

# Chapter II. The 2006–16 National Employment Matrix Structure

The Bureau of Labor Statistics (BLS) develops occupational projections biennially as part of its Employment Projections program. These projections, to 2016, along with 2006 base-year employment data, are presented in the National Employment Matrix. The National Employment Matrix incorporates data from multiple BLS surveys in order to present a comprehensive measure of both base- and projected-year employment. The Matrix measures total employment as a count of jobs, not individual workers. This concept is different from that used by another BLS measure familiar to many readers, the Current Population Survey's total employment as a count of the number of workers. The Matrix total employment concept is also different from the BLS Current Employment Statistics total employment measure which, while a count of jobs, includes nonfarm payroll jobs while the Matrix includes all jobs. The Matrix is constructed using three separate employment matrices consisting of a 2006 base-year employment matrix, a change factor matrix, and a 2016 projected-year employment matrix. These matrices are used as tools for analyzing the utilization of occupations within industries and for projecting occupational employment. There are numerous iterations of these three matrices that incorporate analyst review. Because all matrices share the same configuration, an early step in each projection cycle is defining their occupation and industry employment structure. Occupations define matrix rows, while industries define matrix columns. Wage and salary industries account for the vast majority of columns. Separate columns encompass the other two classes of worker categories—the self-employed and unpaid family workers—which are treated as individual industries. Once defined, the three matrices use the same structure.

As mentioned, the National Employment Matrix was developed to provide the most comprehensive measure possible of base- and projected-year employment. The availability of data for constructing the 2006 base-year employment matrix generally is the limiting factor. Data on current employment for wage and salary industries, the self-employed, and unpaid family workers come from a few different sources.

This chapter first discusses the base-year employment, change factor, and projected-year employment matrices. Afterwards, the occupational and industry structures for the matrices are described in detail, including any adjustments made to data sources to fit the structure. A brief historical overview of the National Employment Matrix can be found in the box at the end of the chapter.

## 2006 base-year employment matrix

Calculating employment for each cell in the 2006 base-year matrix establishes the initial employment levels on which occupational projections are based.

For most industries, Occupational Employment Statistics (OES) survey data identify the occupational staffing pattern—the detailed occupations that comprise each wage and salary industry—and Current Employment Statistics (CES) data provide infor-

mation on total wage and salary employment in each industry.<sup>1</sup> Estimates of wage and salary employment for each occupation in each industry are derived by multiplying each occupation's proportion—or ratio—of employment in each industry, based on OES survey data, by CES industry employment.

Other sources provide information on industries not included in the scope of the OES survey. The OES program obtains Federal Government and U.S. Postal Service (USPS) occupational wage and salary employment data from the U.S. Office of Personnel Management (OPM) and the USPS, respectively. The Current Population Survey (CPS) furnishes wage and salary employment data for agriculture; forestry, fishing, and hunting; support activities for agriculture and forestry; and private households.<sup>2</sup>

Data on self-employed and unpaid family worker employment also come from the CPS. Information on second jobs is collected for one-quarter of the sample each month and is combined with primary-job occupational employment estimates to yield a broader employment measure of the self-employed and unpaid family workers. Employment figures for these two categories of workers are available only at the total, all-industries level.

Total base-year employment for an occupation is the sum of employment in a row across all columns—the combination of wage and salary, self-employed, and unpaid family workers. Occupational employment within each industry, divided by total wage and salary employment in each industry, yields the occupational distribution ratios used in developing the change factor matrix and the projected-year employment matrix.

Over the numerous iterations of the National Employment Matrix, only a few changes are made to the base-year employment matrix to resolve known data issues. These issues are discussed later in the occupational directory section.

