Replicate estimates of the average hourly earnings series

*Average hourly earnings data are compared
with similarly constructed measures ("replicates")
based on employer costs for employee compensation data*

Anthony J. Barkume
and
Michael K. Lettau

Average hourly earnings data, produced each month as part of the Current Employment Statistics (CES) program, have become an integral part of U.S. economic intelligence.[1] Besides their customary use in assessing the economic outlook, average hourly earnings data have been incorporated into a wide variety of analyses, such as simulations of the effects of policy changes (for example, the introduction of the North American Free Trade Agreement, NAFTA) on locality and industry earnings levels.

The CES program is based on employment, hours, and earnings data from a sample of nonfarm establishments, including government. However, the CES has always restricted the coverage of both earnings and jobs to those most likely to be reflected in employer's current payroll records on a regular basis.[2] Earnings coverage excludes "bonuses, commissions, and other lump-sum payments (unless earned and paid regularly each pay period or month)."[3] Job coverage (for the reporting of earnings) is restricted to production workers in goods-producing industries and nonsupervisory workers in the service-producing industries.

In recent years, several analysts[4] have noted that the trend rate of growth in the private industry aggregate of the average hourly earnings measure has been slower than that of other economy-wide average wage measures, such as those derived from unemployment insurance records or Current Population Survey data. The slower growth in the average hourly earnings relative to

other aggregate earnings measures may simply reflect the restrictions on job coverage if the relative earnings of production and nonsupervisory workers have fallen relative to all workers over time. However, this divergence between the series may also reflect differences in how employers, who report payroll data in the CES, define "production and nonsupervisory" employees from what data users assume is the case. For example, employers are instructed to include earnings and hours data for "working supervisors," defined as workers whose supervisory duties are incidental to their job. But some employers may not include hours and earnings of working supervisors in their payroll records because such employers might consider those employees as supervisors in the organization. If working supervisors generally received above-average earnings, then an employer's omission of these earnings from their statistical reports would tend to reduce reported average hourly earnings.

Katharine G. Abraham, James R. Spletzer, and Jay C. Stewart constructed several "replicate estimates" for average hourly earnings concepts using CPS labor force data and different definitions for production and nonsupervisory workers.[5] The job coverage and wage levels of the replicate estimates were compared with the actual average hourly earnings series. For example, restricting job coverage to workers paid hourly, Abraham and others found that the replicate estimate from CPS data generally matched the trend of the actual average hourly earnings data, but that the job coverage and wage levels of this replicate

Anthony J. Barkume and Michael K. Lettau are economists in the Compensation Research and Program Development Group, Bureau of Labor Statistics.

Table 1.	Earnings levels and job coverage of average hourly earnings and employer costs for employee compensation replicate estimates, March 1988 though September 1999		
Job type		Actual average hourly earnings data[1]	Employer costs for employee compensation replicate of average hourly earnings[2]
All production and nonsupervisory jobs in private nonfarm industry:			
Average earnings (dollars per hour)		$11.09	$11.48
Job coverage (percent of sector			
employment)		82.1	86.1
Production worker jobs in goods production:			
Average earnings (dollars per hour) .		$12.68	$12.48
Job coverage (percent of sector			
employment)		70.5	71.2
Nonsupervisory worker jobs in services production:			
Average earnings (dollars per hour) .		$10.52	$11.12
Job coverage (percent of sector			
employment)		86.1	91.3

[1] From the Current Employment Survey.

[2] Standard job coverage.

estimate were both lower than the actual average hourly earnings data.

This article reports the results of additional research on the "replicate estimate" approach to investigate job coverage in average hourly earnings. We use earnings, hours, and detailed information on the types of jobs from the BLS employer costs for employee compensation program. Data from this program can produce earnings and employment estimates that are measured similarly to those produced for the average hourly earnings series. This article compares average earnings levels (in dollars per hour) for these employer costs for employee compensation replicates with the actual average hourly earnings series over the March 1988 to September 1999 period. We focus on long-term comparisons because differences in sample sizes and sample designs in the two data programs generate differences in short-term fluctuations. We also outline our methodology for constructing these estimates and indicate the limitations of the data for this purpose.

