

# Chapter 2. Employment, Hours, and Earnings from the Establishment Survey

The Bureau of Labor Statistics (BLS) cooperates with State Employment Security Agencies in the Current Employment Statistics (CES) survey to collect data each month on employment, hours, and earnings from a sample of nonagricultural establishments (including government). In 2003, the CES sample included about 160,000 businesses and government agencies, which represent approximately 400,000 individual worksites. The active CES sample covers approximately one-third of all nonfarm payroll workers. From these data, a large number of employment, hours, and earnings series are prepared and published each month in considerable industry and geographic detail. The employment data include series on all employees, women workers, and production or nonsupervisory workers. For the production or nonsupervisory workers in private industries, hours and earnings data include series on average hourly and weekly earnings, average weekly hours, and, for manufacturing industries, average weekly overtime hours. For most series, seasonally adjusted data also are published.

## Background

The first monthly studies of employment and payrolls by BLS began in 1915 and covered four manufacturing industries. Before 1915, the principal sources of employment data in the United States were the census surveys—the decennial Census of Population and the quinquennial Census of Manufactures. No regular employment data were compiled between the censuses.

In 1916, the BLS survey was expanded to cover employment and payrolls in 13 manufacturing industries; by 1923, the number of industries had increased to 52, and, by 1932, 91 manufacturing and 15 nonmanufacturing industries were covered by a monthly employment survey.

With the deepening economic crisis in 1930, President Herbert C. Hoover appointed an Advisory Committee on Employment Statistics, which recommended extension of the BLS program to include the development of hours and earnings series. In 1932, the U.S. Congress granted an increase in the BLS appropriation for the survey. In 1933, average hourly earnings and average weekly hours were published for the first time for total manufacturing, for 90 manufacturing industries, and for 14 nonmanufacturing categories.

During the Great Depression, there was controversy concerning the actual number of unemployed people; no reliable

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measures of employment or unemployment existed. This confusion stimulated efforts to develop comprehensive estimates of total wage and salary employment in nonfarm industries, and BLS survey data produced such a figure for the first time in 1936.

Interest in employment statistics for States and areas also grew. Even before BLS entered the field in 1915, three States—Massachusetts, New York, and New Jersey—were preparing employment statistics. In 1915, New York and Wisconsin entered into cooperative agreements with BLS, whereby sample data collected from employers by a State agency would be used jointly with BLS to prepare State and national series. By 1928, five additional States had entered into such compacts, and another five joined the program by 1936. By 1940, estimates of total nonfarm employment for all 48 States and the District of Columbia were available. Since 1949, the CES program has been a fully integrated Federal-State project that provides employment, hours, and earnings information by industry on a national, State, and area basis. Cooperative arrangements were in effect with all 50 States, the District of Columbia, Puerto Rico, and the Virgin Islands by 1980.

In the early 1990s, the CES program began a transition to automated data collection methods. By 1996, it had completed implementation of computer-assisted reporting through telephone interviews and touch-tone self-reporting, and introduced electronic data interchange. Beginning in 1996, improvements to seasonal adjustment techniques were introduced to better control for various calendar and weather effects.

The CES program completed a conversion from its original quota sample design to a probability-based sample survey design and switched from the Standard Industrial Classification system to the North American Industry Classification System in 2003. The industry-coding update included reconstruction of historical estimates in order to preserve time series for data users. Also in 2003, the CES program began concurrent seasonal adjustment, a process that makes use of all available monthly estimates, including those for the latest month.

## Concepts

### Establishment

An establishment is an economic unit that produces goods or services, such as a factory, mine, or store. It generally is at a single location and is engaged predominantly in one type of economic activity. Where a single location encompasses two or more distinct activities, these are treated as separate establishments, if separate payroll records are available and certain other criteria are met.

### Employment

Employment is the total number of persons employed full or part time in nonfarm establishments during a specified payroll period. Temporary employees are included. Data refer to persons who worked during, or received pay for, any part of the pay period that includes the 12th of the month, a standard for all Federal agencies collecting employment data from business establishments.

Workers on an establishment payroll who are on paid sick leave (when pay is received directly from the employer); who are 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 that reports them, whether the duplication is due to turnover or dual jobholding. 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. Those excluded from the employed include 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. The employment statistics for government

refer to civilian employees only. The CES survey scope excludes the self-employed, unpaid family workers, and workers in private households and agriculture.

In addition to employment data for *all employees*, the survey also collects data on a major category of workers in each industry for estimation of hours and earnings.

CES collects data for *production workers* in manufacturing and in natural resources and mining industries. In manufacturing, the production worker group covers employees, up through the level of working supervisors, who engage directly in the manufacture of the establishment's product. 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, engaged primarily in some business other than construction, for its own account and for use by its employees.) Production workers in natural resources and mining are defined in a similar manner. A more detailed description of the classes of employees included in the production and nonproduction worker categories in manufacturing is shown on the sample BLS 790 C data collection form included in the appendix to this chapter.

