longer that take place during the work day.[5] The kinds of activities and the time spent on them are available by various demographic characteristics. Although the ATUS is not designed to collect detailed information on activities at work, it may provide insights on the reporting differences between the establishment and labor force survey estimates of hours. BLS expects to publish data from ATUS in mid-2004.

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[2] Workers on an establishment payroll who are on paid sick leave; on paid holiday or vacation; or who work during only a part of the specified pay period, even though they are unemployed or on strike during the rest of the pay period, are all counted as employed. Persons on the payroll of more than one establishment during the pay period are counted in each establishment which reports them. Persons are considered employed if they receive pay for any part of the specified pay period, but they are not considered employed if they receive no pay at all for the pay period. Also excluded from the CES data are domestic workers in households; persons who are on layoff, on leave without pay, or on strike for the entire pay period; and persons who were hired but have not yet started work during the pay period.

[3] The BLS is planning to collect CES data on earnings and hours for all employees and publish estimates in 2006.

[4] Prior to January 1994, monthly CPS information for industry and occupation referred only to the respondent's primary job. Information about the second job was collected in occasional supplements.

[5] ATUS interviewers are trained to ask for work breaks of 15 minutes or longer any time a respondent reports that he or she worked. Beginning in January 2004, an automated probe will be introduced into the survey instrument. If a respondent reports working for more than 4 hours at one time, the interviewer automatically will be prompted to ask "Did you take any breaks of 15 minutes or longer?" If the respondent reports taking a break, the interviewer records the start and stop time and what was done on that break; if no break, the solid work episode will be recorded.

III. Advantages and Disadvantages of Alternative Types of Hours Measures

There are only two possible data sources in the U.S. for producing timely measures of hours and employment, the CES and the CPS. There are differences in concepts between these two data sources, as described above: the CES collects information on hours paid while the CPS collects information on hours worked. In terms of coverage, only the CPS provides hours data for all persons in the labor force. The CES does not collect data on hours for nonproduction workers in goods-producing industries (roughly 30 percent of workers in these industries) and for supervisory workers in private service-producing industries (roughly 15 percent of workers in these industries). In addition, unincorporated self-employed workers and unpaid family workers are excluded from the CES; these workers account for 8 percent of employment in the private nonfarm business sector.

Establishment data provide reliable reporting and coding on industries and thus are well-suited for producing industry-level measures. Measures for industries based on household reports tend to produce industry estimates with considerable variance, even in a survey as large as the CPS. Thus, BLS's official measures by industry come from establishment surveys wherever possible.

There have been studies that find that labor force surveys may overstate hours worked. A study by Mellow and Sider (1983) provided direct evidence that some workers report working more hours than employers say they work. Using matched CPS and employer record information, they found that the discrepancy between the individual's and the employer's responses was quite small for those paid by the hour but was about 11 percent among managers and professionals. Bound et al. (1989) analyzed individual and firm reports of three different measures of hours of hourly-paid workers. Their data were from the Michigan Panel Study of Income Dynamics (PSID) validation study, a two-wave survey of a sample of workers employed by a single large firm. They found that for these workers there was little bias in the hours worked per week measures, where the bias was defined as the discrepancy between the survey-based measure and the corresponding measure derived from company records.[6]

There is some evidence from household time use diaries that shows that respondents to labor force survey questions such as those in the CPS report higher hours worked compared to the estimates that result from time diary studies; see for instance Hamermesh (1990), who uses Michigan time use diary data for 1975 and 1981; and Robinson and Bostrom (1994), who use three separate studies for 1965, 1975, and 1985.[7] Robinson and Bostrom also show that this reporting difference is greater for those who worked longer hours, and both papers show that it increased over time.[8] Jacobs (1998), however, finds that independent, self-reported measures of

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[6] The focus of their study was on bias due to measurement error when survey-based measures of earnings, hours, and hourly earnings are used in regression analyses.

[7] Note that the sample sizes in these studies are very small.

