Alternative measures of supervisory employee hours and productivity growth

An evaluation of new estimates of nonproduction and supervisory employee hours finds that the procedure currently used by BLS to estimate nonproduction and supervisory employee hours for the major sector productivity statistics does not misstate past productivity trends, but does undercount the number of hours worked

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In searching for explanations for the speedup in productivity growth that began in the mid-1990s, economists have analyzed real factors, as well as possible measurement problems. Most often they scrutinize the measurement of prices and real output. However, some analysts have also suggested that the Bureau of Labor Statistics is undercounting the number of hours people are working, and thus overstating productivity growth.

To construct hours for productivity measures, BLS primarily uses establishment reports from the BLS Current Employment Statistics program (CES). The CES, however, only collects hours for production and nonsupervisory workers. Therefore, to generate measures of hours for all employees, BLS must estimate the hours for nonproduction and supervisory workers. The primary assumption underlying these estimates has been that production/nonsupervisory and nonproduction/supervisory workers work similar hours.

This study 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 procedures currently used to estimate nonproduction and supervisory employee hours.[1] Using data from the BLS-sponsored Current Population Survey (CPS), we construct estimates of the number of nonproduction and supervisory workers and their hours worked under three alternative definitions. We find that the estimated levels of average weekly hours for these workers are quite different from the assumptions currently used to estimate these values in the productivity program, at least for the nonfarm business and nonmanufacturing sectors. We use various criteria to select one of the three alternative definitions as preferred. Using the preferred alternative, we estimate the ratio of supervisory to nonsupervisory employee average weekly hours from the CPS and multiply this ratio by the level of nonsupervisory employee hours from the CES to estimate the level of supervisory employee hours. Nonproduction employee hours are estimated following this same approach. We find that trends in these CPS-adjusted hours series are very similar to trends in the hours series that underlie the official BLS productivity measures. One reason for this finding is that nonproduction and supervisory employees account for only 19 percent of total hours in the nonfarm business sector. Thus, the lack of data for nonproduction and supervisory workers is not resulting in biased measures of productivity trends.

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Productivity measurement

BLS produces productivity statistics for major sectors of the U.S. economy, many domestic industries, and foreign countries. This article focuses on the BLS quarterly labor productivity statistics for the U.S. nonfarm business sector.[2] Labor productivity measures the relationship between real output and the labor resources used in the production of that output. The difference between output growth and labor hours growth is understood to reflect many sources of growth,

including increases in the quantities of nonlabor inputs (that is, capital services, fuels, other intermediate materials, and purchased services); changes in technology; economies of scale; improvements in management techniques; and improvements in the skills of the labor force.

To calculate labor productivity for the U.S. nonfarm business sector, BLS combines indexes of real output, from the National Income and Product Accounts (NIPA) produced by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce, with information on labor inputs from BLS. Indexes of hours paid are constructed primarily with data from the BLS Current Employment Statistics program, and with supplementary data from the BLS Hours at Work Survey, the National Compensation Survey, and the CPS.

The CES is a monthly payroll survey that collects data on employment for all employees from a sample of nonfarm business establishments.[3] The CES also collects data on the average weekly hours-paid for production workers in goods-producing industries and nonsupervisory workers in service-producing industries. Because the CES, however, currently does not collect hours data for nonproduction and supervisory workers, BLS estimates hours for these employees in order to construct productivity measures.[4] For the manufacturing sector, the levels of average weekly hours paid for nonproduction workers are extrapolated from an estimate for 1978 using the growth trends of production worker average weekly hours. The 1978 level estimate is generated using a ratio of office to nonoffice worker average weekly hours from the BLS studies of wages and supplements in manufacturing.[5] For nonmanufacturing industries, it is assumed that average weekly hours for supervisory workers are the same as those for nonsupervisory workers.

In accord with the definition of productivity, it is appropriate to define hours as hours worked.[6] Data from the BLS Hours at Work Survey have been used to convert average weekly hours paid from the CES to an hours-at-work basis. Hours at work exclude all forms of paid leave, but include paid time for traveling between job sites, coffee breaks, and machine downtime. Paid leave is best viewed as a benefit rather than as time available for production.[7] 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. Beginning in August 2003, data from the National Compensation Survey is used to construct the hours-at-work to hours-paid ratios for years after 2000.

Data on proprietors (unincorporated self-employed workers) and unpaid family workers, who are not covered by the CES, are obtained from the CPS, the monthly labor force survey of households.[8] Data from the CPS are collected on an hours worked basis. Remaining data are obtained from various sources.[9]

Alternative sources of hours data

In practice, there are only two sources of data that could be used to construct timely quarterly estimates of hours, the CES and the CPS. Hours measures from these sources may differ both because of survey methodology and concepts. To produce industry-level productivity measures, BLS prefers to use establishment data both for quarterly and annual measures. Establishment reports provide more reliable reporting and coding on industries. Measures for industries based on household reports are less accurate than those from establishment surveys, and household surveys will tend to produce estimates at the industry level with considerable variance, even in a large survey. In addition, establishment hours data are more consistent with the measures of output used to produce productivity measures that are based on data collected from establishments.

Some workers may work hours that are not paid and reported by establishments.[10] Presumably, CPS data capture these hours. A study by Wesley Mellow and Hal Sider provides direct evidence that some workers report working more hours than employers say they work.[11] 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. John Bound and others analyzed individual and firm reports of three different measures of hours of hourly-paid workers.[12] 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, in which the bias was defined as the discrepancy between the survey-based measure and the corresponding measure derived from company records.[13]

Evidence from household time use diaries shows that respondents to labor force survey questions, such as those in the CPS, report higher hours worked, compared with the estimates that result from time diary studies.[14] John P. Robinson and Ann Bostrom also show that this reporting difference is greater for those who worked longer hours, and both studies show that it increased over time.[15] Jerry Jacobs finds that independent, self-reported measures of working time based on time of departures from and returns to work tend to corroborate labor force survey types of hours questions.[16] This would be consistent with a situation in which respondents have personal uses of time at work that they do not subtract from the hours they report on labor force surveys, which is presumably a source of discrepancy between these results and time-use survey results.

Definitive information is lacking on reasons why the labor force survey questions, taken from the pre-1994 CPS ques-

tionnaire, result in higher estimates of hours than do the time-use survey questions. We are not aware of any studies comparing the questions from the redesigned CPS that was implemented in 1994 with time-use survey questions.

Although the CES is the preferred source for industry level analysis, use of this survey for productivity analysis remains limited by the fact that it does not collect hours data for nonproduction and supervisory workers.[17] Therefore, this study looks at data from the CPS to assess the assumptions, used in the productivity measures, concerning the hours worked of nonproduction and supervisory workers relative to production and nonsupervisory workers. Although we acknowledge possible shortcomings associated with household survey data, we reiterate that the CPS is the only alternative to the CES as a source of timely quarterly hours data.

New approach: measuring employee hours

To develop a new measure of total hours for nonproduction and supervisory workers, we utilized the CPS to construct a ratio of the average weekly hours of nonproduction/supervisory workers relative to the average weekly hours of production/nonsupervisory workers. This ratio is then multiplied by the employment data for nonproduction and supervisory workers and the average weekly hours for production/nonsupervisory workers that come from establishment surveys. To the extent that there is similar over-reporting of hours in the CPS for both types of worker groups, use of the ratio to estimate hours will not introduce a bias. If nonproduction and supervisory workers are more likely to over-report hours to the CPS, using the ratio will provide only an upper bound to the true hours of these workers.

In the CPS, respondents are not asked to classify themselves as production/nonsupervisory workers or nonproduction/supervisory workers. They are asked, however, to report information on their occupation and industry of employment. Using this information, there are various ways to sort CPS respondents into groups of production and nonsupervisory workers, versus nonproduction and supervisory workers. We ideally would like to construct these groupings in a manner that is consistent with the way employers report on workers for the CES.

Prior research. In a 1998 study, Katharine G. Abraham, James R. Spletzer, and Jay C. Stewart (Abraham and others) examined alternative weekly earnings and hours series in order to assess their impact on the trends in alternative average hourly earnings series constructed using CES and CPS data.[18] Abraham and others generated a CPS-adjusted earnings series that restricts coverage to production and nonsupervisory workers by identifying those in the CPS data whose reported occupations would be consistent with employers' reports on production and nonsupervisory workers. They then compared earnings of this group of workers with actual CES data. They found that the difference in trends of the CES and CPS average hourly earnings series is primarily a result of divergence of the underlying earnings data, rather than the hours data.

To identify nonproduction and supervisory workers, Abraham and others began by using definitions for these groups based on broad occupational categories. More specifically, supervisory workers in service industries are defined as executives and administrative and managerial workers. In goods industries, nonproduction workers are defined to include professional specialty and technical workers; executive, administrative, and managerial workers; salesworkers, and administrative support workers, including clerical.[19] They refer to this as replication 1.

Replication 1 did not reproduce trends in CES weekly earnings, so Abraham and others speculated that employers might be reporting on nonexempt workers, that is, those who are considered nonexempt from the Fair Labor Standards Act. This act does not differentiate between service-producing and goods-producing industries. Their second approach defines supervisors as exempt workers, including those who are not paid by the hour *and* fall into the following categories: executive, administrative, professional or outside sales positions, as well as certain computer professionals.[20] Abraham and others also considered workers with a supervisory title who are not paid by the hour as professionals, and thus considered them exempt.

Looking at the weekly earnings data separately for goods and services industries, Abraham and others concluded that employers in goods-producing industries seem to be reporting for production workers, as defined in replication 1, and employers in service-producing industries seem to be reporting on nonexempt workers. They defined replication 2 to be the same as replication 1 for goods-producing industries, but assumed that other establishments are reporting for nonexempt rather than nonsupervisory workers. They found that replication 2 more closely identified the proportion of employees that the CES categorizes as production and nonsupervisory workers. From these data they concluded that the fact that the CES only covers production and nonsupervisory workers is the major factor in the divergent trends in average hourly earnings between the CES and CPS.

In addition to analysis on hourly wages, Abraham and others also were concerned about trends in the underlying hours series. They noted that the CPS workweek (converted to a jobs basis) declined at only one half the rate of the CES workweek over the 1983–93 period. Given that CES data include only production and nonsupervisory hours, it is necessary to make assumptions about the hours worked of nonproduction and supervisory workers to compute an all-employee hours series based on CES data. Abraham and others speculated that these assumptions could have imparted a spurious

downward drift in the hours series.[21] However, Abraham and others concluded that this is not the entire story because there is some evidence that individuals may be misreporting hours in the CPS.

Our approach. In this study, our focus is on the hours series underlying BLS productivity measures. For reasons discussed earlier, it is preferable to continue to rely on CES data to the extent possible. Following the Abraham and others methodology, we classify employees in the CPS as production/nonsupervisory workers or nonproduction/supervisory workers, and then we use these data to construct ratios of nonproduction-to-production worker average weekly hours in goods-producing industries and ratios of supervisor-to-nonsupervisor average weekly hours in service-producing industries. These CPS based ratios are used to adjust CES data to arrive at alternative estimates of hours for nonproduction and supervisory workers.

There are several distinctions that exist between the establishment survey and the household survey. To assess the effects on BLS productivity data, our study must adjust the CPS data to be as consistent as possible with CES data. First, the establishment survey excludes proprietors and unpaid family workers, who are covered by the household survey. To arrive at measures for the nonfarm business sector, BLS adds estimates of hours for proprietors and unpaid family workers in the business sector from the CPS. Given that only CPS data are available for these categories of workers, our study assesses differences in CPS and CES hours for private nonfarm wage and salary workers.[22] In our final analysis of hours for the nonfarm business sector, the CPS data for the remaining categories of workers are added back to the wage and salary worker data.