In construction, the term *construction workers* covers workers, up through the level of working supervisors, who are engaged directly in a construction project, either at the site or in shops or yards, at jobs ordinarily performed by members of construction trades. Excluded from this category are executive and managerial personnel, professional and technical employees, and workers in routine office jobs.

For private service-providing industries (trade, transportation, utilities, information, financial activities, professional and business services, education and health services, leisure and hospitality, and other services), data are collected for *nonsupervisory workers*. Nonsupervisory workers include most employees, but exclude those in executive, managerial, and supervisory positions. (See the sample BLS 790 E data collection form included in the appendix to this chapter.)

An *employment benchmark* is a complete count of employment used to adjust estimates derived from a sample. Adjustment is usually done annually. The basic source of benchmark data for the CES survey is data on "all employees" collected from employers by State Employment Security Agencies as a byproduct of the unemployment insurance (UI) system. About 97 percent of all employees on nonfarm payrolls are covered by the UI system. The compilation and use of benchmark data are explained in detail in later sections of this chapter.

### Hours and earnings

The hours and earnings series are based on reports of gross payrolls and the corresponding paid hours for production workers, construction workers, or nonsupervisory workers.

(See the sample BLS 790 C data collection form included in the appendix to this chapter.)

*Aggregate payrolls* include pay before deductions for Social Security, unemployment insurance, group insurance, withholding tax, salary reduction plans, bonds, and union dues. The payroll figures also include overtime pay, shift premiums, and payments for holidays, vacations, sick leave, and other leave made directly by the employer to employees for the pay period reported. Payrolls exclude bonuses, commissions, and other lump-sum payments (unless earned and paid regularly each pay period or month), or other pay not earned in the pay period (such as retroactive pay). Tips and the value of free rent, fuel, meals, or other payments in kind are not included.

*Total hours* during the pay period include all hours worked (including overtime hours), hours paid for standby or reporting time, and equivalent hours for which employees received pay directly from the employer for sick leave, holidays, vacations, and other leave. Overtime and other premium pay hours are not converted to straight-time equivalent hours. The concept of total hours differs from those of scheduled hours and hours worked. The average weekly hours derived from paid total hours reflect the effects of such factors as unpaid absenteeism, labor turnover, part-time work, and strikes, as well as fluctuations in work schedules.

*Overtime hours* are hours worked for which premiums were paid because they were in excess of the number of hours of either the straight-time workday or workweek. Saturday and Sunday hours (or 6- and 7th-day hours) are included as overtime only if overtime premiums were paid. Holiday hours worked as overtime are not included unless they are paid for at more than the straight-time rate. Hours for which only shift differential, hazard, incentive, or similar types of premiums were paid are excluded from overtime hours. Overtime hours data are collected only from establishments in manufacturing industries.

*Average hourly earnings* series, derived by dividing gross payrolls by total hours, reflect the actual earnings of workers, including premium pay. They differ from wage rates, which are the amounts stipulated for a given unit of work or time. Average hourly earnings do not represent total labor costs per hour for the employer, because they exclude retroactive payments and irregular bonuses, employee benefits, and the employer's share of payroll taxes. Earnings for those employees not included in the production worker or nonsupervisory categories are not reflected in the estimates.

*Real earnings* data (those expressed in 1982 dollars) result from the adjustment of average hourly and weekly earnings by means of the BLS Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W); they indicate the purchasing power of money earnings after adjustment for

changes over time in the prices of consumer goods and services. These data cannot be used to measure changes in living standards as a whole, which are affected by other factors such as total family income, the extension and incidence of various social services and benefits, and the duration and extent of employment and unemployment. The long-term trends of these earnings data also are affected by changing mixes of full-time and part-time workers, high-paid and low-paid workers, and so on.

*Straight-time average hourly earnings* are approximated by adjusting average hourly earnings to eliminate only premium pay for overtime at a rate of time and one-half. Thus, no adjustment is made for other premium payment provisions such as those for holiday work, late shift work, and premium overtime rates other than those at time and one-half. Straight-time average hourly earnings are calculated only for manufacturing industries.

### Industrial classification

Industries are classified in accordance with the 2002 North American Industry Classification System (NAICS). Industrial classification refers to the grouping of reporting establishments into industries based on their major product or activity. Using a description provided by the employer on a questionnaire, State Employment Security Agencies assign an industrial code to each establishment as an administrative byproduct of the UI reporting system. All data for an establishment making more than one product or engaging in more than one activity are classified under the industry of the primary product or activity, based on the information reported.