## Change-factor matrix

A second matrix, the change-factor matrix, estimates changes in the utilization of occupations within wage and salary industries. For example, computer systems analysts would be expected to become a greater proportion of each industry's employment as the number of computer applications continues to increase. The

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<sup>1</sup> Since November 2002, the OES survey has been a semiannual mail survey of approximately 200,000 establishments collected in May and November of each year. Over the course of a 3-year cycle, approximately 1.2 million establishments are sampled. For the May 2006 OES survey estimates, data collected in May 2006 were combined with data collected in November 2005, May 2005, November 2004, May 2004, and November 2003. Detailed information about the May 2006 OES survey is available at the OES web site (<http://www.bls.gov/oes/home.htm>). CES wage and salary employment data come from a monthly sample that includes about 160,000 businesses and government agencies, which cover approximately 400,000 individual worksites. The base-year employment matrix uses CES annual average data for 2006. For more information, visit: <http://www.bls.gov/ces/home.htm>

<sup>2</sup> The CPS is a monthly household survey on labor force characteristics. Each month, personal and telephone interviews are conducted at about 60,000 households. The base-year employment matrix uses CPS annual average data for 2006. Detailed information is available at the CPS Web site (<http://www.bls.gov/cps/home.htm>).

change factor multiplied by the occupation's base-year ratio of wage and salary industry employment determines the occupation's projected-year ratio of industry employment. Occupational change factors are prepared only for wage and salary employment in detailed industries. (See chapter IV and table IV-3.)

Over the numerous iterations of the National Employment Matrix, many changes occurred to the change factor matrix to incorporate analyst research and review. However, a change factor matrix was not needed for the final iteration of the projected-year employment matrix, as is discussed in the following section.

### **2016 projected-year employment matrix**

Preparing the projected-year employment matrix is the last step in the projections process. For each wage and salary industry, projected-year industry wage and salary employment is multiplied by the projected-year occupational distribution ratio to yield projected-year wage and salary occupational employment for the industry.<sup>3</sup> Occupational employment data for the self-employed and unpaid family workers are projected separately with the help of time-series analysis and literature review. Total projected-year occupational employment is the sum of employment in a row across all columns—the sum of the employment figures for wage and salary, self-employed, and unpaid family workers.

With each iteration of the National Employment Matrix, numerous changes to the projected-year employment matrix occurred. Usually, changes were due to revisions in the change factor matrix or the industry projections. However, the final iteration of the projected-year employment matrix was adjusted primarily based on analyst recommendations.

### **The 2006–16 National Employment Matrix occupational directory**

The occupational structure of the Matrix is based on the same structure used by the May 2006 OES employment estimates, which includes 801 detailed occupations from the 2000 Standard Occupational Classification (SOC) system. Occupational data for industries not surveyed by the OES were distributed across the full 2000 SOC.

This section will discuss the three types of occupations in the matrix, any adjustments made to the May 2006 OES employment estimates, and any adjustments made to 2006 CPS employment estimates. The occupation structure for the 2006–16 Matrix is shown in table II-1.

**Occupation types.** Occupations define the rows in the matrix, and three types of occupations exist in the final structure of the matrix:

- 1) Line-item occupations (753 published in total) possess the greatest level of published occupation employment detail in the matrix and display 2006 and projected 2016 employment estimates.

- 2) Summary occupations (268) combine employment information on line-item occupations and display 2006 and projected 2016 employment estimates.

- 3) Excluded occupations (52) were suppressed because of insufficient information to prepare projections. For example, in the 2006–16 National Employment Matrix occupational directory, separate projections were not released for three detailed rail transportation occupations: 53-4011, “locomotive engineers”; 53-4012, “locomotive firers”; and 53-4013, “rail-yard engineers, dinkey operators, and hostlers.” Base-year Matrix employment and projected-year Matrix employment for these three occupations were each summed into the corresponding line item occupation 53-4010, “locomotive engineers and operators.” (See table III-2.)

**Adjusting May 2006 OES employment data.** Some alterations to the May 2006 OES survey data were needed to improve the coverage of information in the National Employment Matrix. These adjustments took place primarily in NAICS industry 8131 “religious organizations” and in the OES-designated (non-NAICS) Federal Government sector.

**Religious organizations.** The OES survey generated May 2006 occupational employment estimates by applying industry employment data from the Quarterly Census of Employment and Wages (QCEW) program to OES survey occupation patterns in each industry. The QCEW program measures the employment of workers covered by unemployment insurance programs. QCEW employment for NAICS industry 8131, “religious organizations,” however, does not reflect all workers because unemployment insurance coverage for this industry is incomplete.