Our primary findings reveal that for the 1988–99 period as a whole, the earnings estimates produced by the employer costs for employee compensation replicates of average hourly earnings correspond fairly closely to the actual average hourly earnings series. For production workers in goods production (mining, manufacturing, and construction), the employer costs for employee compensation earnings replicate was on average 1.5 percent lower than the actual average hourly earnings for this group of workers—about $0.20 per hour lower, on average. For nonsupervisory workers in the rest of the private nonfarm economy, the employer costs for employee

compensation earnings replicate was on average 5.8 percent higher than the actual corresponding average hourly earnings series—about $0.60 per hour higher on average. (The average dollar values for the estimates are displayed in table 1.) The earnings estimate for nonsupervisory workers from employer costs for employee compensation data is reduced when excluding jobs that have incidental supervisory duties (that is, excluding the higher pay of "working supervisors" in average earnings). Excluding "working supervisors" from the employer costs for employee compensation replicate for nonsupervisory workers reduces, but does not eliminate, the discrepancy with the actual average hourly earnings. These results indicate to us that factors other than job coverage may be contributing to the differences in worker pay between average hourly earnings and estimates of worker pay from other data sources.

Limitations of CPS-based replicates

The different frames of reference used by household members and employers when reporting on work hours and earnings complicate the use of replicate estimates from CPS labor force data to make inferences about the coverage of the average hourly earnings. An important problem is that hours *paid* is measured in the average hourly earnings series, while hours *worked* is measured in the CPS. However, consistent comparisons between the two series may be possible because the BLS Hours at Work Survey, which collects data on both hours paid and hours worked, shows that the ratio of hours worked to hours paid for production and nonsupervisory workers has not varied greatly over time.

Also, CPS labor force data provide limited historical information on multiple jobholders in the labor force. A particular problem with comparing job coverage in the in the CES with job coverage in the CPS (prior to the redesign of the CPS in 1994) stems from difficulties in identifying the occupations of all nonagricultural wage and salary jobs in the CPS before 1994. The average hourly earnings series is a measure of earnings for all production and nonsupervisory jobs but, prior to 1994, the CPS only obtained information on the "main" job of employed workers, with no regularly collected data available on any additional jobs that the worker held. Thus, Abraham and others restricted their analysis to workers whose main jobs were in the nonagricultural wage and salary sector. Agricultural wage and salary workers, the self-employed, and unpaid family workers who take second jobs in nonagricultural wage and salary employment were excluded.

Methodology

Data collection for the Employer Costs for Employee Compensation as well as the Employment Cost Index (ECI) is designed to obtain a representative sample of the jobs nation-

wide and to measure hours of work and hours of paid leave. Because the ECI is a fixed weight index, it cannot be directly compared with the average hourly earnings, which is an average wage measure. In contrast, employer costs for employee compensation does reflect the current distribution of the employment in the economy.[6] Thus, individual (micro) data records, collected to produce the employer costs for employee compensation measure, were used to construct replicate estimates of the average hourly estimates.

In constructing these replicate estimates, definitions of earnings used for employer costs for employee compensation had to be correctly aligned with those used in the average hourly earnings. Published employer costs for employee compensation statistics measure a different pay concept from those in the average hourly earnings. Average hourly earnings are the average earnings per hour paid, which include overtime pay, any pay differentials for shift work, and cash payments for hours of paid leave. In the employer costs for employee compensation, wages and salaries refer to straight-time pay per scheduled hour of work, while paid leave, overtime, and shift premiums are defined as components of benefits. Therefore, to derive data comparable with average hourly earnings, we combined the pay components for the individual employer costs for employee compensation data records to express each record as average earnings per hour paid.

To better approximate procedures used for the actual average hourly earnings, we used data on scheduled work hours plus typical overtime on the individual job in the employer costs for employee compensation data records. The estimating formula for average hourly earnings is an hours-weighted aggregate; the average hourly earnings series reflect the distribution of paid hours across part-time and full-time jobs.[7] Thus, we also constructed an hours-weighted aggregate from the employer costs for employee compensation data. (Abraham and others also constructed hours worked-weighted aggregates of CPS data to compare with the average hourly earnings series.[8]) An alternative approach, employment-weighted averages from employer costs for employee compensation data, would produce lower pay levels than hours worked-weighted aggregates because full-time jobs receive more weight than part-time jobs and full-time jobs tend to have higher pay than part-time jobs.