## Data Sources and Collection Methods

### Sample data

Each month, the State agencies cooperating with BLS, as well as BLS Data Collection Centers, collect data on employment, payrolls, and paid hours from a sample of establishments. Data are collected through various automated collection modes and by mail. Touch-tone data entry (TDE) serves as the primary type of electronic reporting, although a large number of reports are collected via direct electronic file transmission (EDI), and a small but growing number are received via the Internet (Web). Additionally, many respondents report via computer-assisted telephone interviews (CATI) or FAX. Table 1 summarizes the distribution of the CES sample by collection mode.

**Table 1. Distribution of the CES sample by collection mode**

Collection method	Percent of reports
TDE	30
CATI	22
EDI	19
FAX	15
Mail	13
Web	1

*Sample enrollment.* Each year, new sample units are enrolled in the CES survey to account for the births of new firms, to realign the sample distribution with the universe distribution, and to rotate a portion of the sample. Approximately 40,000 sample units are enrolled each year. New enrollments generally report via CATI for a number of months and then may be converted to one of the automated reporting modes such as TDE, FAX, or Web.

*Data reporting.* Each month, the respondents extract the requested data from their payroll records, which are maintained for a variety of payroll, tax, and accounting purposes. Data are collected for the pay period that includes the 12th of each month. The CES forms shown at the end of this chapter provide information on CES data concepts and definitions.

All firms with 1,000 employees or more are asked to participate in the survey, as is a sample of firms across all employment sizes. In 2003, the CES sample consisted of about 160,000 businesses and government agencies that represented approximately 400,000 individual worksites drawn from a sampling frame of UI tax accounts. The sample rotation plan allows most firms to report for 4 years and then be rotated out of the sample for a similar period.

A CES reporting form (BLS form 790 series) is provided to all CES respondents except those that report via electronic file. For units that report via CATI, TDE, or Web, the form provides a convenient means to record their data each month. For units that report via mail, the form is submitted each month by the respondent, edited by the State agency, and returned to the respondent for use again the following month. The CES report form has been used since 1930, but there have been substantial changes in its design and in the data collected over this timespan. Six variations of the basic CES form currently are used. The variations tailor the data items, concepts, and definitions for each major industry sector. Separate forms are used for natural resources and mining, construction, manufacturing, service-providing industries, public administration, and educational services.

The design of the CES form is particularly important in maintaining continuity and consistency in reporting from month to month. The use of a single form for the entire year allows the respondent to compare the latest data submitted with the data submitted in prior months.

All reported data, regardless of method of collection, are edited by the State agency or the BLS Data Collection Center each month to ensure that the information is correctly reported and that it is consistent with the data reported by the establishment in earlier months. The State agencies and Data Collection Centers electronically transmit the data to the BLS central office in Washington, DC, where the data are further edited to detect processing and reporting errors that might have been missed in the initial editing. When questionable reports are discovered at any stage of the editing process, the collection site responsible for the initial collection of the data contacts the respondent for clarification or correction. The staff of the BLS Washington office prepares

national estimates of employment, hours, and earnings using the edited data. The State agencies also use the data to develop State and area estimates.

### **Benchmark data**

Since 1940, the basic source of benchmark information for “all employees” has been the periodic tabulations compiled by State Employment Security Agencies from reports filed by establishments covered under State UI laws. The State agencies receive quarterly reports from each employer subject to the UI laws; these reports show total employment in each month of the quarter and the total quarterly wages for all employees. The State agencies submit tabulations of these reports to the BLS Washington office each quarter. (See chapter 5.)

For the few industries exempt from mandatory UI coverage, other sources are used for benchmark information. For example, data on employees covered under Social Security laws, published by the U.S. Census Bureau in *County Business Patterns*, augments the UI data for religious organizations, private schools, and interns and trainees in hospitals. The Surface Transportation Board, the Federal agency charged with regulating interstate surface transportation, provides data for interstate railroads.

The UI data for State and local government employment are supplemented as necessary with Census Bureau data derived from the Census of Governments for local elected officials and certain other groups. A short description of the benchmark process is given in the section on estimating procedures for employment, below.

All estimates back to the most recent benchmark month are subject to revision each year when new benchmarks become available. National benchmarks are published 11 months after the benchmark month (March). For example, the revised estimates based on the March 2003 benchmarks were released in February 2004. The interbenchmark revision period extended from April 2002 through February 2003. Estimates based on the new benchmark level also were released in February of 2004 for the postbenchmark period—April 2003 through January 2004. Subsequent estimates also are based on the 2003 benchmark levels until release of the 2004 benchmark.