Second, the establishment survey measures jobs, counting a person who is employed by two or more establishments at each place of employment. In contrast, the household survey employment measure counts a person only once, and classifies the person according to his or her primary job. To conduct industry analysis using CPS data, it is necessary to make adjustments to the employment information to capture multiple jobholders and to redistribute hours to the industry where they were worked.[23] Prior to 1994, monthly CPS information by industry and occupation referred only to the respondent's primary job. Information on the industry and occupation of the second job, and information on hours worked at each job, were available only from supplements to the CPS conducted in May of 1957–80, 1985, 1989, and 1991. In the revised CPS, beginning in January 1994 for outgoing rotation groups, information on hours, industry, and occupation are collected separately for the primary and secondary jobs; information is also collected on hours at all jobs. These multiple jobholder data allow the CPS data to be adjusted to a jobs basis. This study interpolates the available data in order to convert CPS hours and employment data to a jobs basis prior to 1994.[24]

Finally, certain persons on unpaid leave for the entire reference period are counted as employed under the household survey, but are not included in the employment count derived from the establishment survey. Therefore, we define a worker as employed if he or she received pay in a given pay period. CPS collects data on employed at work, employed absent from work, and whether an individual was paid for time off. In our estimates using CPS data, "employed" is defined by "employed at work" or "employed, absent *and* paid for time off."[25]

In the CES, production workers in manufacturing and mining refer to employees who engage directly in the manufacture of the establishment's products.[26] Production workers are defined to include working supervisors and group leaders who may be in charge of a group of employees, but whose supervisory function is only incidental to their regular work. In construction, the term "construction workers" covers workers, up through the level of working supervisors, who are engaged directly on the construction project either at the site or in shops or yards at jobs ordinarily performed by members of construction trades.[27] In the remaining private-sector industries (transportation, communications, and utilities; wholesale and retail trade; finance, insurance, and real estate; and services) data are collected for nonsupervisory workers. Nonsupervisory workers are defined to include most employees except those whose major responsibility is to supervise, plan or direct the work of others, such as top executive and managerial positions, officers of corporations, department heads, and superintendents. Non-supervisory employees include working supervisors and group leaders who may be in charge of a group of employees, but whose supervisory function is only incidental to their regular work.

We used CPS micro data for all private wage and salary workers who were employed at work or on paid leave over the January 1979 through December 2002 period.[28] We then sorted these reports into categories of nonproduction/supervisory or production/nonsupervisory workers based upon occupation codes and three alternative definitions. As did replication 1 from Abraham and others, our alternative A (CPS-A) uses broad occupation categories to group respondents as nonproduction/supervisory or production/ nonsupervisory workers. Alternative B (CPS-B) differs slightly from A in goods-producing industries and more so for service-producing industries. In this alternative, we define supervisors in service-producing industries to include those specified in alternative A, as well as those who have the word "supervisor" in their occupational code title. In goods-producing industries we define nonproduction workers as those defined in alternative A plus medical, food, and personal service workers.[29] Finally, for service-producing industries we construct a third alternative, alternative C (CPS-C), which assumes that employers are reporting for nonexempt workers rather than

production and nonsupervisory workers. This corresponds to how Abraham and others classify workers in service industries in their replication 2.

Our study is conducted at the one-digit industry level and the results are aggregated to the goods sector, service sector, total private nonfarm business and nonfarm business sectors. There are two breaks in our CPS series, 1982–83 and 1993–94. The 1982–83 break is a result of a major change in the occupational classification system. This break made a noticeable shift in the data for alternative A. Because alternative A tracks alternative B so closely prior to the break, we imposed the growth rate of B for 1982–83 on A and adjusted alternative A from 1979 to 1983. The 1993–94 break is a result of the major redesign of the CPS questionnaire and survey methods that was implemented beginning in January 1994. We evaluated annual and quarterly movements of the three CPS-adjusted series over this break and determined that they were in a normal range of volatility. Thus, we elected not to link the data over this time period. The data presented in this study are on the 1987 Standard Industrial Classification system and are as of June 4, 2003.[30]

Empirical assessment

One criterion for assessing the alternative CPS-adjusted data series is to evaluate how well the CPS series capture the CES employment shares for production and nonsupervisory workers.[31] This will determine if the CPS data are identifying the same distribution of production/nonproduction and nonsupervisory/supervisory workers that employers are reporting on in the CES. A second criterion is to review the ability of the CPS alternatives to capture trends in average weekly hours of production and nonsupervisory workers. This will reveal whether the alternative that identifies the same distribution of workers also generates data that behave similarly to the CES data.

Employment shares. We first evaluate how well each alternative is able to identify the share of production and nonsupervisory worker employment that is reported in the CES data. In the goods sector, the CPS data show production workers holding a smaller share of employment than do the CES data. (See chart 1, top panel.) This is also the case in the manufacturing and mining industries, while in the construction industry, the CPS data nearly reproduce the CES production workers' shares of employment. (See table 1.) The trends in production workers' shares of employment over the 1979–2002 period show that the CPS shares tend to decline at a somewhat faster rate than the CES shares. Notice that the two CPS alternatives produce almost identical employment shares for production workers. This is not surprising, because the definition of production workers is very similar for these two alternatives in the goods-producing industries.

We can propose two possible explanations for the understatement of production worker employment shares in the CPS data. First, given that the CPS data are based on self-reports, there may be a tendency for workers to inflate their job titles and move themselves into the nonproduction category of workers. This conceivably could happen with workers who divide their time between the two activities. The employers may weight their responsibilities as primarily production, whereas the employees may consider their responsibilities more heavily weighted toward management.

A second possible reason the CPS data may understate employment shares for production workers is that there may be misreporting among contract workers. That is, contract workers may report themselves as employed in the industry that they actually work in rather than in the temporary help industry. If there is more contracting out of nonproduction jobs than of production jobs, one would expect to see a larger share of nonproduction workers in the CPS data for manufacturing and goods-producing industries than in the CES data, which would not count these workers in the goods sector. Further, as contracting out has been growing, one would expect this difference to grow over time.

In the service sector, the three CPS alternatives produce employment shares that are different from one another. (See chart 1, bottom panel.) Alternative A shows nonsupervisory workers holding a larger share of employment than the CES data, and alternatives B and C show nonsupervisory workers holding a smaller share of employment, relative to the CES data. In the service sector, as in the goods sector, all CPS alternatives show a greater decline in the nonsupervisory workers' share of employment over time as compared with the CES data. This greater decline could be due to misreporting in the CPS among contract workers. As we proposed earlier, regarding the goods sector, if contracted service workers are reporting themselves as nonproduction workers in manufacturing, then we would expect to see a decline in nonsupervisory employment reported in the service sector.

For the service sector data, we observe that in recent years, alternative A is identifying the same shares of nonsupervisory employment as those in the CES data. In the earlier years however, alternative A tends to overstate nonsupervisory workers' employment share. Alternative B is closer to the CES shares for the first few years of our sample, and understates nonsupervisory workers' employment shares in the later years. Alternative C tends to significantly understate the nonsupervisory workers' share of employment over the entire period. Thus among the three alternative CPS-adjusted series, alternative A most closely replicates the CES employment shares.

At the 1-digit industry level, alternative A is slightly closer to the CES series on average for the finance, insurance and real estate and services industries, while alternative B is closer to the CES series for the transportation, communications and

Chart 1. **Comparisons of alternative production worker employment shares in the goods sector and nonsupervisory worker employment shares in the service sector, quarterly, 1979–2002**

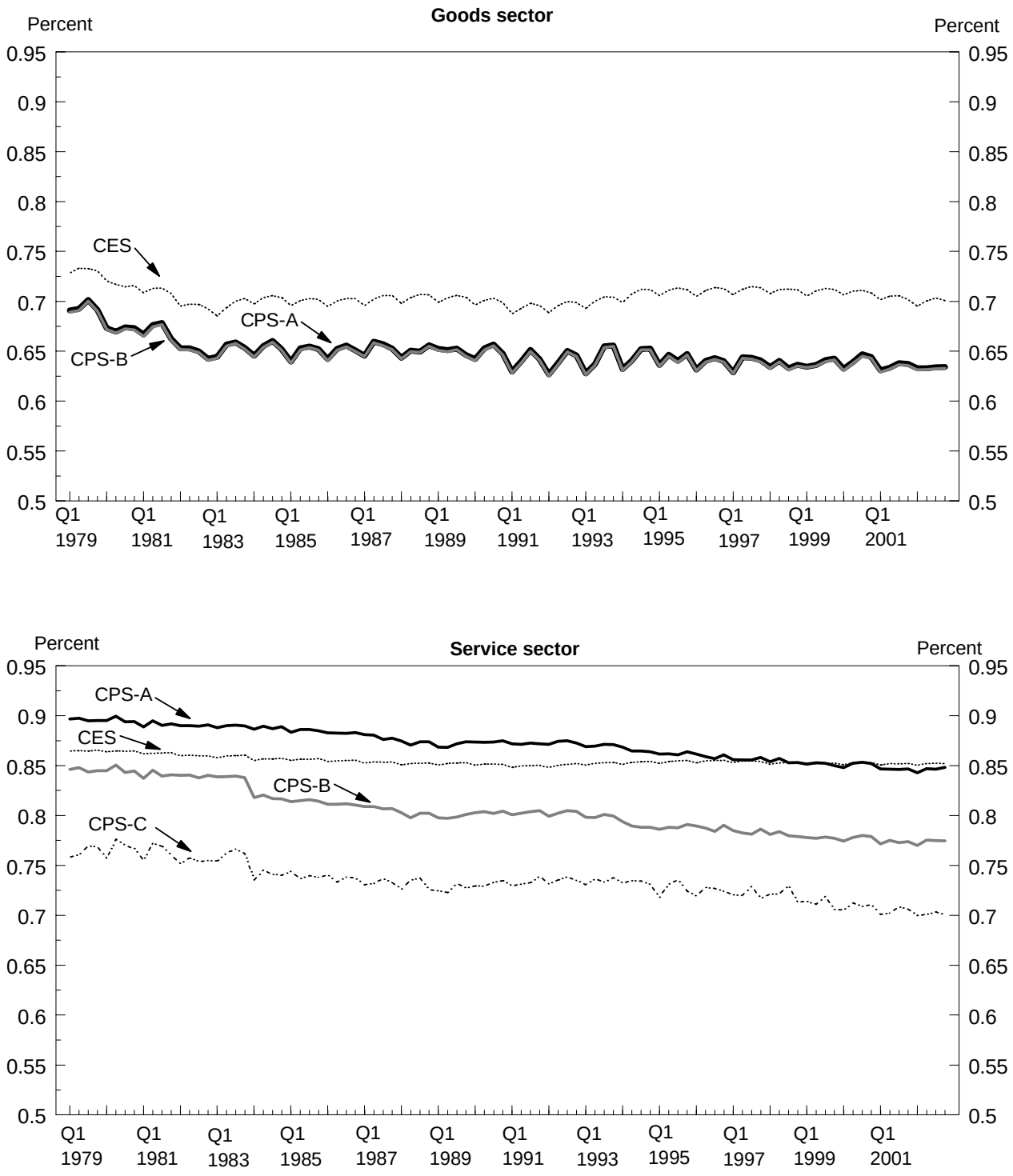


Table 1. Difference between CPS and CES average employment shares for production and nonsupervisory workers, 1979–2002