Both employer costs for employee compensation and average hourly earnings data are collected in the same reference week, but the compensation data are collected only for the months of March, June, September, and December. We assembled average hourly earnings data for these months from March 1988 to September 1999, thus allowing 46 direct comparisons over a 12-year period. Chart 1 plots this time series of employer costs for employee compensation earnings repli-

Chart 1. **Comparison of actual average hourly earnings with replicate estimates, quarterly periods, March 1988 to September 1999**
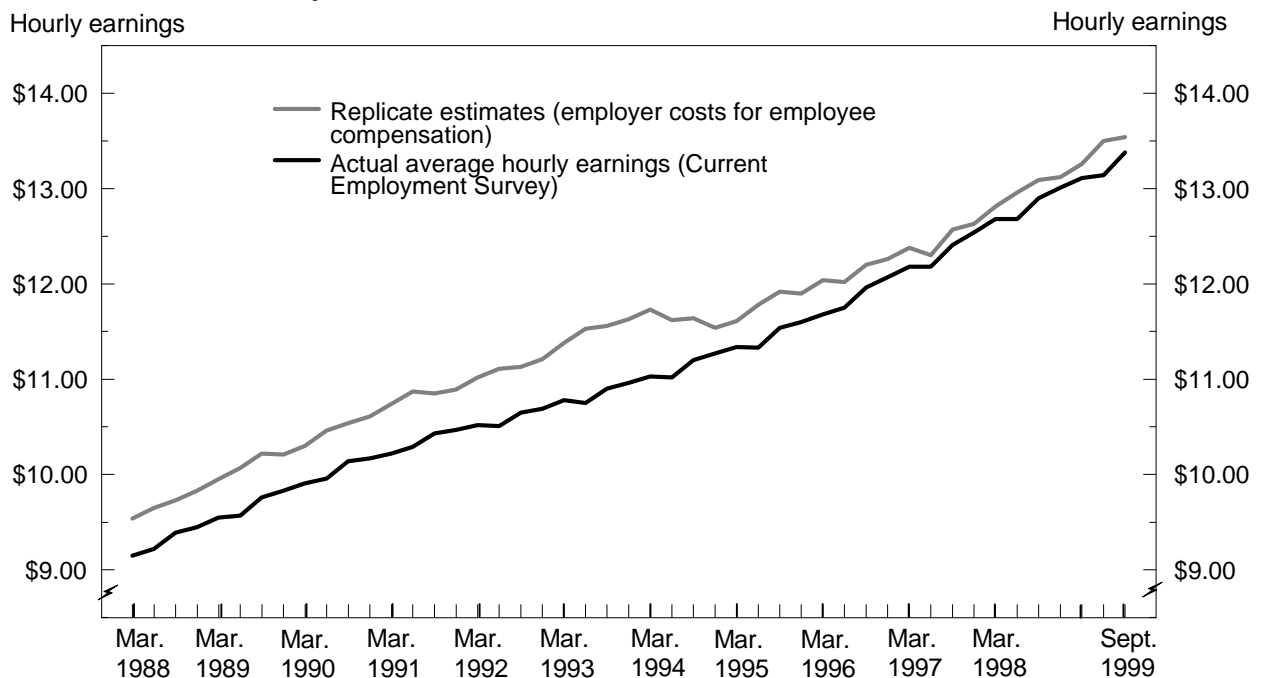
cates for all production and nonsupervisory employment in U.S. private industry, along with corresponding the actual average hourly earnings series from the CES program.

We limit our comparisons to long-term average levels of earnings. Even though both the CES and the employer costs for employee compensation generate statistics on the same subject of interest—earnings of workers in the U.S. economy—differences in data collection procedures and sampling approaches between the two statistical programs limit the ability to make comparisons of short-term movements. Data on hours of work—including overtime—in the employer costs for employee compensation series are obtained only at the initial data collection. Because surveyed jobs can remain in the employer costs for employee compensation sample for up to 5 years, overtime hours reported for the job may not be accurate. In contrast, average hourly earnings should reflect the current use of overtime. However, when making comparisons over longer time periods, employer costs for employee compensation hours should better reflect the usual schedule of hours worked because new jobs are initiated with sample replacement. Over most of the 1988–99 period, the employer costs for employee compensation sample was replenished through an industry rotation scheme so that variation in earnings over short time periods reflects replacement of the sample.[9] (In contrast, primary ECI data are changes in earnings for the same job, and thus are unaffected by sample replacement.) The sample used to construct the actual average hourly earnings is also replenished, but the estimating formula reduces the impact of sample replacement in month-to-month comparisons by heavily weighting earnings in samples which can be matched from one month to the next.[10]