To determine the appropriate revisions, the new benchmarks for March are compared with the estimates previously made for that month. The differences represent: 1) Estimating errors that accumulated since the previous benchmark revision and 2) corrections to establishments’ industry classification. These differences are assumed to have accumulated at a regular rate. The all-employee estimates are wedged, or tapered, in order to smooth out the differences between the new and old benchmarks. Estimates for the 6 months subsequent to the benchmark month are revised by applying the previously computed sample movement and new factors reflecting firm births and deaths to the new benchmark level. (See the section on estimating procedures for a discussion of the treatment of firm births and deaths in the CES program.) Estimates for women workers and production

workers are recomputed using the revised all-employee estimates and the previously computed sample ratios of these workers to all employees. Estimates for the months after the benchmark include the sample updates and new birth/death factors, as well as the effects of linking from a new benchmark level.

## Sample Design

In June of 2003, BLS completed a comprehensive sample redesign of its monthly payroll survey, which coincided with the conversion of all CES series to industry coding based on the 2002 North American Industry Classification System (NAICS). The original CES survey was a quota sample whose inception in the 1940s predated the introduction of probability sampling as the internationally recognized standard for sample surveys.

The design is a stratified, simple random sample of worksites, clustered by UI account number. The sample strata, or subpopulations, are defined by State, industry, and employment size, yielding a State-based design. Sampling rates for each stratum are determined through optimum allocation, which distributes a fixed number of sample units across a set of strata to minimize the overall variance or sampling error on the primary estimate of interest, the statewide total nonfarm employment level.

The sampling frame, and the CES sample itself, are updated twice a year with new quarters of UI-based universe data. This helps to keep the sample up-to-date by adding firm births and deleting business deaths. In addition, the design specifies an annual update process, which includes sample frame maintenance and the redrawing of the entire sample for the first quarter of each year. Frame maintenance provides for the updating of industry, employment size class, and metropolitan area designations and for the merging of semiannual birth samples into the overall frame.

## Estimating Procedures

### Employment

Employment estimates are made at what is termed the basic estimating cell level, and are aggregated upward to broader levels of industry detail by simple addition. Basic cells are defined by industry (usually at the five- or six-digit NAICS level). Within the construction industry, stratification by geographic region also is used.

To obtain all-employee estimates for a basic estimating cell, the following five steps are necessary:

1. A total employment figure (benchmark) is obtained for the basic estimating cell as of a specified month (March).
2. For each report, employment is multiplied by the sample selection weight to obtain weighted employment for the months for which estimates are being made and for the previous month.

3. For each cell, the ratio of the weighted all employees sample total in 1 month to that in the preceding month (termed the weighted link-relative) is computed for sample establishments that reported for both months.
4. Beginning with the benchmark month, the all-employee estimate for each month is obtained by multiplying the all-employee estimate for the previous month by the weighted link-relative for the current month.
5. Add a net birth/death estimate from the model described below.

The following example illustrates how the estimating procedure is applied in preparing a series. Assume that the estimate for all employees for a given cell was 50,000 in July. The sample, comprising 60 establishments that reported for both months, had weighted employment of 25,000 in July and 26,000 in August, a 4-percent increase. The net birth/death estimate for August equals 100. To derive the August estimate, the ratio of weighted sample employment for August to that for July is applied to the July estimate:

$$\left( 50,000 \times \frac{26,000}{25,000} \right) + 100 = 52,100$$

This procedure, known as the weighted link-relative technique, is efficient in that it takes advantage of a reliable, complete count of employment and of the high correlation between levels of employment in successive months in identical establishments.

*Business birth and death modeling.* A net birth/death factor is added to national employment estimates to produce the monthly published estimates. Regular updating of the CES sample frame with information from the UI universe files helps to keep the CES survey current with respect to employment change due to business births and deaths. The timeliest UI universe files available however, always will be a minimum of 9 months out of date. Thus, the CES survey cannot rely on regular frame maintenance alone to provide estimates of the employment effects of business births and deaths. BLS utilizes a model-based approach for this component.

While both the business birth and business death portions of total employment are generally significant, the net contribution is relatively small and stable. To account for this net birth/death portion of total employment, BLS has an estimation procedure with two components. The first component uses business deaths to impute employment for business births. The second component is an ARIMA time-series model designed to estimate the residual net birth/death employment not accounted for by the imputation.

The imputation component is incorporated in the weighted link-relative estimation procedure by simply not reflecting sample units going out of business, but imputing to them the same trend as the other firms in the sample. The ARIMA

time-series model estimates the residual net business birth/death employment that is not accounted for by imputation. The historical time series used to create and test the ARIMA model was derived from the UI universe micro-level database and reflects the actual residual net of births and deaths over the past 5 years. The net birth/death model component figures are unique to each month and exhibit a seasonal pattern that can result in negative adjustments in some months.