In preparing occupation projections, the matrix staff uses industry employment from the Current Employment Statistics (CES) program for most industries, including religious organizations. The CES employment figure for religious organizations is almost 10 times greater than the figure derived from the QCEW; consequently, there is concern that some occupations in this industry may not be represented adequately by the OES survey. In particular, occupation 21-2011, “clergy,” the most significant occupation in religious organizations, is considerably undercounted by using QCEW employment to select the OES sampling frame. Employment for clergy in the 2006 CPS industry-occupation matrix was significantly higher than the QCEW-based OES estimate. Accordingly, the occupational distribution for religious organizations was altered by increasing employment estimates for clergy to match the CPS estimate. This forced a decrease in the ratios for every other occupation within the industry before applying the distribution to 2006 CES employment.

**Federal Government.** Payroll data from the U.S. Office of Personnel Management on Federal occupational employment provided to OES staff use occupational codes and titles unique to the Federal Government. On the basis of information provided by OPM, Federal occupational data are recoded to the appropriate SOC occupations and are used to develop OES staffing patterns. Because of limited information provided for information technology occupations, the OES survey assigns OPM data on computer specialists to two non-residual SOC occupations, with the remainder going

<sup>3</sup> Industry sector employment projections prepared in the Division of Industry Employment Projections use a comprehensive modeling technique that estimates output as well as employment. More detailed industry employment projections produced using historical time series information are included in the Matrix and are consistent with their parent industry sector (See chapter IV and table IV-1).

to the residual occupation 15-1099, “All other computer specialists.” The matrix staff developed a methodology for redistributing the OES occupation data over all SOC-based computer specialist occupations for matrix industry 919999, “Federal Government, excluding Postal Service.” The distribution of computer specialists in this industry is adjusted to better reflect the distribution found across nearly all industries covered by OES outside of matrix industry 919999. However, the ratio for computer programmers in Federal Government is assumed to be less than other industries because computer programming is expected to be increasingly outsourced. The adjustment by matrix staff increases the number of information technology occupations from 3 to 10 as follows:

OES-coded Federal Government information technology occupations in matrix industry 919999

- 1) 15-1011 Computer and information scientist, research
- 2) 15-1041 Computer support specialists
- 3) 15-1099 All other computer specialists

Matrix-coded Federal Government information technology occupations in matrix industry 919999

- 1) 15-1011 Computer and information scientist, research
- 2) 15-1021 Computer programmers
- 3) 15-1031 Computer software engineers, applications
- 4) 15-1032 Computer software engineers, systems software
- 5) 15-1041 Computer support specialists
- 6) 15-1051 Computer systems analysts
- 7) 15-1061 Database administrators
- 8) 15-1071 Network and computer systems administrators
- 9) 15-1081 Network systems and data communications analyst
- 10) 15-1099 All other computer specialists

**Adjusting 2006 CPS employment.** The 2006–16 National Employment Matrix uses 2006 CPS employment data for estimates of the numbers of self-employed and unpaid family workers, as well as wage and salary workers in agriculture and private household industries. The 2006 CPS data were coded using the 2000 Census of Population occupation classification system, which closely resembles the 2000 SOC system. Of the 502 CPS occupations, 373 were exact matches to National Employment Matrix occupations. The remaining CPS occupations were distributed over two or more SOC occupations. When one CPS occupation had the coverage of multiple matrix occupations, CPS self-employed and unpaid family worker employment were distributed over the detailed matrix occupations on the basis of total occupation employment in the 2004 matrix. Occupational analysts then reviewed and recommended changes to the distributed employment.

### The 2006–16 National Employment Matrix industry directory

In order to develop the matrix industry structure, BLS staff made judgments to reconcile data from the CES, OES, and CPS. This section covers the class of worker categories; CPS coverage; CES and OES treatment of educational services, hospitals, and government; and a note on 5-digit NAICS industries covered by OES. The Matrix industry directory can be found in table II-2.

**Class-of-worker categories.** The class-of-worker categories—wage and salary jobs, by industry; self-employed workers; and unpaid family workers—define the columns of the 2006–16 Matrix. Detailed employment by NAICS industry or government sector is presented only for wage and salary jobs. There are two general types found in the industry directory:

- 1) Rollups and line items (311 published in total) show the greatest level of published employment detail in the Matrix.
- 2) Summaries (164) show combined employment for rollups and line-items.

As the following tabulation shows, the CES survey contributes industry employment for wage and salary jobs in 299 of the 311 most detailed matrix columns and is by far the largest source of industry data.