The effects of the second aspect of employer costs for employee compensation data collection—sample replacement—are evident in chart 1. In 1994, a considerable number of new sample units in the employer costs for employee compensation measure had lower wage levels than comparable jobs in previous samples so that between March 1994 and March 1995 the replicate estimates of average earnings using employer costs for employee compensation data actually declined. As is also evident in chart 1, the 1994–95 shift in sample composition also affected the growth rate of earnings in the employer costs for employee compensation replicate estimate. From March 1988 to March 1994, the employer costs for employee compensation earnings replicate grew faster than the corresponding average hourly earnings data, but from March 1995 until September 1999 the reverse pattern held.[11] However, throughout either of these periods, the employer costs for employee compensation replicate earnings estimate was always higher than the corresponding average hourly earnings; it is this long-term difference in earnings levels pattern on which we focus our analysis.

When making comparisons over long periods of time, the direct control over sample selection in the employer costs for employee compensation measure provides a diagnostic aid to investigate various hypotheses concerning job coverage in the average hourly earnings. Because ECI sample weights are benchmarked to CES employment at the 2-digit Standard Industrial Classification (SIC) level, total employment for the employer costs for employee compensation replicates is essentially the same as total employment published for the CES.[12] Each sample job in the employer costs for employee compensation measure is classified by occupation, so that replicates can be estimated for production jobs in the goods-producing sector and nonsupervisory jobs in service-producing sector. Using the sample weights attached to jobs, the employment associated with a particular employer cost for employee compensation replicate of the average hourly earnings also can be estimated.

Results with usual job coverage

We can compare both earnings levels and job coverage between the actual average hourly earnings and employer costs for employee compensation replicate estimates, employing the standard definitions of production and nonsupervisory jobs. Reflecting the pattern evident in chart 1, the mean employer costs for employee compensation replicate estimate for all production and nonsupervisory jobs is higher (by 3.6 percent) than the corresponding average hourly earnings statistic. (See table 1.) However, this pattern does not hold when making separate comparisons for production jobs and nonsupervisory jobs. For production jobs in the goods producing sector, the employer costs for employee compensation replicate estimate was on average 1.5 percent lower than the corresponding average hourly earnings measure. In contrast, the employer costs for employee compensation replicate for nonsupervisory jobs in the services producing sector—representing about 80 percent of all production and nonsupervisory employment—was on average 5.8 percent higher than the corresponding average hourly earnings figure.

The lower employer costs for employee compensation replicate earnings estimates for production jobs in goods production could be the result of undercounting actual overtime payments in the data collection. As discussed earlier, overtime hours for any job in employer costs for employee compensation data collection is held constant while the job remains in the sample. However, comparison of additional employer costs for employee compensation and average hourly earnings data for the manufacturing component of goods production (that is, not including mining or construction) does not support this hypothesis. For the manufacturing sector, overtime hours are separately collected in the CES so two variants of the average hourly earnings series are produced; actual hourly earnings and an estimate of the average straight-time wage. Employer costs for employee compensation data also can be used to construct replicates for these two series.

The employer costs for employee compensation replicate estimates of average hourly earnings for production jobs in manufacturing, either including or excluding overtime costs, are virtually identical to the corresponding average hourly earnings series. For the March 1988 through September 1999 period, the mean level of the actual average hourly earnings for production jobs in manufacturing was $11.98; slightly higher than the mean of the corresponding employer costs for employee compensation replicate estimates, $11.94. In the same period, the estimated straight-time wage (exclusive of overtime costs) from the average hourly earnings was $11.38, while the corresponding employer costs for employee compensation replicate estimate was $11.40.

The employer costs for employee compensation replicate earnings estimates for nonsupervisory jobs may be higher because some employers may not report earnings to the CES for some of these jobs having higher pay. (This explanation would also account for the higher employment coverage in the employer costs for employee compensation earnings replicate.) As discussed earlier, employers providing data in the CES are instructed to include earnings and hours data for nonsupervisory workers who are designated as "working supervisors" (workers whose supervisory duties are incidental to their job). However, employers also may not have the hours and earnings for these jobs located with the payroll records of the workers they supervise. Job coverage for the employer costs for employee compensation replicates is higher than that for the actual average hourly earnings for both goods-production jobs and nonsupervisory service jobs, but the discrepancy is more substantial for nonsupervisory jobs in services. On average, over the March 1988 to September 1999 period, job coverage in the average hourly earnings series was 86.1 percent, compared with 91.3 percent of sector employment for the employer costs for employee compensation replicate. Because the service-producing sector is so large, these differences in shares translate to a much larger number of jobs included in the employer costs for employee compensation replicate, compared with that in the average hourly earnings. For example, in September 1999, about 4.7 million more jobs in the service-producing sector were covered in the employer costs for employee compensation replicate of the average hourly earnings.[13] If these additional workers tended to receive higher pay, their exclusion from CES earnings reporting could account for part of the discrepancy between the average hourly earnings and estimates of worker pay from other data, such as the CPS.