*Production and nonsupervisory workers.* To obtain estimates of production (or construction or nonsupervisory) worker employment, the ratio of weighted production workers to the weighted all employees in the sample is assumed to equal the same ratio in the universe. The current month's production worker ratio is thus estimated and then multiplied by the all-employee estimate. The weighted difference-link and taper formula, described in the section on hours and earnings, is used to estimate the current month's production worker ratio. This formula adds the change in the matched sample's production worker ratio (the weighted difference link) to the prior month's estimate, which has been slightly modified to reflect changes in the sample composition (the taper). An analogous method is used to estimate the number of women workers.

The estimates for each type of series (all employees, production workers, and women workers) for individual basic estimating cells are summed to obtain corresponding totals for broader industry sectors.

### Hours and earnings

Independent benchmarks are not available for the hours and earnings series; consequently, the levels derive directly from the CES weighted-sample averages.

*Average weekly hours and average hourly earnings.* Before hours and earnings sample averages or estimates are calculated, production workers and aggregate hours and payrolls must be multiplied by sample weights both for the month for which estimates are being made and for the prior month. To obtain average weekly hours for a basic estimating cell, the sum of reported worker hours for the establishments classified in the cell is divided by the total number of production workers reported for the same establishments. In computing average hourly earnings, the reported payroll is divided by the reported worker hours for the same establishments.

Sample averages of average weekly hours and average hourly earnings are first modified at the basic estimating-cell level through the use of a wedging technique designed to compensate for month-to-month changes in the sample of reporting establishments (weighted difference-link and taper).

For example, unmodified sample averages for the current month,  $\bar{x}_c$ , are obtained from aggregates from a matched sample of establishments reporting for both the current month and the previous month. Similarly, unmodified sample aver-

ages for the previous month,  $x_p$ , are calculated from the same matched sample. The expression  $x_c - x_p$  denotes the change between the 2 months.

The other component of the weighted difference-link and taper formula is the estimate of average hourly earnings for the previous month,  $X_p$ . Because the panel of establishments reporting in the sample is not completely fixed from month to month,  $X_p$  and  $x_p$  may differ. An estimate for the current month,  $X_c$ , is obtained by using both pieces of information:

$$\bar{X}_c = (0.9X_p + 0.1x_p) + (x_c - x_p)$$

The procedure reflected in this formula has the following advantages: (1) It uses matched sample data; (2) it tapers the estimate toward the sample average for the previous month of the current matched sample ( $x_p$ ) before applying the current month's change; and (3) it promotes continuity by heavily favoring the estimate for the previous month ( $X_p$ ) when applying the numerical factors.

Average weekly hours and average hourly earnings for industries and groups above the basic estimating cell level are weighted averages of the figures for component cells. The average weekly hours for each basic estimating cell are multiplied by the corresponding estimate of the number of production workers to derive aggregate worker hours. Payroll aggregates are the product of the aggregate worker hours and average hourly earnings. The payroll and worker-hour aggregates for industry groups and divisions are the sums of the aggregates for the component industries.

Average weekly hours for industry groups are obtained by dividing the worker-hour aggregates by the corresponding production worker estimates. Average hourly earnings for industry groups are computed by dividing the payroll aggregates by the worker-hour aggregates. This method is equivalent to weighting average weekly hours by the estimated number of production workers in the universe and weighting average hourly earnings by the estimated worker hours for the universe.

For all levels, from basic estimating cells to supersectors and higher aggregates, average weekly earnings are computed by multiplying average hourly earnings by average weekly hours.

*Overtime hours.* Average weekly overtime hours are estimated in basically the same way as average weekly hours. Overtime worker-hour sample averages are used in the computations in place of the sample averages for total worker hours. The sample totals for production workers used in the computations are those for the reports containing overtime worker hours (including those reporting zero overtime hours) as well as production workers, total payroll, and total worker hours. The wedging technique and the summary level estimating technique for the overtime hours estimation also are comparable to those used to estimate average weekly hours.

*Average hourly and weekly earnings in 1982 dollars.* Aver-

age hourly and weekly earnings are computed and published in terms of 1982 dollars to give an approximate measure of changes in “real” average earnings (earnings in constant dollars). These series are computed by dividing the average hourly and weekly earnings (in current dollars) for a given month by the BLS Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) (1982 = 100) for the same month.

*Average hourly earnings, excluding overtime, for the manufacturing supersector.* These estimates are computed by dividing the total production worker payroll for an industry group by the sum of the total production worker hours and one-half of the total overtime worker hours, which is equivalent to the payroll divided by straight-time hours. This method excludes overtime earnings at an assumed rate of 1 1/2 times the straight-time rates; no further adjustment is made for other premium payment provisions.

*Indexes of aggregate weekly hours and payrolls.* These indexes are prepared by dividing the current month’s aggregates by the annual average aggregate for 2002. The hours aggregates are the product of average weekly hours and production, construction, or nonsupervisory worker employment; the payroll aggregates are the product of the hours aggregates and average hourly earnings.

