AN EVALUATION OF THE OCCUPATIONAL STAFFING PATTERN AND MEAN WAGE RATES OF STATE GOVERNMENT WORKERS

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1. Introduction

The Occupational Employment Statistics (OES) survey is an annual survey of approximately 400,000 nonfarm business establishments conducted by the Bureau of Labor Statistics. Establishments in the survey are sampled across 375 three-digit industries and local government (i.e., government at the city, county, or township level). In addition, the survey takes a census of all state government establishments except for state-owned hospitals and schools. From this point forward, we will define "state government" to be all state government establishments except hospitals and education.

In recent years, some states have questioned the need for an annual census of state government because they believe

(1) that the occupational staffing pattern of state government changes little from year to year and
(2) that the mean wage rates of state government workers in the current year are not significantly different from mean wage rates in the previous year after adjusting for inflation.

Both hypotheses are evaluated in this paper. If both are correct, the OES survey will consider taking a census of state government less frequently; for example, every other year or every third year.

The paper is divided into seven sections. Section 2 gives a brief overview of the OES survey. Section 3 describes the data used for analyses. Section 4 discusses the occupational coding structure of state government. Section 5 gives an explanation of the methodology used. Section 6 discusses the research results, and section 7 provides concluding remarks.

2. The OES Survey

The Occupational Employment Statistics (OES) survey is a Federal-State cooperative program in which the State Employment Security Agencies (SESAs) conduct a periodic mail survey of nonfarm business establishments to obtain employment and wage rate data of workers by occupation. The Bureau of Labor Statistics develops survey procedures and provides technical assistance to the SESAs. Data collected by the SESAs are used to produce annual estimates of total employment, mean wage rate, and median wage rate by occupation and industry for the Nation, each state, each metropolitan statistical area (MSA), and each residual area not covered by an MSA.

Producing employment and wage rate estimates by occupation and industry at the MSA level for a pre-specified reliability requires a sample of approximately 1.2 million establishments. Collecting an annual sample of this magnitude exceeds the financial and labor resources of the OES program. A sample this large also makes it likely that many establishments on the sampling frame would be sampled every year. The OES program, however, has taken great pains to avoid sampling most establishments more often than once every three years so as to ease establishment response burden. Distributing a sample of 1.2 million across a 3-year cycle where overlap among the three samples is minimized will reduce that burden to a tolerable level. In addition, the OES program has sufficient resources to collect an annual sample of 400,000 establishments. Combining the samples from a 3-year cycle makes it possible to produce reliable MSA-level estimates annually. Wage rate data from the previous two years' samples, however, would have to be adjusted to account for inflation. Estimates of the rate of change in wages are used to adjust these data for inflation. These estimates are obtained from the Bureau's Employment Cost Index survey.

Reminder: As was mentioned in the introduction, the OES survey currently takes an annual census of state government. With the notable exception of this industry, samples are taken of all other industries.

The questionnaire used by the OES survey to collect employment and wage rate data is a 2-dimensional grid. Occupations form the grid's rows. Eleven contiguous, non-overlapping, wage rate intervals form the grid's columns. Collecting wage rate data grouped into intervals instead of collecting the exact wage rate of individual workers reduces the response burden on an establishment. However, a consequence of collecting grouped wage data is that

the survey must use "grouped data" estimation procedures to calculate mean and median wage rates.

3. Data Used for the Analyses

Occupational employment and mean wage rate estimates were obtained for the following state governments and years. See the chart below.

	Years		
State Govt	1998	1997	1996
All 50 states			
Alabama			
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.			
Wyoming			
plus			
Dist. of Col.			
Guam			
Puerto Rico			
Virgin Islands			

4. Occupational Coding Structure in State Government

The questionnaire used to collect employment and wage rate data for state government lists 170 detailed occupations and 30 residual occupations dispersed across seven major occupation groups:

- managerial and administrative occupations;
- professional, paraprofessional, and technical occupations;
- sales and related occupations;
- clerical and administrative support occupations;
- service occupations;
- agricultural, forestry, fishing, and related occupations; and
- production, construction, operating, maintenance, and material handling occupations.

In the OES survey, detailed occupations are specific, narrowly defined occupations. For example, chemical engineers, civil engineers, electrical engineers, and mechanical engineers are detailed occupations. Residual occupations are generic, broadly defined occupations. 'All other engineers' is an example of a residual occupation.

The questionnaire for state government lists only three engineering occupations: civil engineers, electrical engineers, and 'all other engineers.' If a state receives employment data for chemical engineers and mechanical engineers, it can do one of the following:

(a) report its chemical engineers and mechanical engineers as 'all other engineers' or
(b) add the occupations 'chemical engineer' and 'mechanical engineer' to its list of valid state government occupations and then report these engineers as themselves.

Option (b), also known as "coding to the full structure," is preferred because it allows the state to retain the identity of chemical engineers and mechanical engineers.

5. Theory and Methodology

Analyzing Occupational Staffing Patterns

Our primary method of analyzing occupational staffing patterns involves tests of homogeneity for 2-way tables. Two-way tables arise naturally both in the presentation and analysis of our data. It is through these tables that we can compare vectors of 'state government' employment distributions to determine whether occupational staffing patterns vary over time.