Results with alternative job coverage

To investigate whether a more restrictive definition of production and nonsupervisory jobs would yield a replicate that would have job coverage and wage levels closer to the actual average hourly earnings, we estimated additional employer costs for employee compensation replicates that excluded jobs that were classified as "working supervisors." To mimic the possible exclusion of "working supervisors" by employers reporting in the CES, we identified all production and nonsupervisory jobs in the employer costs for employee compensation database that included the term "supervisors" in their occupational title. Table 2 lists these occupations and their estimated share of total private nonfarm employment in March 1997. Total private industry employment represented by these "working supervisors" is similar to the difference in job coverage between the average hourly earnings and the employer costs for employee compensation replicate estimates shown in table 1. For example, table 2 shows that the working supervisor jobs constituted about 4.8 percent of all employment in March 1997. In contrast, for that same period, job

Table 2. Census occupations chosen to simulate "working supervisor" jobs, with estimated percent share of total private nonfarm employment, March 1997

Census code	Occupational title	Percent share
...	Total, all working supervisor jobs	4.8
C243	Supervisors, sales occupations	1.58
D303	Supervisors, general office	.49
D305	Supervisors, computer equipment operators	.21
D307	Supervisors, distribution, scheduling, and adjusting clerks	.17
E503	Supervisors, mechanics and repairers	.26
E553	Supervisors, brickmasons, stonemasons, and tilesetters	.01
E554	Supervisors, carpenters and related workers	.06
E555	Supervisors, electricians and power transmission installers	.05
E556	Supervisors, painters, paperhangers, and plasterers	.01
E557	Supervisors, plumbers, pipefitters, and steamfitters	.04
E558	Supervisors, construction trades, n.e.c.	.19
E613	Supervisors, extractive occupations	.08
E628	Supervisors, production occupations	.71
G803	Supervisors, motor vehicle operators	.12
H498	Supervisors, forestry and logging occupations	.02
H864	Supervisors, handlers, equipment cleaners, and laborers, n.e.c.	.17
K415	Supervisors, guards	.05
K433	Supervisors, food preparation and service occupations	.35
K448	Supervisors, cleaning and building service workers	.18
K456	Supervisors, personal service occupations	.05

NOTE: "Percent share" is estimated share of total private nonfarm employment using Employer Costs for Employee Compensation microdata with March 1997 sample weights.

n.e.c. = not elsewhere classified.

Table 3. Earnings and job coverage, average hourly earnings and employer costs for employee compensation replicates, 1994 to September 1999

Job type[1]	Actual average hourly earnings (Current Employment Survey) data	Employer costs for employee compensation replicate of average hourly earnings	
		Standard definition for job coverage	Exclusion of supervisors from coverage
All production and nonsupervisory jobs in private nonfarm industry:			
Average earnings (dollars per hour)	$12.32	$12.56	$12.32
Job coverage (percent of sector employment)	82.4	86.8	82.2
Production worker jobs in goods production:			
Average earnings (dollars per hour)	$13.86	$13.55	$13.13
Job coverage (percent of sector employment)	70.8	72.0	67.6
Nonsupervisory jobs in services:			
Average earnings (dollars per hour)	$11.80	$12.24	$12.06
Job coverage (percent of sector employment)	86.2	91.5	86.9

[1] The data are based on alternative definitions of production and nonsupervisory jobs.

NOTE: The number of comparisons is less than that shown in table 1 because the required occupational detail is only available in 10 selected months of the year, usually for the months of March. "Job coverage" is the share of total employment in the respective sector that is included in the average hourly earnings calculation.

coverage in the employer costs for employee compensation replicate estimate exceeded that of the actual average hourly earnings by 4.1 percent.