*Indexes of diffusion of employment changes.* These indexes measure the dispersion among industries of the change in employment over the specified timespan. The overall indexes are calculated from seasonally adjusted employment series for four-digit NAICS-coded industries. The diffusion indexes for private nonfarm payroll employment are based on estimates for 278 industries, while the manufacturing indexes are based on estimates for 84 industries. Each component series is assigned a value of 0, 50, or 100 percent, depending on whether its employment showed a decrease, no change, or an increase over a given period. The average (mean) value is then calculated, and this percent is the diffusion index number. The reference point for interpreting the diffusion indexes is 50 percent, the value that indicates that the same number of component industries have increased in employment as have decreased. The direction and distance of the index number from the 50 percent reference point indicate whether growing (above 50) or declining (below 50) industries predominate and by what magnitude. The margin between the percentage of industries that increased and the percentage that decreased employment equals twice the difference between the index number and 50 percent.

### **Seasonally adjusted series**

Many economic statistics reflect a regularly recurring seasonal movement that can be measured from past experience. By eliminating that part of the change attributable to the normal seasonal variation, it is possible to observe the cyclical and other nonseasonal movements in these series. Seasonally adjusted series are published regularly for selected

employment, hours, and earnings series. CES published 146 seasonally adjusted employment series in 2003.

X-12 ARIMA software, developed by the U.S. Census Bureau, is used to seasonally adjust CES data on a concurrent basis. Using special features of X-12 ARIMA, adjustments are made to remove the effect of the variable number of weeks between surveys from month to month (about 1 month in 3 has a 5-week instead of a 4-week interval) and to remove the effect of the variable number of work days in the reference month, to adjust for moving holidays, and to adjust for the variations in the number of election poll workers in November from year to year.

CES processes concurrent seasonal adjustment on a monthly basis using the latest estimates of employment, hours, and earnings. Seasonally adjusted employment series for broader industry groups are obtained by summing the seasonally adjusted data for the component industries. Seasonally adjusted hours and earnings averages for broader level industry groups are weighted averages of the seasonally adjusted component series.

## **Data Presentation**

National employment estimates are published for all NAICS three-digit and higher level aggregate industries, 92 percent of the four-digit industries, 86 percent of the five-digit industries, and 44 percent of the six-digit industries.

The CES program currently publishes more than 5,200 national series each month. Tables 2, 3, and 4 in this chapter summarize the published national detail by industry supersector. Table 2 describes the primary series produced by the program, that is, those computed directly from the sample data. Table 3 indicates the special series derived from the primary series, and Table 4 lists the seasonally adjusted series.

The national series on employment, hours, and earnings appear in several BLS publications. The summary data are first published each month in *The Employment Situation* news release, which contains preliminary national estimates of nonfarm employment, average weekly hours, and average hourly and weekly earnings in the preceding month for industry supersectors. Preliminary estimates are based on tabulations of data for less than the full sample (about 57 percent) to permit early release of these widely used economic indicators. This release is normally issued on Friday, 3 weeks after the reference week. The news release also includes a brief analysis of current trends in employment, hours, and earnings.

Most of the national estimates at the level of detail described in tables 2, 3, and 4 are published monthly on the Internet on the morning of the release. Estimates also are published in *Employment and Earnings*. The summary data are in the issue available about 5 weeks after the week of reference; preliminary estimates for the full industry detail, based on about 74 percent of the sample, are in the following month’s issue. Final (prebenchmark) figures are issued 1

month later. Special articles describe technical developments in the program. The *Monthly Labor Review* also presents many of the national series as well as articles exploring industry employment trends.

Detailed employment, hours, and earnings data also are available on the Internet. The data can be accessed directly at <http://data.bls.gov/labjava/outside.jsp?survey=ce> or through the CES homepage, which provides extensive documentation on the program. National data also are disseminated in the publications or online databases of other Federal agencies, such as the U.S. Department of Commerce, the Board of Governors of the Federal Reserve System, and the Council of Economic Advisers. Data also are regularly republished in summary form or for specific industries in many trade association journals, the labor press, and in general reference works.

In addition to the national estimates, BLS publishes in *Employment and Earnings* monthly employment estimates for all 50 States, the District of Columbia, Puerto Rico, the Virgin Islands, and 288 metropolitan areas.<sup>1</sup> These estimates were adjusted to March 2003 benchmarks with the publication of January 2004 data. The employment series cover total nonfarm employment and industry supersectors (for example, construction and manufacturing) for each State and area. Hours and earnings data generally are limited to manufacturing production workers. Detailed industry data also are available monthly in releases published by the State Employment Security Agencies that cooperate with BLS in collecting the State and area information. State and area data also are available from the State and Area Current Employment Statistics homepage, which contains extensive information related to the CES State and area program, including contacts, news releases, and data.