[8] In the Michigan time diary data reported in Hamermesh, respondents categorized time on the main job into normal work, lunch at work, coffee breaks, and other breaks. Of the total 42.5 average weekly hours, lunch breaks accounted for 4.6 percent of the time and coffee and other breaks combined accounted for 4.17 percent. The time diary total hours are less than the report of 44.0 average weekly hours from the CPS-type usual weekly hours question. Thus, it is possible to use time diary data to construct alternative hours measures. Robinson and Bostrom

working time based on time of departures to and returns from work tend to corroborate labor force survey types of hours questions.[9]

The CPS was redesigned in 1994. The revised questionnaire changed the way hours information is obtained.[10] We are not aware of any studies comparing the post-redesign CPS questions with time use questions, but presumably the discrepancy is less, if it exists at all.[11]

IV. Use of Hours Data in U.S. Productivity Measurement

The most basic measure of productivity is labor productivity, which is an index of output divided by an index of hours worked. Labor productivity measures the efficiency with which output is produced. Sources of labor productivity growth include changes in the quantity used of other inputs (i.e., capital, fuels, other intermediate materials, and purchased services); changes in technology; economies of scale; improvements in management techniques; and improvements in the skills of the workforce. A broader measure of productivity is multifactor productivity, which is an index of output divided by an index of combined inputs.

Understanding productivity trends is important for businesses, labor, policy makers, and researchers. To produce the official U.S. productivity series, BLS determines the sectors that are important for analyzing productivity and for which the underlying data are sufficiently well measured to merit publication.[12]

BLS produces quarterly measures of labor productivity for major sectors of the economy, including business, nonfarm business, nonfinancial corporations, manufacturing, and durable and nondurable manufacturing. The business sector measure excludes from GDP the following sectors: non-profit institutions, paid employees of private households, general government, and the rental value of owner-occupied housing.[13] Annual labor productivity measures are produced for all 3- and 4-digit SIC level manufacturing, wholesale and retail trade industries and a variety of industries in mining and the service-producing sector. Annual multifactor productivity

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do not clearly define how they construct their hours measures, but imply throughout their discussion that they are dissatisfied with people including work breaks in the time they report on labor force surveys; those hours, however, should not be excluded for purposes of productivity measures. Time use surveys generally have much lower response rates than do labor force surveys, so discrepancies estimated from the former surveys may not apply to all workers.

[9] He argues that Robinson and Bostrom's result that those who work longer hours tend to over report hours more may be a statistical artifact of regression to the mean.

[10] In the revised CPS, the question on usual hours is asked first, followed by questions about overtime and taking time off for reasons such as illness, slack work, vacation or holiday.

[11] Polivka and Rothgeb (1993, p. 16) report that "The mean of reported hours measured with the current [pre-1994] wording was 39.0 compared to 37.9 hours measured with the revised [1994- and later] wording." This is a combined survey effect of the employment and hours questions.

[12] This does not mean, of course, that the data underlying the published measures are ideal. BLS continues to consider measurement issues as part of its data construction, analysis, and publication effort.

[13] The real gross products of general government, of private households, and of nonprofit institutions are estimated primarily using data on hours worked and thus move with measures of input data and would bias labor productivity trends toward zero. The gross product of owner-occupied housing and the rental value of buildings and equipment owned and used by nonprofit institutions serving individuals are excluded because no adequate corresponding labor input measures can be developed. The business sector measure includes government enterprises.

measures are produced for major sectors, all 2- and 3-digit manufacturing industries and one service-sector industry. The BLS's measures of multifactor productivity for the business and nonfarm business sectors utilize a more complex measure of labor input, in which labor hours are adjusted to allow for differing contributions by workers of differing skill levels.[14] We focus attention in this paper on the treatment of hours in the major sector labor productivity measures.[15]

In measuring productivity, it is appropriate to define hours as all hours spent at work. In measuring hours worked, we exclude paid vacations and other forms of paid leave but include paid time for traveling between job sites, coffee breaks, and machine downtime. These are best viewed as benefits rather than as time available for production. Off-the-clock hours affect output and ideally should be included. Such hours seem unlikely to occur for hourly-paid workers. For salaried workers, the concept of hours paid or worked may be fuzzy in some instances. Different types of data will treat off-the-clock hours differently.