[Percentage points]

Sector	1979–2002			1979–1990			1990–95			1995–2002		
	CPS-A	CPS-B	CPS-C	CPS-A	CPS-B	CPS-C	CPS-A	CPS-B	CPS-C	CPS-A	CPS-B	CPS-C
Goods sector	–5.6	–5.8	…	–4.7	–4.8	…	–5.8	–5.9	…	–7.0	–7.2	…
Mining	–13.2	–13.3	…	–13.1	–13.2	…	–12.1	–12.2	…	–13.6	–13.8	…
Construction	.4	.3	…	.5	.5	…	.9	.8	…	–.1	–.2	…
Manufacturing	–7.2	–7.3	…	–5.7	–5.8	…	–7.4	–7.6	….	–9.3	–9.5	…
Durable	–8.6	–8.7	…	–8.1	–8.2	…	–9.2	–9.3	…	–9.2	–9.3	…
Nondurable	–6.2	–6.4	…	–3.7	–3.9	…	–6.0	–6.3	…	–10.1	–10.3	…
Service sector	1.7	–5.1	–12.1	2.7	–3.5	–11.1	1.8	–5.4	–11.9	.1	–7.3	–13.8
Transportation, communications, and utilities	3.9	–.1	–4.8	5.0	1.2	–3.8	4.0	–.7	–5.5	2.2	–1.7	–6.0
Wholesale trade	7.7	–8.0	–22.8	7.9	–5.7	–23.0	7.6	–8.7	–22.9	7.4	–11.0	–22.6
Retail trade	4.1	–8.8	–3.4	4.0	–7.6	–3.2	4.5	–9.0	–3.3	4.0	–10. 5	–3.9
Finance, insurance, and real estate	.6	–4.8	–19.1	2.9	–2.1	–17.8	.5	–5.5	–18.8	–2.9	–8.9	–21.4
Services	–1.0	–3.0	–16.3	.3	–1.4	–15.1	–1.1	–3.3	–15.8	–3.1	–5.3	–18.5

NOTE: CPS-A and CPS-B define nonproduction and supervisory workers according to occupational categories. CPS-C applies to service-producing industries only and defines supervisors as exempt workers. See text for details.

utilities industry (table 1). In the retail trade industry, alternatives A and C are roughly equal distance from the CES series, and in the wholesale trade industry, alternative A is slightly closer to the CES series than alternative B, while C is much further away. We also found that, with the exception of the 1990-95 subperiod, alternative A most closely replicates the trends in the CES employment share series.[32]

Based on the ability of the CPS data to capture the employment distribution that we observe in the CES data, alternative A appears to do a somewhat better job among the service-producing industries than do the other alternatives, especially in the recent years. There is no observable difference between the performance of alternatives A and B in the goods-producing industries.

Average weekly hours. Although alternative A most closely captures employment shares of production and nonsupervisory workers, it is important to be sure that trends in average weekly hours for these workers do not differ dramatically among the alternatives. To this end, we compare the trends in average weekly hours of production and nonsupervisory workers from the CPS alternatives with the series that underlies the hours measures used by the BLS Office of Productivity and Technology (OPT) in constructing productivity measures for major sectors. The OPT series adjusts the CES average weekly hours for production and nonsupervisory workers to an hours-worked basis.[33] We see from chart 2 that the trends in the CPS average weekly hours appear to do a better job of capturing movements in the OPT series for the goods sector as compared with the service sector.

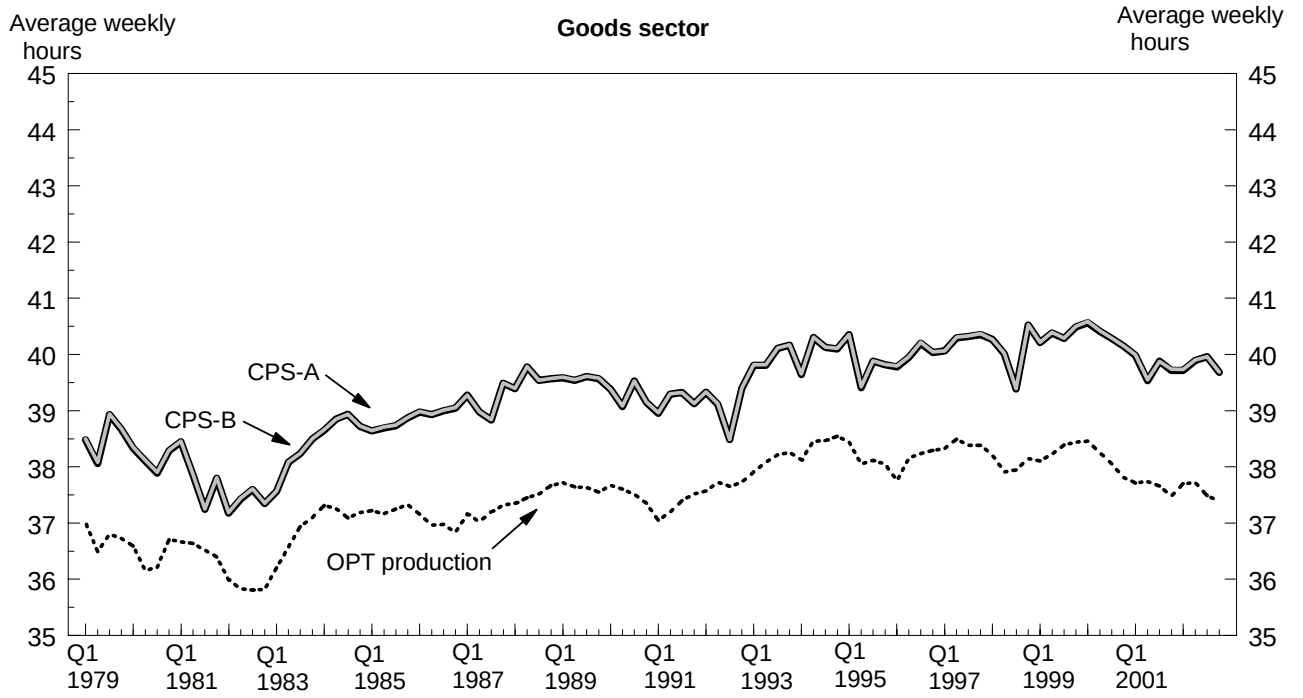
As is the case for employment shares, alternatives A and B produce almost identical results for long-run annual trends in average weekly hours in the goods sector. (See table 2.) In the period prior to 1990, the CPS data do a good job of mimicking the trends in average weekly hours for production workers in the goods sector, as well as for all 1-digit industries within the sector. In the 1990–95 subperiod, the two CPS-based average weekly hours series for production workers are growing slightly slower than the OPT series, compared with the 1995–2002 period, during which, the CPS data are relatively constant and the OPT series is declining. Looking at the 1-digit industry data, we see that the largest difference between the OPT and CPS series appears in the mining industry, while the series are most similar in the construction industry.

For the service sector, the CPS data show a slight increase in the average weekly hours of nonsupervisory workers over the 1979–2002 period, while the OPT series shows a slight decline (table 2). Notice that in all of the 1-digit industries, the three alternative series tend to trend together, although the levels are different. Prior to 1990, we observe the CPS average weekly hours for nonsupervisory workers are showing little or no growth, while the OPT data are showing a slight decline. Over the 1995–2002 period, the CPS series show slight growth, while the OPT average weekly hours series is relatively constant. For every industry, the difference among trends in the three alternative series is small, with each alternative performing the best in at least one industry.

The performance of the long-run annual trends in average weekly hours for the three alternatives is very similar in the service sector, and the performance of trends between the

Chart 2. **Comparisons of alternative average weekly hours for production workers in the goods sector and nonsupervisory workers in the service sector, quarterly, 1979–2002**

[Seasonally adjusted]



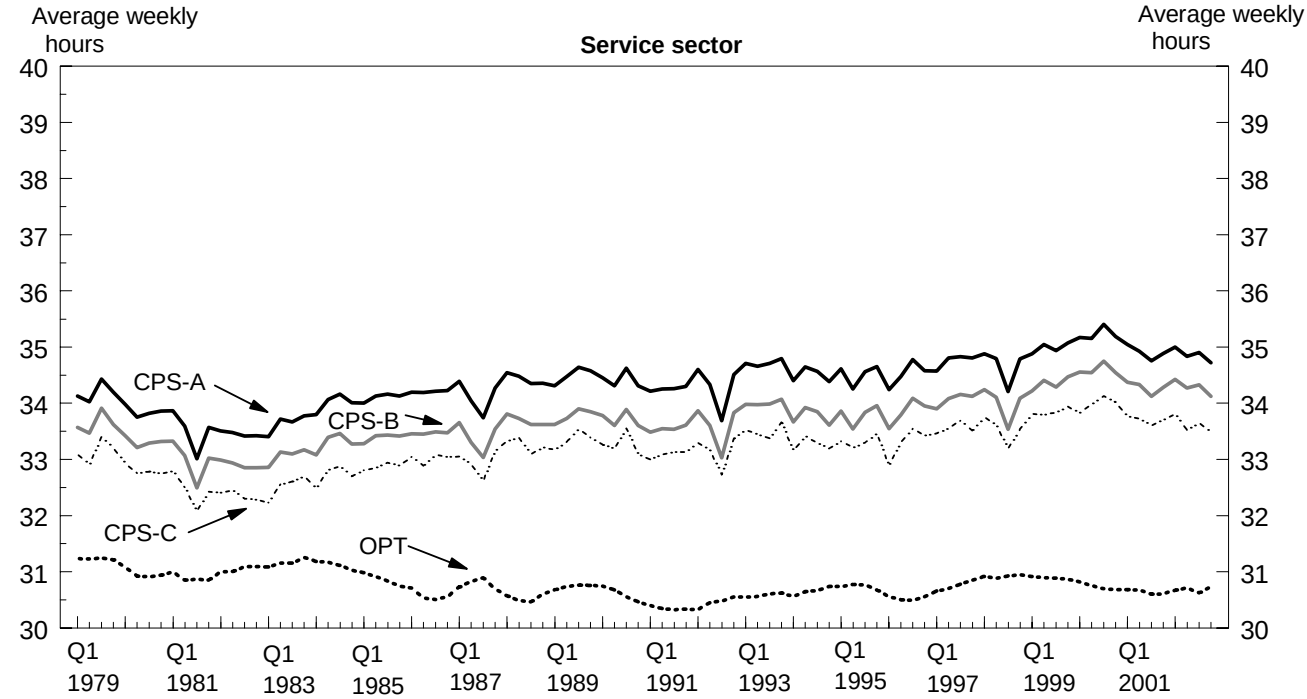


Table 2. **Difference in average weekly hour trends for production and nonsupervisory workers between the Office of Productivity and Technology series and the three alternative CPS-adusted series, 1979–2002**

[Annual average percent change]

Sector	1979–2002			1979–1990			1990–1995			1995–2002		
	CPS-A	CPS-B	CPS-C	CPS-A	CPS-B	CPS-C	CPS-A	CPS-B	CPS-C	CPS-A	CPS-B	CPS-C
Goods sector	.05	.05	…	.00	.00	…	–.05	–.05	…	.20	.20	…
Mining	.52	.52	…	.07	.07	…	.76	.76	…	1.07	1.07	…
Construction	.05	.05	…	.04	.04	…	.01	.01	…	.09	.09	…
Manufacturing	.07	.07	…	.00	.00	…	–.10	–.10	…	.28	.28	…
Durable	.07	.07	…	.01	.01	…	–.13	–.13	…	.33	.32	…
Nondurable	.05	.05	…	.00	–.01	…	–.08	–.08	…	.23	.23	…
Service sector	.16	.16	.14	.25	.21	.22	–.04	–.05	–.08	.17	.23	.15
Transportation, communications, and utilities	.10	.09	.01	.25	.23	.18	–.68	–.70	–.82	.40	.43	.34
Wholesale trade	.10	.11	.13	.26	.23	.27	.00	.00	.12	–.08	.00	–.08
Retail trade	.30	.28	.27	.61	.52	.49	–.22	–.26	–.17	.19	.31	.23
Finance, insurance, and real estate	.21	.18	.11	.41	.37	.29	–.26	–.30	–.54	.23	.23	.30
Services	.07	.06	.09	–.08	–.11	.05	.28	.27	.20	.15	.17	.08

NOTE: CPS-A and CPS-B define nonproduction and supervisory workers according to occupational categories. CPS-C applies to service-producing industries only and defines supervisors as exempt workers. See text for details.

two alternatives is almost identical in the goods-producing sector. Therefore, the analysis of the trends in average weekly hours does not give us any cause to diverge from the selection of alternative A.