## Comparison with the Current Population Survey

The Current Employment Statistics survey, also known as the payroll survey, excludes unpaid family workers, domestic workers in private homes, agricultural workers, proprietors, and other self-employed persons, all of whom are covered by the Current Population Survey (CPS), a survey of households. Moreover, the payroll survey counts a person who is employed by two or more establishments at each place of employment, but the household survey counts a person only once, and classifies the individual according to the major activity. 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 payroll survey.

The household survey emphasizes the employment status of individuals and provides much information on the demographic characteristics (sex, age, and race) of the labor force. The survey is not well suited to furnishing detailed

<sup>1</sup> Data for Puerto Rico and the Virgin Islands are not used in compiling national estimates. CES data at the national and State and area levels can be found on the Internet at <http://bls.gov/ces/> and <http://www.bls.gov/sae/home.htm>, respectively.

information on the industrial and geographic distribution of employment. The establishment survey provides limited information on personal characteristics of workers; however, it is an excellent source for detailed industrial and geographic data. In addition, it provides hours and earnings information that relates directly to the employment figures. The payroll and household surveys thus complement each other.

## Uses

Data from the CES program, along with the CPS data, are the first major economic indicators released each month. As such, they are used in the formulation of fiscal and economic policy. CES employment estimates are a primary component of the Index of Coincident Economic Indicators and have proved to be an extremely reliable measure of current economic activity. The manufacturing average weekly hours series is used in the Index of Leading Economic Indicators, which forecasts changes in the business cycle.

Aggregate earnings data are the major component of the preliminary Personal Income estimates in the National Income and Product Accounts. Productivity measures (chapters 12 and 13) and the Industrial Production Index are based on the aggregate hours data. Employment series are a basic input for employment projections by BLS (chapter 15) and State Employment Security Agencies.

The series also are used in the private sector by business firms, labor unions, universities, trade associations, and private research organizations to study economic conditions and to develop plans for the future. Business firms, for example, use the employment, hours, and earnings data for guidance in plant location, sales, and purchases. In addition, firms negotiating long-term purchase contracts often use escalation clauses based on the average hourly earnings series as an aid to adjust payments for changes in wages. Escalation clauses permit an adjustment of the contract price of the products or services being purchased depending on the movement of average hourly earnings in a selected industry.

Both labor and business have shown wide need for industry series on hourly earnings and weekly hours to provide a basis for labor-management negotiations. They not only furnish current and historical information on a given industry but also provide comparative data on related industries.

## Reliability of Estimates

The establishment survey, like other sample surveys, is subject to two types of error, sampling and nonsampling error. The magnitude of sampling error, or variance, is directly related to the size of the sample and the percentage of universe coverage achieved by the sample. The establishment survey sample covers over one-third of total universe employment; this yields a very small variance on the total nonfarm estimates.

Unlike most sample surveys that publish sampling error as their only measure of error, the CES can derive an annual



approximation of total error, on a lagged basis, because of the availability of the independently derived universe data. While the benchmark error is used as a measure of total error for the CES survey estimate, it actually represents the difference between two independent estimates derived from separate survey processes (specifically, the CES sample process and the UI administrative process) and thus reflects the errors present in each program. Historically, benchmark revisions have been very small for total nonfarm employment. Over the past decade, percentage benchmark error has averaged 0.3 percent, with an absolute range from less than 0.05 percent to 0.7 percent.

The estimation of sample variance for the CES survey is accomplished through use of the method of Balanced Half Samples (BHS). This replication technique uses half samples of the original sample and calculates estimates using those subsamples. The sample variance is calculated by measuring the variability of the subsample estimates. The weighted link estimator is used to calculate both half sample estimates and the variances estimates. The sample units in each cell; where a cell is based on State, industry, and size classification; are divided into two random groups. The basic BHS method is applied to both groups. The subdivision of the cells is done systematically, in the same order as the initial sample selection. Weights for units in the half sample are multiplied by a factor of  $1+\gamma$ , where weights for units not in the half sample are multiplied by a factor of  $1-\gamma$ . Estimates

from these subgroups are calculated using the estimation formula described above.

The formula used to calculate CES variances is as follows:

$$v_k^+(\hat{\theta}) = \frac{1}{\gamma^2 k} \sum_{\alpha=1}^k \left( \hat{\theta}_{\alpha}^+ - \hat{\theta} \right)^2$$

where

$\hat{\theta}_{\alpha}^+ = \theta(\hat{Y}_{\alpha}^+, \hat{X}_{\alpha}^+, \dots)$  is the half-sample estimator

$$\gamma = 1/2$$

$k$  is the number of half-samples

$\hat{\theta}$  is the original full sample estimates

Variances statistics are useful for comparison purposes, but they do have some limitations. Variances reflect the error component of the estimates that is due to surveying only a subset of the population, rather than conducting a complete count of the entire population. However, they do not reflect the nonsampling error, such as response errors and bias due to nonresponse. The overall performance of the CES employment estimates is best measured in terms of the benchmark revisions. The variances of the over-the-month change estimates are very useful in determining when changes are significant at some level of confidence.