A natural notation for our analysis is the following. Let X_{ij} denote the estimated number of people employed in occupation i and year j. Subscript i is indexed from 1 to R where R denotes the number of state government occupations being analyzed. Subscript j is indexed from 1 to C(=2) where C denotes the number of years being compared. The margin totals and grand total for the X_{ij}'s are defined as follows:

$$(1) \qquad X_{+j} = \sum_{i=1}^{R} X_{ij}$$

$$X_{i+} = \sum_{j=1}^{C} X_{ij}$$

$$X_{++} = \sum_{i=1}^{R} \sum_{j=1}^{C} X_{ij}$$

Let $E_{ij}=(X_{i+}X_{+j})/X_{++}$ denote the expected number of people employed in occupation i and year j. The Pearson chi-square statistic for homogeneity is then given by

$$(2) \qquad \chi_H = \sum_{i=1}^{R} \sum_{j=1}^{C} [(X_{ij} - E_{ij})^2 / E_{ij}]$$

Based on the homogeneity hypothesis that the distribution of state government workers among R occupations between C(=2) years is the same, we

expect χ_H to be small. Large values of χ_H, however, tend to reject that hypothesis.

State government occupational staffing patterns were compared twice between the years 1998 and 1997. And then compared twice again between the years 1997 and 1996.

The first comparison was carried out as follows:

For each state government,

- create a vector of R=21 occupations for year t and year t-1. Each vector contains the top 20 detailed occupations in the state plus a "super" residual that encompasses all remaining occupations. Top detailed occupations were chosen based on their estimated employment in year t.
- calculate a Pearson chi-square statistic for the two occupation vectors.

The second comparison was carried out as follows:

For each state government,

- aggregate all detailed and residual occupations into the major occupation group that encompasses them.
- create a vector of R=7 major occupation groups for year t and year t-1.
- calculate a Pearson chi-square statistic for the two 'occupation group' vectors.

We assume a priori that the likelihood of state government workers changing vocation from one detailed occupation to another is greater than the likelihood of their changing major occupation group. If this assumption is correct, then we expect the occupational staffing pattern for vectors of size R=21 to be more volatile than the staffing pattern for vectors of size R=7.

Analyzing Wage Rates

Mean wage rates of state government workers were analyzed empirically to evaluate the hypothesis that mean wage rates in the current year are not markedly different from mean wage rates in the previous year after adjustment for inflation.

The procedure used to analyze mean wage rate data is described below.

- Calculate the ratio of the mean wage rate in year t to the inflation adjusted mean wage rate in year t-1 for each occupation. We will refer to this ratio as the "occupation" ratio. If the ratio is 1, then there is no difference between the occupation's mean wage rate in year t and its inflation adjusted mean wage rate in year t-1.

- Subtract 1 from each "occupation" ratio. This difference will be referred to as the "occupation" difference. If the "occupation" difference is 0, then the "occupation" ratio must be 1. The closer the difference is to 0, the smaller the difference between the occupation's mean wage rate in year t and its inflation adjusted mean wage rate in year t-1.

- Determine the frequency count for each "occupation" difference. Use the occupation's estimated employment from year t as the counter.

- Construct a histogram of "occupation" differences based on these frequency counts.

Two sets of histograms were constructed. Histograms in the first set were constructed for each state between the years 1998 & 1997. Histograms in the second set were constructed for each state between the years 1997 & 1996.

6. Research Results

This section consists of two parts. The first part discusses our research into the occupational staffing pattern of state government workers. Overall results are presented first, followed by selected specific results. The second part discusses our analysis of state government mean wage rates.

6.1 Occupational Staffing Patterns

Overall Results

The Pearson chi-square tests for homogeneity are presented for a subset of states in Table 1. Column 1 of the table identifies the state government being tested. Columns 2 and 3 show the chi-square statistic for each state government based on occupation vectors of sizes R=21 and R=7, respectively, for the years 1998-1997. Columns 4 and 5 show the chi-square statistic for each state government based on occupation vectors of sizes R=21 and R=7, respectively, for the years 1997-1996. Shaded boxes indicate that the occupation vectors are NOT significantly different at α=0.01.