<i>Class-of-worker category</i>	<i>Number of columns</i>	<i>Data Source</i>
<i>Total, rollups and line items</i>	<i>311</i>	<i>CES/CPS</i>
<i>Nonfarm wage and salary jobs</i>	<i>299</i>	<i>CES</i>
<i>Wage and salary workers, primary job, agriculture, forestry, fishing, and private households</i>	<i>6</i>	<i>CPS</i>
<i>Wage and salary workers with secondary job, agriculture, forestry, fishing, and private households</i>	<i>2</i>	<i>CPS</i>
<i>Self-employed workers, primary job</i>	<i>1</i>	<i>CPS</i>
<i>Self-employed workers, secondary job</i>	<i>1</i>	<i>CPS</i>
<i>Unpaid family workers, primary job</i>	<i>1</i>	<i>CPS</i>
<i>Unpaid family workers, secondary job</i>	<i>1</i>	<i>CPS</i>

In comparison, the BLS Division of Industry Employment Projections (DIEP) uses the same employment data, but has less detail in their industry structure—about 200 line item columns.

For industries using CES employment, OES occupational distribution information—or industry staffing patterns—for wage and salary jobs is multiplied by CES industry control totals to find occupational employment within each industry. When CPS data are used for wage and salary industry control totals, as in agriculture or private households, industry staffing patterns are based on CPS data. Occupational distribution information for self-employed or unpaid family workers is based on CPS data.

The CPS provides data on industries and classes of worker outside of the scope of the CES and OES surveys. As seen in the table above, CPS data are primarily used for wage and salary workers in agriculture or private households, self-employment, and unpaid family workers.

The only industry group within NAICS sector 11, “Agriculture, forestry, fishing and hunting,” fully surveyed by both the CES and OES programs is NAICS 113300, “Logging.” For the remainder of NAICS 11, data from the CPS are used because the CES and OES surveys have limited or no coverage.

**ces and oes treatment of educational services, hospitals, and government.** The ces program publishes industry employment data for private educational services and private hospitals separately from State or local government education and hospitals. Conversely, the oes program develops occupational distribution information for education and hospitals by combining public and private ownership. In order to identify differences between public and private ownership and match the structure used by DIEP, the 2002–12 and the 2004–14 versions of the National Employment Matrix presented employment data in the configuration used by the ces program. However, the 2006–16 projections return to presenting employment data in education and hospitals for public and private ownership combined, to be consistent with the oes program. Correspondingly, employment data for State and local government exclude education and hospitals.

The CES and OES programs have special designations for government sectors that are not part of the 2002 NAICS structure, except for NAICS 491100, “Postal Service.” The National Employment Matrix uses the following non-NAICS codes and titles for these government sectors:

- 919999 Federal Government, excluding Postal Service
- 929200 State government, excluding education and hospitals
- 939300 Local government, excluding education and hospitals

When CES industry employment detail was unavailable, industry control totals were estimated by distributing CES employment with information from the Quarterly Census of Employment and Wages (QCEW). The summaries NAICS 611000, “Educational services, public and private,” and NAICS 622000, “Hospitals, public and private,” used only CES data for industry control totals. However, employment data for 4-digit NAICS detail under these summaries was only available for the private sector. To determine employment estimates for 4-digit NAICS detail in State and local government, CES employment data were distributed using ratios calculated from QCEW employment data. As mentioned above, the OES program currently publishes occupational distribution information for all of the published detailed levels of education and hospitals for public and private ownership combined.

The industry control totals for the following industries partly used CES data that were distributed with information from QCEW data:

Code	Title	Type
611100	Elementary and secondary schools, public and private	Line item
6112-3	Junior colleges, colleges, universities, and professional schools, public and private	Summary
611200	Junior colleges, public and private	Line item

611300	Colleges, universities, and professional schools, public and private	Line item
6114-7	Other educational services, public and private	Summary
611400	Business schools and computer and management training, public and private	Line item
611500	Technical and trade schools, public and private	Line item
611600	Other schools and instruction, public and private	Line item
611700	Educational support services, public and private	Line item
622100	General medical and surgical hospitals, public and private	Line item
622200	Psychiatric and substance abuse hospitals, public and private	Line item
622300	Specialty (except psychiatric and substance abuse) hospitals, public and private	Line item
721100	Traveler accommodation, including hotels and motels	Summary

**Example of distributing ces employment using information from qcew.** For 2006 annual average employment data, the ces program combines naics 721100, “traveler accommodation,” with naics 721300, “rooming and boarding houses.” This happens because a part of the traveler accommodation industry group, namely naics 721190, “other traveler accommodation,” is combined with rooming and boarding houses. To determine employment in other traveler accommodation separately from rooming and boarding houses, employment ratios are calculated with qcew data and these ratios are applied to ces employment estimates.