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**Table 2. Number of primary national series on employment, hours, and earnings published from the Current Employment Statistics program, by industry, June 2003.**

Industry	All employees	Production or nonsupervisory workers <sup>1</sup>	Women workers	Average weekly hours	Average weekly overtime hours	Average hourly earnings	Average weekly earnings
Total .....	1,011	856	35	856	285	856	856
Total nonfarm.....	1	-	1	-	-	-	-
Total private .....	1	1	1	1	-	1	1
Goods-producing .....	1	1	1	1	-	1	1
Natural resources and mining .....	18	18	2	18	-	18	18
Construction .....	41	38	1	38	-	38	38
Manufacturing .....	339	299	3	299	285	299	299
Service-providing .....	1	-	1	-	-	-	-
Private service-providing .....	1	1	1	1	-	1	1
Trade, transportation, and utilities .....	218	186	5	186	-	186	186
Information .....	31	26	1	26	-	26	26
Financial activities .....	72	59	3	59	-	59	59
Professional and business services .....	95	87	4	87	-	87	87
Education and health services .....	67	47	3	47	-	47	47
Leisure and hospitality .....	51	44	3	44	-	44	44
Other services .....	53	49	1	49	-	49	49
Public administration .....	21	-	4	-	-	-	-

<sup>1</sup> Production workers in manufacturing and natural resources and mining, construction workers in construction, and nonsupervisory workers in all other industries.

**Table 3. Number of special national series derived from primary series of employment, hours, and earnings published from the Current Employment Statistics program, by industry, June 2003.**

Industry	Indexes of aggregate weekly hours	Indexes of aggregate weekly payrolls	Average hourly earnings, excluding overtime	Average hourly earnings (1982 = 100)	Average weekly earnings (1982 = 100)
Total .....	40	19	24	17	17
Total private .....	1	1	-	1	1
Goods-producing .....	1	1	-	1	1
Natural resources and mining .....	1	1	-	1	1
Construction .....	1	1	-	1	1
Manufacturing .....	24	3	24	1	1
Private service-providing .....	1	1	-	1	1
Trade, transportation, and utilities .....	5	5	-	5	5
Information .....	1	1	-	1	1
Financial activities .....	1	1	-	1	1
Professional and business services .....	1	1	-	1	1
Education and health services .....	1	1	-	1	1
Leisure and hospitality .....	1	1	-	1	1
Other services .....	1	1	-	1	1

**Table 4. Number of seasonally adjusted national series on employment, hours, and earnings published from the Current Employment Statistics Program, by Industry, June 2003.**

Industry	All employees	Production or nonsupervisory workers <sup>1</sup>	Women workers	Average weekly hours	Indexes of aggregate weekly hours	Indexes of aggregate weekly payrolls	Average weekly over-time hours	Average hourly earnings		Average weekly earnings	
								Current dollars	1982 dollars	Current dollars	1982 dollars
Total .....	146	40	35	40	40	19	3	19	17	19	17
Total nonfarm .....	1	-	1	-	-	-	-	-	-	-	-
Total private .....	1	1	1	1	1	1	-	1	1	1	1
Goods-producing .....	1	1	1	1	1	1	-	1	1	1	1
Natural resources and mining .....	7	1	2	1	1	1	-	1	1	1	1
Construction .....	4	1	1	1	1	1	-	1	1	1	1
Manufacturing .....	28	24	3	24	24	3	3	3	1	3	1
Service-providing .....	1	-	1	-	-	-	-	-	-	-	-
Private service-providing .....	1	1	1	1	1	1	-	1	1	1	1
Trade, transportation, and utilities .....	32	5	5	5	5	5	-	5	5	5	5
Information .....	8	1	1	1	1	1	-	1	1	1	1
Financial activities .....	13	1	3	1	1	1	-	1	1	1	1
Professional and business services .....	15	1	4	1	1	1	-	1	1	1	1
Education and health services .....	12	1	3	1	1	1	-	1	1	1	1
Leisure and hospitality .....	8	1	3	1	1	1	-	1	1	1	1
Other services .....	4	1	1	1	1	1	-	1	1	1	1
Public administration .....	10	-	4	-	-	-	-	-	-	-	-

<sup>1</sup> Production workers in manufacturing and natural resources and mining, construction workers in construction, and nonsupervisory workers in all other industries.

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