The BLS constructs a quarterly measure of hours worked for all persons for use in measuring major sector productivity by combining data available from various sources. The primary source of hours information for the productivity program is the monthly establishment survey, the CES. Consideration of the characteristics of the two major sources as discussed above led the productivity program to prefer to utilize the CES data, where possible. In addition, establishment hours data are more consistent with the measures of output used to produce productivity measures; output data are based on data collected from establishments. The CES data, however, must be converted to an hours worked basis and be appended to incorporate the hours of nonproduction and supervisory workers. Data on employees of farms, proprietors, and unpaid family workers are not available from the CES. Data on these workers are obtained from the Current Population Survey (CPS).[16]

Data from other BLS surveys are used to convert hours paid from the CES to an hours worked basis. Information from the National Compensation Survey program is used for 2000 forward and the annual Hours at Work Survey (HWS), which was terminated after 2000, is used for years prior to 2000. The conversion from hours paid to hours worked is carried out at approximately the two-digit SIC level for manufacturing and the one-digit SIC level for other sectors.

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[14] BLS's productivity program also produces unit labor cost series. Unit labor costs equal hourly compensation divided by labor productivity (or equivalently compensation per unit of real output). Changes in unit labor costs are watched widely as an indicator of potential cost/inflationary pressures.

[15] Output measures are based on a variety of sources: the Bureau of Economic Analysis' (BEA's) National Income and Product Accounts (business, nonfarm business, nonfinancial corporations), the Federal Reserve Board Index of Industrial Production and Census Bureau sources (total manufacturing, durable manufacturing, nondurable manufacturing), Census Bureau and other sources for detailed industry measures, and BLS's Producer Price Index and Consumer Price Index programs. Series are being converted from an SIC basis to a NAICS basis.

[16] Employment counts for employees in agricultural services, forestry and fishing are extrapolated in the current period using limited information on employment in agricultural services. The number of employees of government enterprises comes from the BEA. These are extrapolated using information from the CES. Average weekly hours for these employees are from the CPS. The CPS is also used in producing the labor composition adjustment to the labor input measure used to construct the multifactor productivity numbers for the private business and nonfarm business sectors.

In constructing the productivity measures for major sectors, BLS estimates the hours for nonproduction and supervisory workers. For the manufacturing sector, the levels of hours paid for nonproduction workers for 1977 and earlier years are derived using data from BLS studies of wages and supplements in manufacturing. At the time those data were discontinued, it was decided that the best approach was to assume that the average weekly hours of nonproduction workers change at the same rate as those of production workers.[17] For non-manufacturing industries, it is assumed that the average weekly hours of nonproduction and supervisory workers are the same as those of production and nonsupervisory workers, i.e. they move at the same rate and have the same level. The primary assumption underlying these estimates is that production/nonsupervisory and nonproduction/supervisory workers work similar hours.

V. Estimating the Hours Worked of Nonproduction and Supervisory Workers

An ongoing BLS study (Eldridge, Manser, and Otto, 2001) evaluates the hours series that underlie the major sector labor productivity statistics and sheds light on the direction and magnitude of any bias created by the estimation of nonproduction and supervisory employee hours. In this section we summarize results of their study, which generates alternative hours measures for nonproduction and supervisory workers and compares these hours with those underlying the BLS productivity estimates.

Eldridge et al. use data from the CPS to construct ratios of average weekly hours worked by nonproduction/supervisory workers relative to average weekly hours worked by production/ nonsupervisory workers. Because workers are not classified as production/nonproduction or nonsupervisory/supervisory in the CPS, they utilized three alternative approaches to defining those worker groups. They selected a preferred alternative based on the ability of each alternative to reproduce estimates from the CES of employment shares of nonproduction and supervisory workers, the ability to reproduce trends in the average weekly hours of production and nonsupervisory workers, and the quarterly movements of each alternative series around peaks and troughs.