For ease of presentation, we present our analysis of the effects of using the CPS adjustment and only alternative A. The choice of CPS alternative makes little difference to the conclusion.[34]

Assessment of current assumptions

In producing the productivity statistics for major sectors, BLS makes certain assumptions about the hours worked by nonproduction and supervisory employees in order to construct hours for all employees. Having selected alternative A as the best means to group CPS data into types of workers, we now use these data to assess the current assumptions underlying the estimates of nonproduction and supervisory worker hours. For the goods-producing industries, the CPS-adjusted average weekly hours for nonproduction workers are calculated by multiplying the OPT average weekly hours for production workers by the ratio of average weekly hours of nonproduction to production workers from the CPS. For the service-producing industries, the CPS-adjusted average weekly hours for supervisory workers are calculated by multiplying the OPT average weekly hours for nonsupervisory workers by the ratio of average weekly hours of supervisors to nonsupervisors from the CPS. These measures are constructed as:

$$AWH_P^{OPT} * \frac{AWH_{NP}^{CPS}}{AWH_P^{CPS}}$$

where AWH_P^{OPT} represents the OPT measure of average weekly hours worked for production and nonsupervisory workers, AWH_{NP}^{CPS} represents the CPS measure of average weekly hours for nonproduction and supervisory workers, and AWH_P^{CPS} represents the CPS measure of average weekly hours for production and nonsupervisory workers. This approach abstracts from the overall upward bias in CPS hours by using ratios of CPS average weekly hours. Because OPT presently uses slightly different estimation techniques for constructing total hours for manufacturing and nonmanufacturing industries, we will present the assessment of the assumptions for the manufacturing and nonmanufacturing sectors, rather than the goods and services sectors.

As mentioned earlier, the OPT hours series for nonproduction workers in the manufacturing sector is constructed by extrapolating an estimate of 1978 average weekly hours using the growth trends of production worker average weekly hours.[35] OPT is assuming that the trends in average weekly hours are virtually the same among production and nonproduction workers.[36] Chart 3, top panel shows the OPT series of average weekly hours for nonproduction and production workers in the manufacturing sector, as well as the alternate CPS-adjusted series for nonproduction workers. We see that the OPT average weekly hours for nonproduction workers are slightly lower than those for production workers. In contrast, the CPS-adjusted average weekly hours for nonproduction workers are slightly greater than those for production workers. Although this suggests that the 1970's levels generated in BLS studies of wages and supplements in manufacturing may be outdated, we are most interested in the behavior of trends.

Table 3 presents the difference between trends in average weekly hours of nonproduction and production workers in manufacturing corresponding to the OPT and CPS-adjusted series.

For the manufacturing sector as a whole, both series show that the average weekly hours of nonproduction workers grew faster than the average weekly hours of production workers prior to 1995. The difference grew slightly faster according to the CPS series than the OPT series. From 1995 to 2002, the OPT series shows average weekly hours of nonproduction workers declined slower than the average weekly hours of production workers, while the CPS-adjusted series shows nonproduction worker average weekly hours declined faster than those of production workers. Therefore, the difference in trends of average weekly hours between nonproduction and production workers grew somewhat according to the OPT series and declined slightly according to the CPS-adjusted series.[37] Thus, based on the CPS-adjusted data, the OPT assumption is slightly understating growth in average weekly hours for nonproduction workers in manufacturing over the 1979–2002 period as well as the 1979–90 and 1990–95 subperiods. From 1995 forward, the OPT assumption is slightly understating the decline in average weekly hours for nonproduction workers in manufacturing. Results are qualitatively similar for the durable and nondurable sectors separately.

For nonmanufacturing industries, hours worked for all employees used in the major sector productivity measures are calculated at the 1-digit level as:

$$AWH_P^{OPT} * N * 52$$

where AWH_P^{OPT} represents the OPT measure of average weekly hours worked for production and nonsupervisory workers and N represents the CES number of paid employees. Using this formula, BLS is implicitly assuming that the average weekly hours of nonproduction/supervisory employees are the same as the average weekly hours of production/ nonsupervisory employees within each 1-digit industry. Aggregating to the nonmanufacturing sector, compositional affects make them not exactly equal, but very close.

From chart 3, bottom panel, it is clear that for nonmanufacturing industries as a whole, the levels of average weekly hours for supervisors from the CPS-adjusted data are significantly greater than the average weekly hours of nonsupervisors. This is true for all service-producing industries, with the exception of wholesale trade. This finding shows that OPT's use of nonsupervisory worker average weekly hours as a proxy for supervisory workers average weekly hours may not be satisfactory. Because trends are most important for productivity measurement, we also must look at the difference in trends in average weekly hours among supervisors and nonsupervisors.

Table 4 presents the difference in trends in average weekly hours for supervisors and nonsupervisors in nonmanufacturing industries. By construction, the OPT measures of average weekly hours for supervisors grow at the same rate as the average weekly hours of nonsupervisors for each industry. Comparing the CPS-adjusted average weekly hours trends for nonsupervisors and supervisors, we see that over the 1979–2002 period, the average weekly hours for supervisors in the nonmanufacturing sector declined at a slightly faster rate than the average weekly hours of nonsupervisors. In the 1990–95 period, the CPS-adjusted average weekly hours of supervisors grew at a slightly faster rate than the average weekly hours of nonsupervisors. Over the 1995–2002 period, the CPS-adjusted average weekly hours for supervisors in the nonmanufacturing sector declined at a somewhat faster rate than the average weekly hours of nonsupervisors.

Thus, the CPS-adjusted series do not support the assumption that the average weekly hours of nonsupervisors in nonmanufacturing industries grow at the same rate as those of supervisors. If we are willing to accept the CPS-adjusted average weekly hours for supervisors, this implies that OPT is overstating the growth in supervisors' average weekly hours in nonmanufacturing over the periods 1979–90, 1995–2002 and understating growth over the 1990–95 period. In view of criticism that productivity growth may be understated because of higher growth in average weekly hours of nonproduction and supervisory workers, it is surprising to see the opposite result in

Table 3. Difference in trends of average weekly hours between nonproduction and production workers

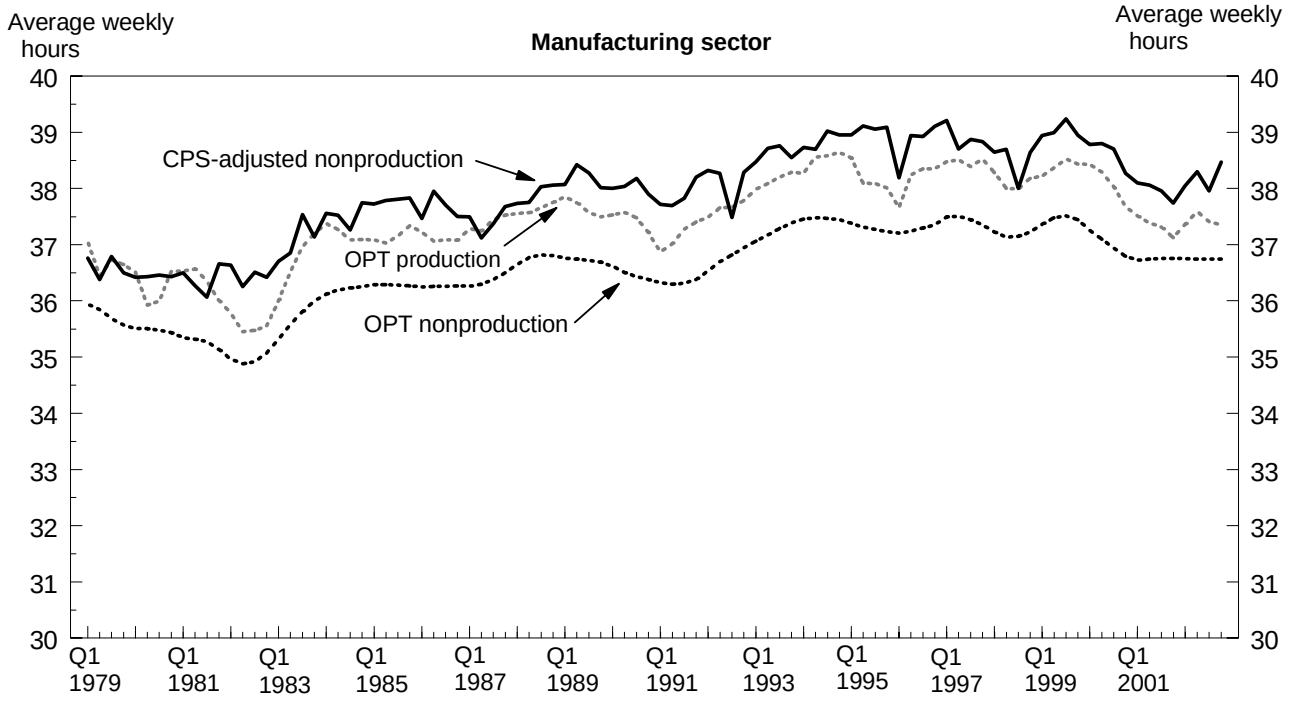
[Annual average percent change]

Industry	1979–2002		1979–90		1990–95		1995–2002	
	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted
Manufacturing	0.05	0.10	0.03	0.16	0.05	0.13	0.07	–0.02
Durable	.06	.06	.03	.08	.06	.13	.09	–.04
Nondurable	.03	.17	.01	.26	.03	.20	.06	.00

NOTE: OPT – This series underlies the hours measures used by the BLS Office of Productivity and Technology. CPS-adjusted –This series adjusts the OPT series using CPS data and alternative A. See text for details.