At the time of developing the 2006 base-year matrix, the most recent annual average QCEW employment data available were for 2005. The following tabulation summarizes the results.

NAICS	2005 QCEW employment	2006 CES employment
721190, 721300	37,075	34,800
721190	26,316	24,701 *
721300	10,759	10,099 *

\* Estimated by Matrix staff.

The formula to determine 2006 CES employment in NAICS 721300 would be:

$$34,800 * (10,759 / 37,075) = 10,099$$

While NAICS 721190 and NAICS 721300 were both excluded industries, the summary NAICS 721100 published in the National Employment Matrix no longer includes rooming and boarding houses.

**Note on 5-digit NAICS industries covered by OES.** While the matrix provides 4- and 5-digit NAICS industry detail whenever possible, the 2006–16 Matrix has less 5-digit detail than the 2004–14 matrix. Because of confidentiality or reliability concerns, industries that were a combination of more than one 5-digit NAICS industry are suppressed in the 2006–16 Matrix. For example, 2004–14 matrix industry code 2371RR, “Water and sewer system and all other

utility system construction” is a combination of NAICS 237110 and NAICS 237120. There were 22 such industries published in the 2004–14 National Employment Matrix that are excluded from the 2006–16 Matrix. However, single 5-digit NAICS industries, such as NAICS 237130, “Power and communication line and related structures constructions,” continue to be included in the 2006–16 National Employment Matrix.

### History of National Employment Matrix data sources and changes to classification systems

Since its inception, the National Employment Matrix has incorporated industry-by-occupation wage and salary employment information from two different data sources. Data from the Census Bureau’s decennial Census of Population initially yielded industry-by-occupation employment patterns based on individuals’ responses coded to that Agency’s industry and occupation classification systems.

The OES survey-based industry-by-occupation employment data, first adopted for use with the 1980-90 projections, became the primary data source used in preparing the National Employment Matrix. OES survey data were preferred because the data were collected from establishments that were given occupational definitions for reporting employment and because the OES data were collected more frequently than the Census was conducted. The BLS National Employment Matrix used OES data based on a structure consistent with the 1980 Standard Occupational Classification (SOC) through its 1998–2008 set of occupational employment projections.

Occupational projections for 2000-10 incorporated the newly available 2000 SOC system for the first time.<sup>1</sup> This revised classification system resulted in major changes to the occupational definitions and taxonomy used in the projections. These differ-

ences between the 2000 SOC-structured OES survey data and earlier 1980 SOC-system-based OES survey occupational data resulted in a break in the historical occupational employment time series. In this case, the differences resulted not from a change in a data source, but from the change in the classification system.

The OES survey’s industry classification system—based first on the 1977 Standard Industrial Classification (SIC) system and later on the 1987 revision to the SIC system—underwent relatively few changes until the creation of the 2002 North American Industry Classification System (NAICS), which was first used with the 2002–12 employment projections, replacing the 1987 SIC.<sup>2</sup>

The CPS began collecting 2000 SOC- and 2002 NAICS-based data in the January 2003 survey.

The 2006–16 BLS National Employment Matrix uses May 2006 OES data coded to the 2000 SOC system and CES data coded to the 2002 NAICS. CPS industry and occupational data used to construct the 2006–16 National Employment Matrix also are consistent with the 2000 SOC system and 2002 NAICS.

<sup>1</sup> See “Chapter I. 2000-10 Occupational Projections Incorporate the 2000 Standard Occupational Classification System,” *Occupational Projections and Training Data*, Bulletin 2542 (Bureau of Labor Statistics, January 2002).

<sup>2</sup> See “Chapter II. 2002–12 National Employment Matrix Structure,” *Occupational Projections and Training Data*, Bulletin 2572 (Bureau of Labor Statistics, March 2004).