Next, Eldridge et al. use the chosen CPS ratio to construct a CPS-adjusted series of average weekly hours worked for nonproduction and supervisory workers. This adjusted series is used to assess the validity of the assumptions underlying the official productivity data. Eldridge et al. find that the levels of average weekly hours of nonproduction/ supervisory workers in the nonfarm business sector constructed by adjusting the CES hours by the CPS ratios differ notably from those constructed using the current assumptions, that is, they do not support the assumptions that underlie the published productivity measures.[18] This is the case for various industries (at the one-digit SIC level), with the greatest difference arising for retail trade.

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[17] These studies provide data before 1978 on the regularly scheduled workweek of white-collar employees. See *Employee Compensation in the Private Nonfarm Economy*, *1977,* Summary 80-5 (Bureau of Labor Statistics, April 1980).

[18] To the extent that there is similar over reporting of hours in the CPS for both nonproduction/supervisory workers and production/nonsupervisory workers, use of estimated ratios of hours for the two groups of workers to construct a total hours measure will not introduce a bias. However, if nonproduction and supervisory workers are more likely to over-report hours to the CPS, using these ratios will provide only an upper bound to the true hours of these workers.

The CPS-adjusted average weekly hours series for nonproduction/ supervisory workers is then used to construct a CPS-adjusted total hours series for the nonfarm business sector. The annual percent change in the total hours series for the nonfarm business sector using the current assumptions is given in line 1 of Table 1 for four periods between 1979 and 2002. The corresponding CPS-adjusted series is shown in line 2 of Table 1. The corresponding trends in productivity are found in Table 2. We see that trends in the adjusted total hours series for nonfarm business are identical to the trends in the hours series that underlie the official productivity measures to within 0.04 percent, while the series are published at the one decimal level. The primary reason for this finding is that nonproduction and supervisory employees account for only 18 percent of total hours in the nonfarm business sector. Thus, the lack of data for nonproduction and supervisory employee hours is not resulting in biased measures of major sector labor productivity statistics. In addition, the data do not support recent criticism that the BLS is overstating productivity growth because of an undercount of the number of hours people are working. Finally, the behavior of the CPS-adjusted series over the business cycle is very similar to that of the existing series.

There are good reasons to make adjustments to the productivity program's hours series for nonproduction and supervisory workers using CPS data, however. First, the current trends in average weekly hours for nonproduction and supervisory workers underlying this hours series are based largely on assumptions rather than data. In addition, Eldridge et al. have shown that the level of the CPS-adjusted average weekly hours for nonproduction/ supervisory workers is not the same as that of production/nonsupervisory workers, so that our levels series needs revision. They have also shown that, according to the CPS-adjusted data, the trends in average weekly hours for nonproduction/supervisory workers and production/nonsupervisory workers are not the same in some industries for some time periods. Therefore, it is important to replace current assumptions and improve current estimates of hours for nonproduction and supervisory workers. Adjustments currently are being developed for more detailed industry series. The BLS plans to collect CES data and produce estimates of earnings and hours for all employees in 2006, so that use of the adjusted series will provide a series that is consistent both conceptually and empirically with the future data at all industry levels.

VI. Impact on Productivity for the Nonfarm Business Sector: CES vs. CPS

The recent divergence in the CES and CPS employment data have led some to speculate about the impact of using different sources of hours data to construct labor productivity measures. Therefore, for research purposes, we compared the BLS productivity program's hours series and two "hypothetical" hours series.

For this exercise, we constructed the two hypothetical series using methods as similar as possible to those used to construct the hours series that underlie the official productivity series. Both data series are constructed using average weekly hours and employment for wage and salary employees by industry. The hours of nonprofit employees are removed and the data are then aggregated to the private nonfarm business sector, excluding government and private households. CPS hours for self-employed, unpaid family workers and general government are added to the aggregate to arrive at a series for all persons in the nonfarm business sector.