Chart 3. **Comparisons of average weekly hours by type of worker in the manufacturing and nonmanufacturing sectors, quarterly, 1979–2002**

[Seasonally adjusted]



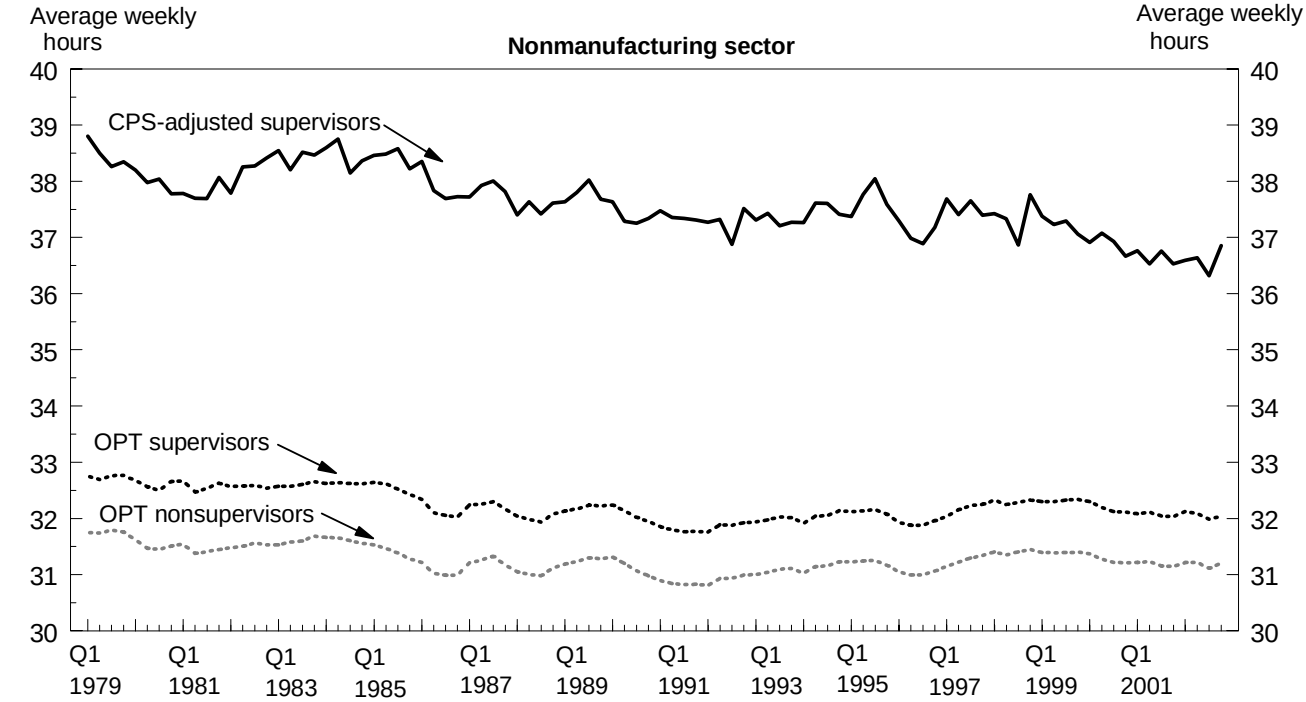


Table 4. Difference in trends of average weekly hours between supervisors and nonsupervisors, 1979–2002

[Annual average percent change]

Sector	1979–2002		1979–1990		1990–1995		1995–2002	
	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted
Nonmanufacturing	–.01	–.14	.0	–.09	–.03	.12	–.01	–.40
Mining	.0	–.43	.0	–.36	.0	–.32	.0	–.61
Construction	.0	–.14	.0	–.09	.0	–.30	.0	–.12
Transportation, communications, and utilities	.0	.01	.0	.06	.0	.56	.0	–.45
Wholesale trade	.0	–.04	.0	–.04	.0	–.19	.0	.06
Retail trade	.0	–.24	.0	–.24	.0	.25	.0	–.59
Finance, insurance, and real estate	.0	–.06	.0	.0	.0	.15	.0	–.30
Services	.0	–.33	.0	–.34	.0	–.08	.0	–.50

NOTE: OPT – This series underlies the hours measures used by the BLS Office of Productivity and Technology. CPS-adjusted – This series adjusts the OPT series using CPS data and alternative A. See text for details.

the CPS data over the 1979–2002 period, as well as in the recent periods since 1995.

This analysis demonstrates that there are good reasons to make adjustments to the OPT hours series for nonproduction and supervisory workers using CPS data. First, the current trends in average weekly hours for nonproduction and supervisory workers underlying the OPT hours series are based largely on assumptions rather than data. In addition, we have shown that, in manufacturing, the trends in the CPS-adjusted average weekly hours for nonproduction workers are not the same as those of production workers. We have also shown that, according to the CPS-adjusted data, the levels of average weekly hours for supervisors are higher than for nonsupervisors in nonmanufacturing industries and the trends in average weekly hours for supervisors and nonsupervisors are not the same. Therefore, it is important to replace current assumptions and improve current estimates of hours for nonproduction and supervisory workers.

Nonproduction and supervisory employee total hours. In constructing productivity measures, BLS does not construct measures of total hours separately for production/nonsupervisory and nonproduction/supervisory employees. However, due to the magnitude of production/nonsupervisory employee hours in the private nonfarm sector, it is more revealing to evaluate the impact of the new methodology on nonproduction and supervisory employee hours independently. To this end, we construct a total hours series for nonproduction and supervisory employees consistent with the published totals by removing the estimated hours of production and nonsupervisory employees from the official hours series for all employees at the 1-digit industry level. Then we aggregate the data to arrive at measures of nonproduction and supervisory hours for the private nonfarm sector, private nonfarm goods sector, and private nonfarm service sector. We compare these series to measures of hours for nonproduction and supervisory workers, incorporating the ratios from the CPS data. The CPS-adjusted estimates of hours for nonproduction and supervisory employees are calculated as:

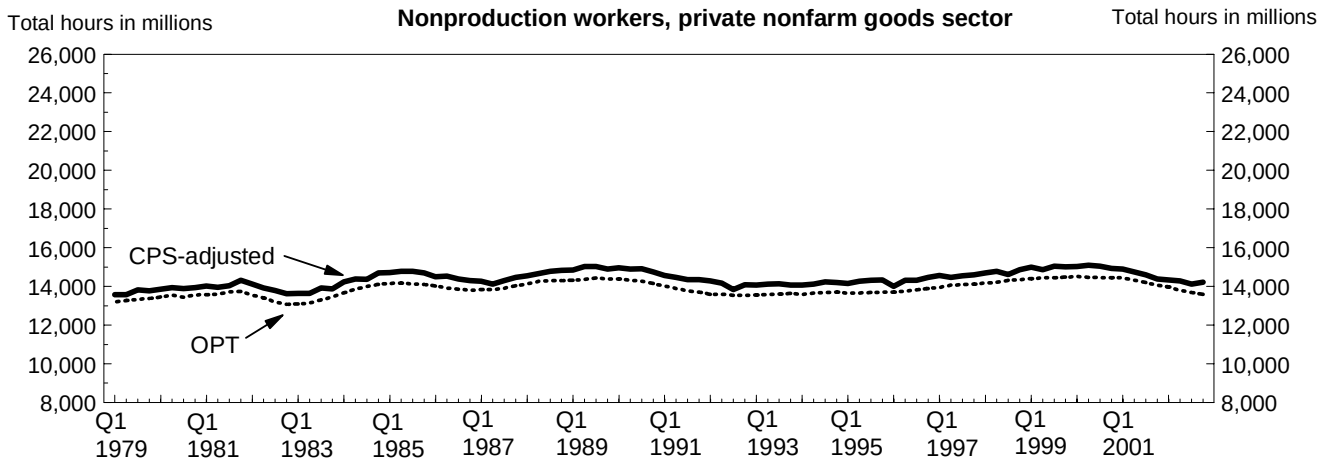
$$AWH_P^{OPT} * \frac{AWH_{NP}^{CPS}}{AWH_P^{CPS}} * N_{np} * 52$$

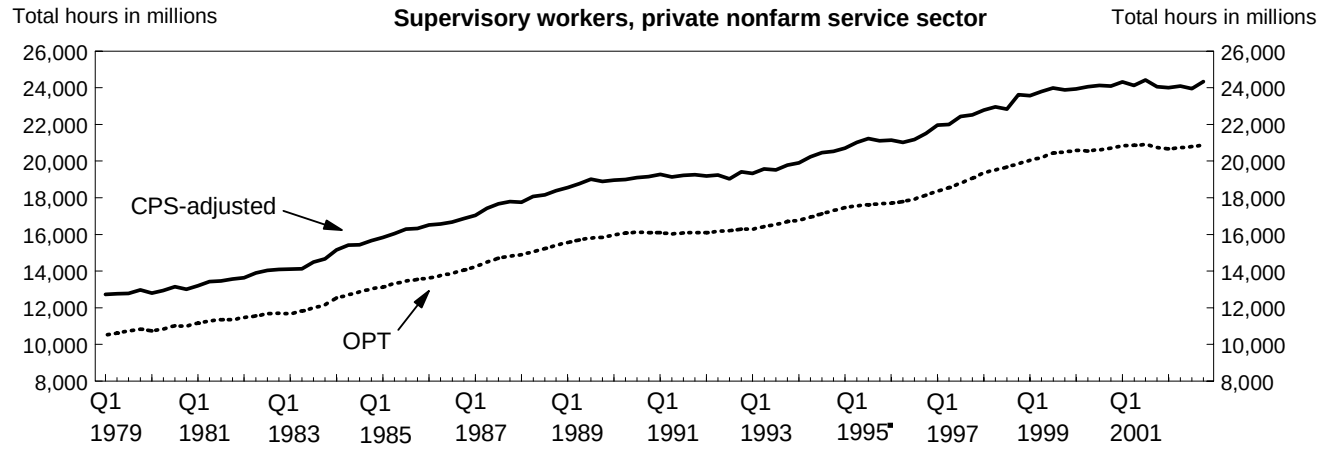
where AWH_P^{OPT} represents the OPT measure of average weekly hours for production and nonsupervisory workers, AWH_{NP}^{CPS} and AWH_P^{CPS} represent CPS measures of average weekly hours for nonproduction/supervisory and production/nonsupervisory workers respectively, and N_{np} represents CES employment for nonproduction and supervisory workers. These series are calculated at the 1-digit industry level and then are aggregated to arrive at measures of nonproduction and supervisory hours for the private nonfarm sector, private nonfarm goods sector, and private nonfarm service sector.

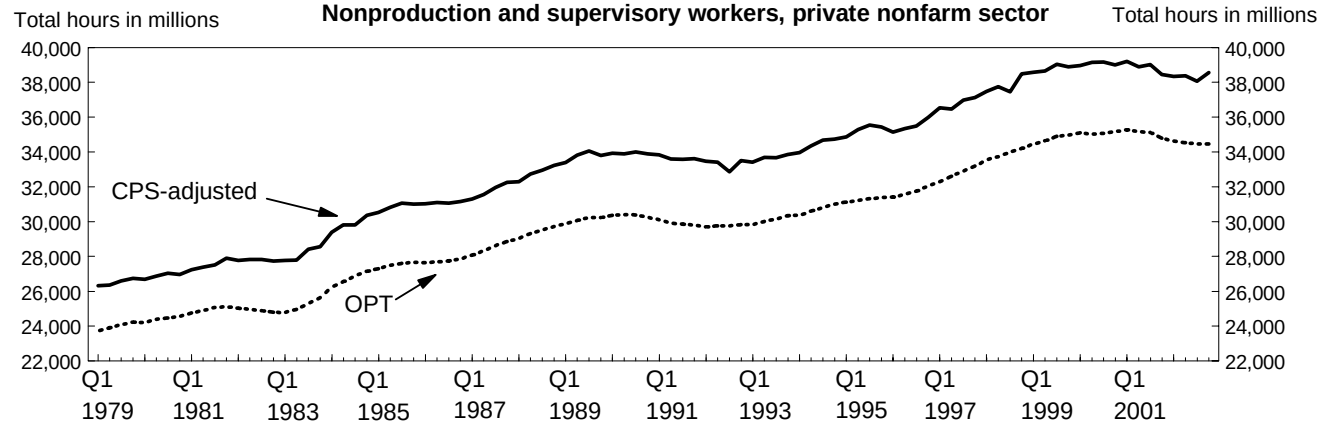
For the 1979–2002 period, the CPS-adjusted data produce nonproduction and supervisory employee hours that are higher than the OPT series. These data are presented in chart 4. Notice that the hours of nonproduction workers in the goods sector are practically unchanged as a result of the CPS adjustment. The biggest difference in the goods-producing sector is in durable manufacturing, in which hours of nonproduction workers adjusted using the CPS data are approximately 6 percent greater than the OPT series in the year 2002. For the service sector, the CPS adjustment has a significant impact on the hours series for supervisory workers, raising the levels of hours approximately 16 percent in 2002. (The average increase is 20 percent over the 1979–2002 period. The biggest difference is in the retail trade industry, in which the CPS-adjusted hours of

Chart 4. **Comparisons of hours for nonproduction and supervisory workers by sector, quarterly, 1979–2002**

[Seasonally adusted]







supervisory workers are on average 37 percent higher than the OPT series over the 1979–2002 period.)