The results of calculating employer costs for employee compensation earnings replicates using available data to exclude "working supervisors" are illustrated in table 3. The detailed occupational information necessary to exclude working supervisors from the employer costs for employee compensation measure is not available every period, so comparisons are limited to 10 months. For this limited set of comparisons, job coverage and earnings level for the aggregate series are both virtually identical to these statistics for the actual average hourly earnings. However, this matching of the two series breaks down when comparing production and nonsupervisory jobs separately. Excluding working supervisors in production jobs increases the discrepancy of the employer costs for employee compensation earnings replicate with the comparable average hourly earnings series. Eliminating working supervisors from nonsupervisory jobs in services in the employer costs for employee compensation database substantially reduces, but does not eliminate, the gap in earnings with the comparable average hourly earnings series. Thus, other factors besides job coverage of "working supervisors" appear to be contributing to the discrepancies.

Conclusions

There has been widespread interest in comparing average hourly earnings to other broad wage and compensation mea-

sures. This article presented a new set of comparisons between the average hourly earnings series from the CES program and data from the Employment Costs for Employee Compensation program, which samples earnings of individual jobs within a nationwide survey of establishments. Data limitations require us to focus on comparisons of levels of earnings and employment rather than on trends. We derive independent estimates ("replicate estimates") from the microdata used to produce the employer costs for employee compensation to compare with estimates from the average hourly earnings series. The employer costs for employee compensation replicates showed higher earnings and coverage of employment than the actual average hourly earnings over the 1988–99 period. For production workers in goods production, these differences in earnings levels and job coverage were small— on average, about $0.40 per hour in earnings and 0.7 percent of the sector's job coverage. Discrepancies in earnings levels and job coverage were greater for nonsupervisory workers in services production, and we conducted further analysis of the hypothesis that these discrepancies were caused by omission of "working supervisors" from the actual average hourly earnings. Omitting "working supervisors" from the employer costs for employee compensation replicates of earnings estimates were reduced, but that did not eliminate discrepancies in earnings levels and job coverage with the actual average hourly earnings series. However, the replicate approach used in this article and that used by Abraham and others only provides indirect evidence on the possible role of limited job coverage in average hourly earnings levels. □

Notes

[1] For more information on the Current Employment Statistics program and the average hourly earnings series, see *BLS Handbook of Methods*, Bulletin 2490 (Bureau of Labor Statistics, 1997), pp. 15 and 17.

[2] The Current Employment Statistics program is researching and tentatively planning for transition to all employee hours and earnings estimates. However, existing historical data cannot be revised to correspond with this potential new series.

[3] See *BLS Handbook of Methods*, p. 17.

[4] See American Statistical Association Panel for the Bureau of Labor Statistics Current Employment Statistics Survey, "A Research Agenda to Guide and Improve the Current Employment Statistics Survey," Mimeo (American Statistical Association, January 1994); and Barry Bosworth, and George Perry, "Productivity and Real Wages: Is There a Puzzle?" *Brookings Papers on Economic Activity*, 1994, no. 1, pp. 317–43.

[5] Katharine G. Abraham, James R. Spletzer, and Jay C. Stewart, "Divergent Trends in Alternative Wage Series," in John C. Haltiwanger, Marilyn E. Manser, and Robert Topel, eds., *Labor Statistics Measurement Issues* (University of Chicago Press, 1998), pp. 293–324.

[6] Bosworth and Perry, "Productivity and Real Wages," compared the rate of growth in the Employer Cost Index for production and nonsupervisory jobs with the growth rate of the average hourly earnings series; also see Michael K. Lettau, Mark A. Loewenstein, and Aaron T. Cushner, "Explaining the Differential Growth Rates of the ECI and ECEC," *Compensation and Working Conditions*, Summer 1997, pp. 3–14. In this study, Lettau and others show that over the 1986–96 period, growth in the ECI exceeded the growth in employer costs for employee compensation.

[7] See *BLS Handbook of Methods*, p. 21.

[8] Abraham and others, "Divergent Trends in Alternative Wage Series."

[9] See *Report on the American Workforce* (Bureau of Labor Statistics, 1995), p. 162.

[10] See *BLS Handbook of Methods*, p. 21.

[11] In the earlier period, the annualized mean percent quarter-to-quarter growth rate of the average hourly earnings was 3.16 percent, while the corresponding growth rate of the employer cost for employee compensation replicate was 3.51 percent. In the latter period, the average hourly earnings grew on average by 3.68 percent, while the employer costs for employee compensation replicate grew by 3.42 percent.

[12] Industry classification numbers and levels are listed in the *Standard Industrial Classification Manual 1987* (Washington, Office of Management and Budget).

[13] Published Current Employment Statistics employment for nonsupervisory jobs in September 1999 was 71.3 million, while the estimate of employment coverage for the corresponding employer costs for employee compensation replicate was 76.0 million.