The first hypothetical hours series (CES-CPS) is constructed using CES employment and CPS average weekly hours. In order to combine the CES series based on jobs and the CPS series based on persons, we made an adjustment for multiple job holders. The multiple job holder adjustment was constructed from our earlier research. The second hypothetical hours series (CPS-based) is constructed using CPS average weekly hours, as well as CPS employment. Because a consistent time series of CPS data that incorporates the updated Census population controls does not exist, we wedged-back the 2000 Census benchmark to 1990. In addition, there is also no adjustment for the 1994 CPS redesign. Therefore, we reiterate, that these series are strictly for research purposes and should be used with caution.

From the chart below we see that the two series that are constructed using CPS data produce higher levels of hours worked than the hours series that underlies the official productivity series. This is consistent with the conjecture that average weekly hours from the household survey may be overstated. The difference in employment leads to the CES-CPS series being slightly greater than the adjusted all CPS hours series. Note that the CES-CPS series also includes the hours of nonemployees from the CPS.

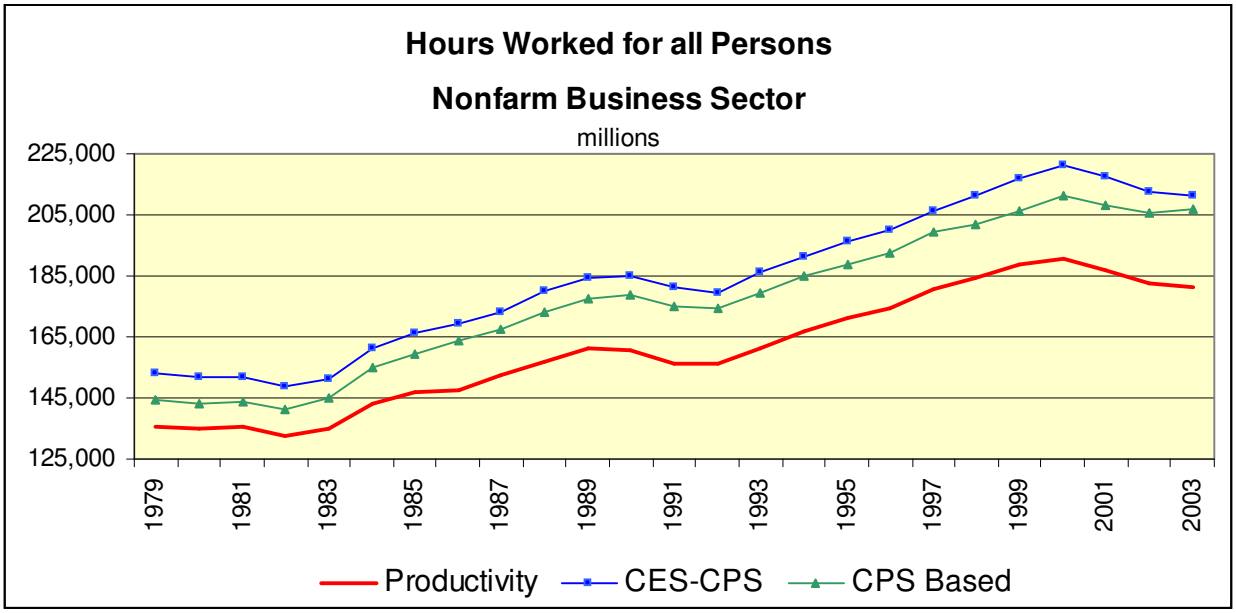

Table 3 presents the annual average percent change in the three hours series. The trends show that the Productivity hours series grows more slowly than the two other series prior to 1990. This is a result of CPS average weekly hours growing faster than CES average weekly hours, and CPS employment growing faster than CES employment. From 1990-1995 the Productivity and CPS hours series grow at relatively similar rates, however the CES-CPS series grows less rapidly. This implies that differences in the trends in average weekly hours and employment must be offsetting one another.

From 1995-2000, the Productivity series grows more slowly than the two others and the CES-CPS series grows faster. This suggests that the CPS average weekly hours are growing faster than the CES average weekly hours. Comparing the CES-CPS and CPS based series

suggests that CPS employment is growing more slowly than CES employment for the 1995-2000 period. From 2000-2003 the Productivity hours and the CES-CPS hours are declining at a much faster rate than the all CPS hours. This results primarily from the differences in employment trends over this period.