Although the levels data are interesting for various purposes, our primary interest remains on the trend data, which affect the OPT productivity change estimates. In the private nonfarm sector, the CPS-adjusted hours of nonproduction and supervisory workers grew somewhat faster than the OPT hours prior to 1995, but grew somewhat more slowly than the OPT hours after 1995. (See table 5.) Over the entire period, trends in the two series are very similar. Except for mining, a very small sector, the greatest difference in trends between the OPT and CPS-adjusted series occurs for the services industry. For services, the CPS-adjusted hours of supervisors grew more slowly than the OPT series for each subperiod examined.

There are two types of shifts that have an impact on trends in hours (because nonproduction/supervisor hours based on the CPS data are constructed as the product of CES employment and OPT average weekly hours for production/nonsupervisory workers, multiplied by a ratio of CPS average weekly hours for nonproduction/ supervisors to production/nonsupervisors). First, shifts in the proportion of nonproduction and supervisory workers in the workforce will affect the trends. Second, recall that the levels of average weekly hours of nonproduction/supervisory workers are greater than those of production/ nonsupervisory hours, and this difference is notably higher in the service-producing sector, compared with the goods-producing sector. Thus, the CPS-adjusted nonproduction and supervisory hours series can change as a result of the growth of employment in services-producing industries relative to employment in goods-producing industries.

Nonfarm business sector hours and productivity. To calculate the adjusted hours series for private nonfarm employees at the 1-digit industry level, we add the hours of production and nonsupervisory employees that underlie the official productivity measures to the CPS-adjusted series for nonproduction and supervisory employees, described in the previous subsection, and we remove the hours of employees of nonprofit institutions. These hours are then aggregated to arrive at a measure of total hours for private nonfarm employees. To calculate all-person hours in the nonfarm business sector, we combine the CPS-adjusted private nonfarm employee hours with data on hours of employees of government enterprises, proprietors, and unpaid family workers from the official OPT series. The hours series for all persons in the nonfarm business sector that underlie the official OPT productivity measures and the CPS-adjusted series are presented in chart 5, top panel.

Notice that in the nonfarm business sector, the CPS-adjusted hours series closely tracks the OPT series. The levels of total hours from the CPS-adjusted series are approximately 2 percent greater than the OPT series over the entire period 1979–2002. This series is much closer to the OPT series than the CPS-adjusted series for nonproduction/supervisory employee hours is to the corresponding OPT series. The primary reason is that nonproduction/supervisory employee hours account for only 19 percent of total all-person hours in the nonfarm business sector; both the OPT and CPS-adjusted series use identical data for a large portion of the total-person hours calculation.

Comparisons of trends in OPT hours and CPS-adjusted hours are presented in the table 6. For all of the subperiods considered, trends in the CPS-adjusted estimates of hours of all persons in the nonfarm business sector are identical

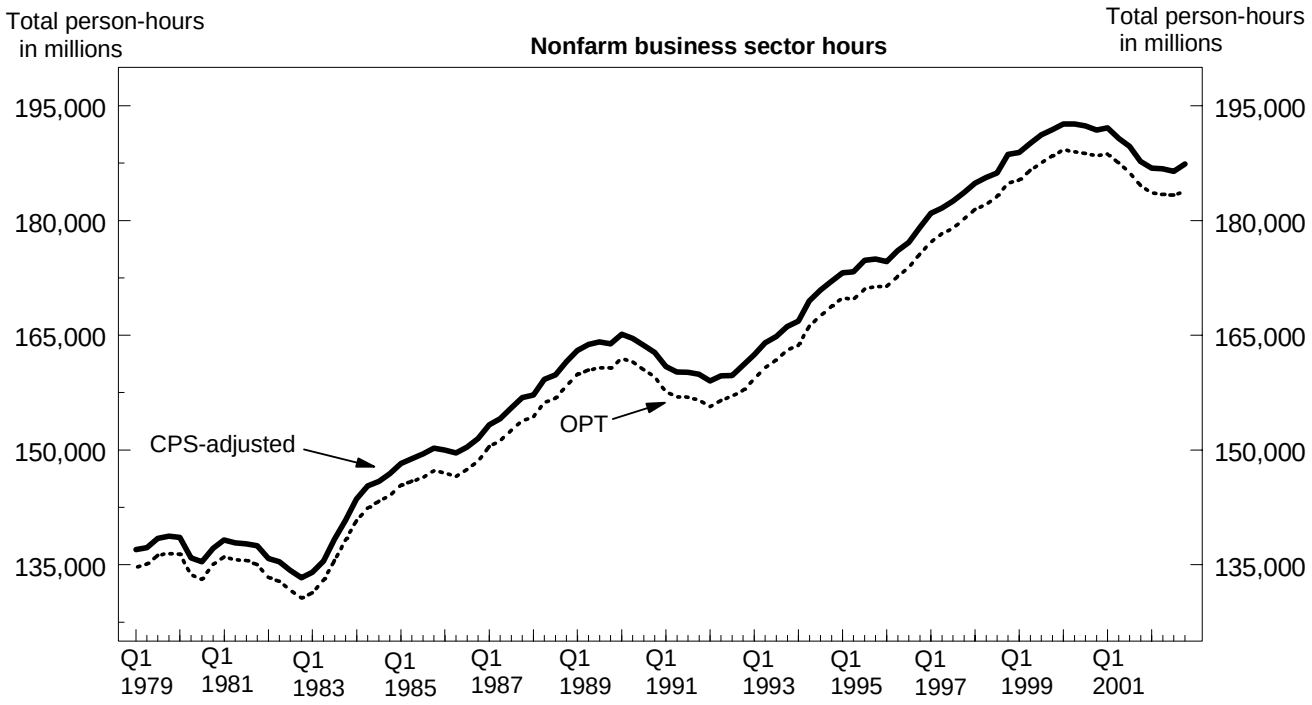
Table 5. Nonproduction and supervisory employee hours trends, 1979–2002

[Average annual percent change]

Sector	1979–2002		1979–90		1990–95		1995–2002	
	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted
Private nonfarm sector	1.6	1.6	2.2	2.3	.6	.8	1.4	1.2
Private nonfarm goods	.2	.2	.7	.8	–.9	–.8	.1	.0
Mining	–2.9	–3.3	–1.4	–1.7	–4.5	–4.8	–4.0	–4.6
Construction	2.5	2.4	2.5	2.4	.6	.3	3.8	3.7
Manufacturing	–.2	–.2	.4	.6	–1.0	–.9	–.7	–.8
Durable	–.3	–.3	.4	.5	–1.6	–1.5	–.5	–.6
Nondurable	–.1	.0	.4	.7	–.2	.0	–1.0	–1.0
Private nonfarm services	2.9	2.8	3.8	3.7	1.8	2.0	2.4	2.0
Transportation, communications, and utilities	1.4	1.4	1.4	1.4	.8	1.3	1.7	1.3
Wholesale trade	1.5	1.5	2.3	2.2	.3	.1	1.3	1.3
Retail trade	2.4	2.2	3.1	2.8	2.7	3.0	1.1	.5
Finance, insurance, and real estate	2.5	2.4	3.9	3.9	.3	.4	1.9	1.6
Services	4.6	4.3	5.9	5.5	3.0	2.9	3.8	3.3

NOTE: OPT – This series underlies the hours measures used by the BLS Office of Productivity and Technology. CPS-adjusted – This series adjusts the OPT series using CPS data and alternative A. See text for details.

Chart 5. **Comparisons of nonfarm business sector person-hours and productivity, quarterly, 1979–2002**



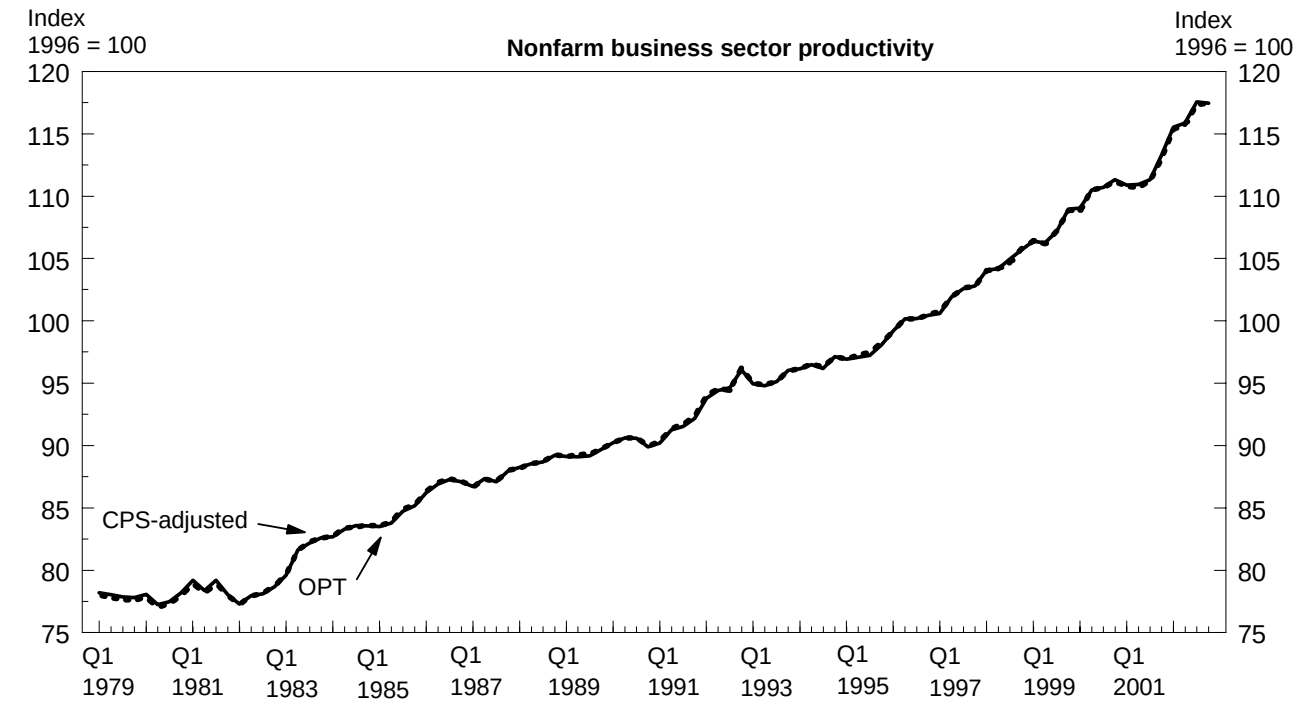


Table 6. Comparison of trends in hours, 1979–2002

[Annual average percent change]

Sector	1979–2002		1979–90		1990–95		1995–2002	
	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted	OPT	CPS-adjusted
Nonfarm business sector, all persons	1.33	1.34	1.59	1.62	1.17	1.20	1.03	.99
Good sector employees	–.35	[1] –.34	–.36	[1] –.32	–.16	–.16	–.47	–.50
Mining	–2.34	[1] –2.43	–2.46	[1] –2.56	–3.63	[1] –3.70	–1.21	[1] –1.30
Construction	1.87	[1] 1.84	1.55	1.54	.37	[1] .30	3.45	[1] 3.43
Manufacturing	–.90	–.88	–.71	–.66	–.17	–.15	–1.72	–1.73
Durable	–1.00	–.99	–1.07	[1] –1.02	–.23	–.24	–1.45	–1.47
Nondurable	–.75	[1] –.71	–.18	[1] –.11	–.08	[1] –.03	–2.10	–2.11
Service sector employees	2.38	2.37	2.76	2.76	2.08	2.11	2.00	[1] 1.93
Transportation, communications, and utilities	1.16	1.16	.84	[1] .86	2.08	[1] 2.16	.99	[1] .92
Wholesale trade	1.06	1.05	1.37	1.37	.97	[1] .93	.63	[1] .65
Retail trade	1.69	1.68	1.94	1.95	1.69	[1] 1.77	1.29	[1] 1.19
Finance, insurance, and real estate	1.94	1.94	2.63	[1] 2.66	.57	.61	1.85	[1] 1.76
Services	4.21	4.18	5.18	5.16	3.35	[1] 3.33	3.33	3.26

[1] Indicates the CPS-adjusted and the OPT series are not the same at the one decimal place.

NOTE: OPT – This series underlies the hours measures used by the BLS Office of Productivity and Technology. CPS-adjusted – This series adjusts the OPT series using CPS data and alternative A. See text for details.

to the OPT official series within a half of a percentage point. Trends in the CPS-adjusted estimates of hours of all persons in most industries and periods are virtually identical to the OPT series; within 0.1 percentage points.

Combining the CPS-adjusted hours series with output, we construct adjusted productivity measures. These results mirror those for the hours series. The CPS-adjusted productivity series are essentially the same as the official OPT productivity statistics for the nonfarm business sector for 1979–2002 and for most of the three subperiods. (See chart 5 bottom panel.)

The following tabulation presents a comparison of the trends in nonfarm business productivity from the official OPT series and the CPS-adjusted series (average annual percent change). Again, we see that the series behave similarly. Thus, the use of the CPS-adjusted average weekly hours series for nonproduction and supervisory does not have an impact on long-term trends in productivity.

	OPT series	*CPS-adjusted series*
1979–2002	1.77	1.76
1979–90	1.35	1.32
1990–95	1.52	1.50
1995–2002	2.61	2.64

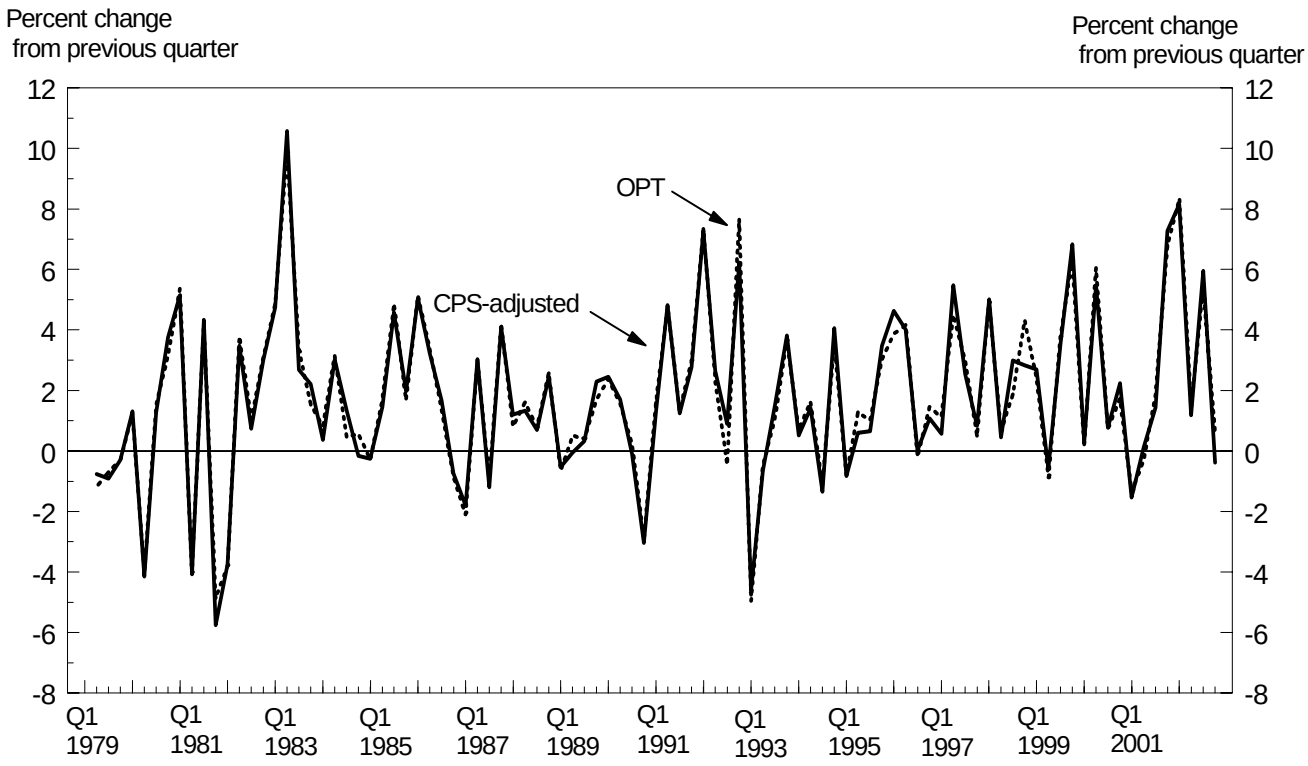
Volatility of the quarterly series

Trends in nonfarm business sector productivity using the CPS-adjusted hours series are essentially equal to the trends in nonfarm business sector productivity constructed using existing OPT methods, but users are often interested in short-term movements. Chart 6 shows the quarter-to-quarter changes in productivity at an annual rate for the official OPT productivity series and the CPS-adjusted series. There are some measurable, but relatively small, differences in the quarterly movements between the two productivity series.

As a measure of volatility in each series, we look at the average percent change from the previous quarter at an annual rate and its associated variance. The following tabulation compares the OPT and CPS-adjusted average percent change from the previous quarter at an annual rate and the variance in parentheses. On average, the CPS-adjusted productivity series fluctuates approximately 0.01 percentage point more than the official OPT quarterly productivity series over the 1979–2002 period, as well as in the subperiods in the study. Given that the series are published only at the one-decimal-place level, the average volatility of the two series is essentially the same for the whole period and the three subperiods.[38]

	OPT series	*CPS-adjusted series*
1979: first quarter–2002: fourth quarter	1.78 (.08)	1.77 (.08)
1979: first quarter–1990: fourth quarter	1.26 (.08)	1.24 (.08)
1990: first quarter–1995: fourth quarter	1.56 (.08)	1.54 (.07)
1995: first quarter–2002: fourth quarter	2.43 (.06)	2.43 (.07)

Chart 6. Comparisons of quarterly change in nonfarm business sector productivity growth, 1979–2002



The pattern of quarterly productivity movements over the business cycle is of particular interest. One might expect businesses to vary the utilization of production workers relative to nonproduction workers around recessions, and similarly for the utilization of nonsupervisory workers relative to supervisory workers. The current OPT assumptions do not allow for such variations. Consequently, we compare the behavior of the CPS-adjusted series with the official series around identified business cycle peaks and troughs. During the period of our study, there are four business cycle peaks and four business cycle troughs identified by the National Bureau of Economic Research (NBER). These peaks and troughs are based upon studies of monthly economic activity across the entire economy.[39] The top panel of table 7 shows the quarterly productivity rates for the three quarters going into and coming out of an identified business cycle peak. The bottom panel presents this information for troughs. As expected, there are some differences between the series in many of the quarter-to-quarter movements, but the patterns of the movements of the two series are similar. We also examine the percent changes three quarters before and after the peaks and troughs, also shown in table 7. The differences between the OPT and CPS-adjusted series are modest, and there is no consistent direction of differences. Thus, in general, the CPS-adjusted series behaves in a similar manner to the official series over business cycles.

Conclusion

In the BLS productivity measures, labor hours are largely based on CES data. The CES does not collect hours data for nonproduction and supervisory workers, however. Therefore, OPT estimates hours for these workers using assumptions. The primary assumption underlying these estimates for major sectors has been that production and nonproduction workers work similar hours, and that nonsupervisory and supervisory workers work similar hours. In this study, we use data from the CPS to construct ratios of average weekly hours worked by nonproduction/supervisory workers relative to production/nonsupervisory workers. These ratios are multiplied by official data for nonproduction and supervisory worker hours to create a "CPS-adjusted" series. This adjusted series is used to assess the validity of the assumptions underlying the official OPT data. Although the CPS-adjusted average weekly hours series for the

Table 7. Nonfarm business sector productivity growth selected quarters

[Percent change from previous quarter at an annual rate]

Date of peak and trough	P-3 to peak	P-3	P-2	P-1	Peak	P+1	P+2	P+3	Peak to P+3
Peak									
2001, first quarter:									
OPT	.36	6.05	.73	1.73	–1.34	–.31	1.88	6.79	2.74
CPS-adjusted	.45	5.55	.79	2.24	–1.63	.20	1.46	7.28	2.94
1990, third quarter:									
OPT	1.39	1.70	2.39	1.56	.23	–2.93	1.60	4.76	1.09
CPS-adjusted	1.35	2.28	2.31	1.81	–.05	–3.02	1.15	4.93	.97
1981, third quarter:									
OPT	1.76	3.17	5.36	–4.04	4.21	–4.85	–3.80	3.79	–1.70
CPS-adjusted	1.73	3.63	5.02	–3.96	4.37	–5.75	–3.88	3.59	–2.10
1980, first quarter:									
OPT	.08	–1.18	–.69	–.29	1.23	-4.01	1.52	3.17	.18
CPS-adjusted	–.02	–.70	–.89	–.24	1.07	-3.97	1.40	3.63	.30
	T-3 to trough	**T-3**	**T-2**	**T-1**	**Trough**	**T+1**	**T+2**	**T+3**	**Trough to T+3**
Trough									
2001, fourth quarter:									
OPT	2.74	–1.34	–.31	1.88	6.79	8.35	1.45	5.43	5.04
CPS-adjusted	2.94	–1.63	.20	1.46	7.28	8.02	1.27	5.97	5.05
1991, first quarter:									
OPT	–.39	1.56	.23	-2.93	1.60	4.76	1.33	2.98	3.01
CPS-adjusted	–.65	1.81	–.05	-3.02	1.15	4.93	1.31	2.78	3.00
1982, fourth quarter:									
OPT	2.64	–3.80	3.79	1.05	3.09	4.85	9.92	3.35	6.00
CPS-adjusted	2.46	–3.88	3.59	.78	3.03	4.57	10.71	2.72	5.95
1980, third quarter:									
OPT	–.45	–.29	1.23	–4.01	1.52	3.17	5.36	–4.04	1.42
CPS-adjusted	–.53	–.24	1.07	–3.97	1.40	3.63	5.02	–3.96	1.49

NOTE: OPT - This series underlies the hours measures used by the BLS Office of Productivity and Technology. CPS-adjusted- This series adjusts the OPT series using CPS data and alternative A. See text for details.

two employee groups do not support the OPT assumptions, we find that trends in the CPS-adjusted total hours series are essentially identical to the trends in the hours series that underlie the official OPT productivity measures. One reason for this finding is that nonproduction and supervisory employees account for only 19 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 criticism that the BLS is understating the growth of hours people are working, and thus overstating productivity growth. Finally, the behavior of the CPS-adjusted series over the business cycle is very similar to that of the existing series.