Productivity trends using the three different hours series are presented in Table 4. The results mirror those in Table 3. Prior to 1990, the official productivity series grows faster than those incorporating any CPS data for wage and salary workers. For the period 2000-2003, the official productivity series and the CES-CPS series grow significantly faster than the all CPS series, due to differences in the underlying trends in trends in employment.

From this exercise, we see that the choice of hours will impact measures of productivity. However, the exercise also reveals that the acceleration in productivity growth exists in all three series.

VII. Concluding Remarks

The BLS produces hours series based on data sources with different purposes. For purposes of productivity measurement, we combine data from different sources but have always preferred to use establishment data where possible. In this paper we discuss various concepts, data sources and estimation procedures for measuring employee hours worked and their implications for productivity measures. Results reported in Section VI show that using household survey (CPS) data on average weekly hours to construct a total hours series provides a somewhat different picture of the growth of hours than does the hours series used to construct productivity measures, which is based primarily on the monthly establishment payroll survey (CES).

Eldridge et al.'s (2001) study summarized in Section V of this paper used CPS information on the ratios of hours worked by nonproduction and supervisory workers relative to hours worked by production and nonsupervisory workers together with CES hours estimates for included workers to construct an alternative hours series. This alternative series yields essentially the same result on hours changes as the series currently used for the productivity measures, and hence does not yield a different estimate of productivity change. In sum, the productivity estimates are biased trivially, if at all, by the absence of data on the actual hours of nonproduction and supervisory workers. The adjusted series, however, provides an improved estimate of the level of total hours for all employees that could be used for a variety of purposes. It is always possible that a greater distortion will emerge in future years, therefore BLS is planning to incorporate the CPS-adjusted total hours series into the labor productivity series calculations. As information from the ATUS becomes available in the future, it will be important to examine information from it to compare with CPS hours and also to research various issues about use of time at work.

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TABLE 1
Average Annual Percent Change in
Total Hours of All Persons, Nonfarm Business

Measure	1979-90	1990-95	1995-2000	2000-02
1. Official productivity series	1.59%	1.17%	2.08%	-1.56%
2. Adjusted productivity series	1.62	1.20	2.04	-1.58

TABLE 2
Average Annual Percent Change in
Labor Productivity, Nonfarm Business

Measure	1979-90	1990-95	1995-2000	2000-02
1. Official productivity series	1.35%	1.52%	2.49%	2.90%
2. Adjusted productivity series	1.32	1.50	2.53	2.92
3. Output	2.96	2.71	4.62	1.30

Notes:
Data as of June 2003

Line 2 computations from Eldridge, Manser, and Otto (2001); CPS ratio used to estimate hours for nonproduction and supervisory workers.

All series are adjusted to remove employees of nonprofits and include CPS measures of hours for employees of government enterprises, proprietors, and unpaid family workers. All series are constructed from the 1-digit sector level.

TABLE 3
Average Annual Percent Change in
Total Hours of All Persons, Nonfarm Business

Measure	1979-90	1990-95	1995-2000	2000-03
1. Official productivity series	1.54%	1.26%	2.20%	-1.73%
2. CES employment, CPS average weekly hours	1.74	1.16	2.47	-1.56
3. CPS employment and average weekly hours	1.96	1.23	2.26	-0.68

TABLE 4
Average Annual Percent Change in
Labor Productivity, Nonfarm Business

Measure	1979-90	1990-95	1995-2000	2000-03
1. Official productivity series	1.46%	1.57%	2.46%	3.82%
2. CES employment, CPS average weekly hours	1.26	1.68	2.19	3.64
3. CPS employment and average weekly hours	1.04	1.61	2.41	2.73

Notes:
Data as of March 4, 2004

Lines 2 and 3 are approximations that were developed for research purposes. Adjustments are made to make hours approximations comparable to the productivity hours series.

All series are adjusted to remove employees of nonprofits and include CPS measures of hours for employees of government enterprises, proprietors, and unpaid family workers. All series are constructed from the 1-digit sector level.