There are two good reasons to make adjustments to the OPT 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 the OPT hours series are based largely on assumptions rather than data. And second, as this study shows, in the nonmanufacturing sector and for the business sector as a whole, the levels of hours underlying the series are different. Therefore, it is important to replace current assumptions and improve current estimates of hours for nonproduction and supervisory workers. BLS plans to incorporate the CPS-adjusted hours series for nonproduction and supervisory worker average weekly hours into the OPT total hours and productivity calculations for major sectors in August 2004. □

Notes

[1] Preliminary results using annual data and a draft paper were presented at the June 2001 meeting of the Federal Economic Statistics Advisory Committee.

[2] BLS publishes quarterly productivity and related series for six major sectors. The output measures for the business sector, nonfarm business sector and nonfinancial corporations make use of Bureau of Economic

Analysis data; those for manufacturing, durable goods manufacturing, and nondurable goods manufacturing utilize information from the Census Bureau's economic censuses and annual surveys, the Federal Reserve Board Index of Industrial Production, and BLS price programs.

[3] CES employment data refer to persons who worked during, or received pay for, any part of the pay period that includes the 12th of the month. 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. Proprietors other (unincorporated self-employed persons), and unpaid family workers are not included. 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. See U. S. Department of Labor, Bureau of Labor Statistics, *BLS Handbook of Methods*, Bulletin 2490, April 1997.

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

[5] 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).

[6] Some hours at work may not be spent actively engaged in production. From the employer's perspective such downtime can arise for a variety of reasons. Although some types of downtime may be integral to the production process and thus increase output, others may have zero marginal productivity. Improving production processes to reduce machine downtime or organizing work to motivate workers and reduce shirking will increase hours actively engaged in production and increase output without changing hours at work. This will result in an increase in measured productivity, which is inherently a part of what we want to capture in a broad measure of productivity change. Similarly, effects due to reallocation of labor from a firm that is less productive as a result of more worker shirking to a firm with less shirking should be picked up in an aggregate measure.

[7] It might be argued that to some extent paid leave can result in higher output. This effect is unlikely to be significant at the levels of time worked in the U.S. today. For instance, a BLS report based on a large number of case studies of productivity in U.S. manufacturing plants during World War II examined the impact on output and work injuries of patterns of workdays and workweeks that were dramatically longer than those typically observed in the United States; see, *Hours of Work and Output*, Bulletin no. 917 (Bureau of Labor Statistics 1947). (There were not enough observed workweeks shorter than 40 hours to examine the impact of shorter days and weeks.) Although the study did conclude that of the patterns examined the 8-hour day, 5-day week seemed optimal, increases in daily hours or workdays did yield very substantial output increases for all but extreme workweeks. There is, however, some research that concludes that vacations may be good for a person's health; for a summary, see Sue Shellenbarger, "Canceling a vacation could cost you dearly in the long run," Work and Family column, *Wall Street Journal*, Apr. 11, 2001.

[8] BLS publishes data from the CPS on the labor force status of the civilian noninstitutional population, 16 years of age and older. The CPS is collected each month from a probability sample of approximately 60,000 occupied households. See the BLS *Handbook of Methods.*

[9] Employment counts for employees in agricultural services, forestry and fishing come from the BLS 202 program, based on administrative records from the unemployment insurance system. These counts are moved forward in the current period using limited information on employment in agricultural services (part of SIC 07). The number of employees of government enterprises comes from the Bureau of Economic Analysis. These are moved forward using information from the CES. Average weekly hours for employees of government enterprises are from the CPS.

[10] Off-the-clock hours affect output and ideally should be included for productivity measurement purposes. Such hours seem unlikely to occur for hourly paid workers. For salaried workers, the concept of hours paid or worked may not be clear in some instances. Different types of data will treat off-the-clock hours differently.

[11] Wesley Mellow and Hal Sider, "Accuracy of response in labor market surveys: Evidence and implications," *Journal of Labor Economics*, 1983, vol. 1, no. 4, pp. 331–44.

[12] John Bound, Charles Brown, Greg J. Duncan, and Willard L. Rodgers, "Measurement Error in Cross-Sectional and Longitudinal Labor Market Surveys: Results from Two Validation Studies," in J. Hartog, G. Ridder, and J. Teeuwes, eds., *Panel Data and Labor Market Studies* (Amsterdam, the Netherlands, Elsevier, 1990), pp. 1–19.

[13] The study by John Bound and others focused on the bias due to measurement error when survey-based measures of earnings, hours, and hourly earnings are used in regression analyses.

[14] Note that sample sizes are small. See for instance, Daniel S. Hamermesh, "Shirking or Productive Schmoozing: Wages and the Allocation of Time at Work," *Industrial and Labor Relations Review*, 1990, vol. 43, no. 3, pp. 121S–133S. Hamermesh uses Michigan time use diary data for 1975 and 1981; and John P. Robinson, and Ann Bostrom, "The overestimated workweek? What time diary measures suggest," *Monthly Labor Review*, August 1994, pp. 11 –23. Robinson and Bostrom use three separate studies for 1965, 1975, and 1985.

[15] It is unclear if Robinson and Bostrom excluded time on breaks, which should not be excluded for productivity measurement, from their estimates of time use survey hours worked. Robinson and Bostrom, "The overestimated workweek?" 1994. It is clear from the data reported in Hamermesh that the general conclusion that labor force survey estimates of hours worked are higher than time use estimates of hours worked holds even when breaks are not excluded from the latter measures. Hamermesh, "Shirking or Productive Schmoozing," 1990.

[16] He argues that Robinson and Bostrom's result that those who work longer hours tend to overreport hours more may be a statistical artifact of regression to the mean. See Jerry A. Jacobs, "Measuring time at work: are self-reports accurate?" *Monthly Labor Review*, December 1998, pp. 42–53. Also see Robinson and Bostrom, "The overestimated workweek?" 1994.

[17] Note this is for employees only, as data for the self-employed come from the CPS.

[18] Katharine G. Abraham, James R. Spletzer, and Jay C. Stewart, "Divergent Trends in Alternative Wage Series," in John Haltiwanger, Marilyn E. Manser, and Robert Topel, *Labor Statistics Measurement Issues*, National Bureau of Economic Research, Studies in Income and Wealth, vol. 60 (Chicago, The University of Chicago Press, 1998, pp. 293–324).

[19] This classification scheme is the same as that underlying the BLS Employer Cost Index (ECI) series for production and nonsupervisory workers. See Employee Cost Indexes, Bulletin 2532, appendix B. for service industries: CPS codes 003–037; for goods industries: CPS codes 003–389.

[20] CPS codes 03–199, 243–263, 226, 229.

[21] Abraham and others, 1998, p. 316.

[22] The Abraham and others 1998 study focused on the private sector less agriculture and private households.

[23] Multiple jobholders are employed persons who, during the reference week, had either two or more jobs as a wage and salary worker, or were self-employed and also held a wage and salary job, or worked as an unpaid family worker and also held a wage and salary job.

[24] "Appendix A: Multiple Jobholder Adjustment," is available upon request to Lucy Eldridge via e-mail **Eldridge.Lucy@bls.gov** or by telephone (202) 691–6598.

[25] The Abraham and others, 1998, study did not adjust for unpaid absences.

[26] Among those excluded from this category are persons in executive and managerial positions and persons engaged in activities such as accounting, sales, advertising, routine office work, professional and technical functions, and force-account construction. (Force-account construction is construction work performed by an establishment, primarily engaged in some business other than construction, for its own account and for use by its own employees.)

[27] Excluded from this category are executive and managerial personnel, professional and technical employees, and workers in routine office jobs.

[28] The full sample CPS data, that is all four rotation groups, was used for alternatives A and B for all years and alternative C for 1982–2002. For 1979–81 only, the outgoing rotation group was used for alternative C because data on whether a respondent was paid by the hour was not in the full CPS sample data.

[29] CPS codes 433–446, 456–469. We have decided not to include those with supervisory titles because the workers remaining in occupations 417–889 seem to be in professions where one envisions working supervisors who are involved in production.

[30] According to the *Standard Industrial Classification Manual, 1987*, Executive Office of the President, Office of Management and Budget.

[31] We chose to assess employment shares rather than employment levels because CPS employment growth over the 1990s fell short of CES employment growth. The employment share quarterly data are not seasonally adjusted.

[32] According to the 1-digit industry data, alternative A most closely captures the trends in nonsupervisory workers employment shares over the 1979–2002 period in all industries except finance, insurance, and real estate. In those industries, alternative C trends are the closest to trends in CES data, yet the levels are much lower than the CES data.

[33] The OPT average weekly hours for production/nonsupervisory workers is constructed by multiplying the hours worked/ hours paid ratio for production workers to the CES average weekly hours paid production/ nonsupervisory workers. Thus, the new series represents a measure of hours worked to paid employment. (hours paid/employment paid) * (hours worked/ hours paid) = (hours worked/employment paid). Therefore, we construct the CPS-adjusted series as hours worked/ employment paid.

[34] "Appendix B: Analysis using alternative CPS-adjustments," presents the results using all three alternatives. Appendix B is available upon request to Lucy Eldridge via e-mail: **Eldridge.Lucy@bls.gov or via telephone:** (202) 691–6598.

[35] 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).

[36] OPT calculates the average weekly hours for nonproduction workers in durable and nondurable manufacturing by applying the 1977 ratio of average weekly hours of office workers to non-office workers for durable and nondurable manufacturing employees to a 23-month centered moving average of the average weekly hours of production workers in durable and nondurable manufacturing.

[37] The 2001 and 2002 OPT average weekly hours for nonproduction workers are based on a 23-month moving average through January 2001 of the trends in average weekly hours for production workers. Therefore, the difference in the OPT series is not as close to zero as would be expected.

[38] We also looked at the average absolute quarterly fluctuations in productivity and obtained the same results. (1979: quarter I–1990: quarter IV OPT: 2.39 percent, CPS-adjusted: 2.41 percent; 1990: quarter I–1995: quarter IV OPT: 2.45 percent, CPS-adjusted: 2.42 percent; 1995: quarter I–2000: quarter IV OPT: 2.45 percent, CPS-adjusted: 2.44 percent; 2000: quarter I–2002: quarter IV OPT 2.90 percent, CPS-adjusted 2.91percent; 1979: quarter I–2002: quarter IV OPT: 2.56 percent, CPS-adjusted: 2.56 percent. The variance for both series over all time intervals prior to 2000 is 0.04 percent; for the 2000–02 period, the variance for both series is 0.09 percent.

[39] See NBER's Business Cycle Dating Committee Web site on the Internet at: **www.nber.org/cycles**.