Table 1

State Code**	χ^2_H and p-value for occ vectors of size R=21 (1998-1997)	χ^2_H and p-value for occ vectors of size R=7 (1998-1997)	χ^2_H and p-value for occ vectors of size R=21 (1997-1996)	χ^2_H and p-value for occ vectors of size R=7 (1997-1996)
11	297.07; $\leq$ 0.001	221.10; $\leq$ 0.001	426.22; $\leq$ 0.001	43.40; $\leq$ 0.001
12	123.88; $\leq$ 0.001	16.19; 0.013	149.87; $\leq$ 0.001	59.20; $\leq$ 0.001
13	13.65; 0.848	2.31; 0.890	87.78; $\leq$ 0.001	7.30; 0.294
14	428.28; $\leq$ 0.001	12.20; 0.058	13,034.88; $\leq$ 0.001	2,561.57; $\leq$ 0.001
15	29.80; 0.073	14.98; 0.020	670.56; $\leq$ 0.001	19.09; 0.004
16	119.37; $\leq$ 0.001	33.48; $\leq$ 0.001	678.93; $\leq$ 0.001	532.83; $\leq$ 0.001
21	1,140.06; $\leq$ 0.001	695.73; $\leq$ 0.001	2,382.04; $\leq$ 0.001	1,805.93; $\leq$ 0.001
22	5,207.52; $\leq$ 0.001	1,955.57; $\leq$ 0.001	4,419.49; $\leq$ 0.001	926.34; $\leq$ 0.001
23	9,179.01; $\leq$ 0.001	2,294.16; $\leq$ 0.001	37.80; 0.009	15.83; 0.015
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
99	0.03; 1.000	0.48; 0.998	659.24; $\leq$ 0.001	333.51; $\leq$ 0.001

** Note: The states were assigned a numeric 2-digit code between 11 through 99 in a quasi random manner to conceal their identity.

A review of the unabridged version of Table 1 found the following results at the α=0.01 level of significance.

- For occupation vectors of size R=21 for the years 1998-1997, the chi-square tests showed that all state governments except 13, 15, 81, 88, and 99 experienced significant changes in their occupational staffing pattern.
- For occupation vectors of size R=7 for the years 1998-1997, the chi-square tests showed that all state governments except 12, 13, 14, 15, 81, 88, 95, 97, and 99 experienced significant changes in their occupational staffing pattern.
- For occupation vectors of size R=21 for the years 1997-1996, the chi-square tests showed that all state governments except 63 experienced significant changes in their occupational staffing pattern.
- For occupation vectors of size R=7 for the years 1997-1996, the chi-square tests showed that all state governments except 13, 23, and 63 experienced significant changes in their occupational staffing pattern.

Some Specific Results

There are a number of possible factors that can explain why state government occupational staffing patterns change over time. These factors can be broadly classified into two categories:

economic factors such as

- changes in the politico-economic environment
- adoption and implementation of new technologies

and

non-economic factors such as

- measurement error
- nonresponse
- response bias.

An Example of the Politico-Economic Environment

In 1997, State 74 employed 22,590 "correction officers & jailers" and 200 "adjudicators & hearing officers." Together these occupations accounted for 15.0 percent and 0.1 percent, respectively, of all state government workers. The following year, the state employed 30,081 "correction officers" and 7,910 "adjudicators." The occupations now account for 19.4 percent and 5.1 percent, respectively, of all state government workers.

The unusually large employment growth in these occupations has caused the occupational staffing pattern for state government to shift. Pending confirmation from State 74, we speculate that the state may be getting tough on crime. And as part of its "get tough" campaign, the state may be meting out mandatory prison sentences. Hence the substantial increase in correction officers and adjudicators.

In addition to State 74, three other states also experienced sharp employment increases in "correction officers & jailers."

Two Examples of Measurement Error

Example 1: In 1997, State 56 reported 358 workers in a residual occupation called "all other management workers." At the time, the occupation accounted for 0.5 percent of all state government workers. The following year, State 56 reported 10,461 employees as "all other management workers." The occupation now accounts for 16.8 percent of all state government workers. Not surprisingly, this huge employment increase caused the occupational staffing pattern for state government to shift noticeably. Initial contact with State 56 indicated that they had serious difficulty converting occupations based on their indigenous coding structure to occupations based on the OES coding structure.

A few other states also experienced shifts of a similar nature in their occupational staffing pattern. We suspect that these shifts are also due to occupation coding conversion problems. Confirmation is pending.

Example 2: Recall in section 4 that the questionnaire for state government lists three engineering occupations. Two of the occupations, civil engineers and electrical engineers, are detailed occupations. The third, 'all other engineers,' is a residual. If a state receives employment data for chemical engineers and mechanical engineers, it can code them as either 'all other engineers' or as themselves. The difficulty with giving a state an option to code "non-listed" detailed occupations as a residual or as themselves is that the state could choose the former option in year t-1 and then reverse course and choose the latter option in year t. Flip-flopping on the options will undoubtedly cause some shifting of the state government occupational staffing pattern between years t-1 and t.

6.2 Mean Wage Rates

Overall & Specific Results

A review of the "1998-1997" histograms found that for most states the mean wage rates of state government workers in 1998 were not noticeably[1] different from mean wage rates in 1997 after adjusting for inflation. Noticeable differences, however, were found in 13 states (31, 33, 43, 51, 52, 53, 55, 56, 58, 63, 72, 73, and 98).

Similarly a review of the "1997-1996" histograms found that for most states the mean wage rates of state government workers in 1997 were not noticeably different from mean wage rates in 1996 after adjusting for inflation. Noticeable differences, however, were found in eight states (31, 33, 53, 55, 74, 83, 87, and 99).

Two histograms highlighting our findings are presented in Tables 2A and 2B.

Table 2A is a frequency distribution of the occupation difference for State 88 where "occupation difference" is the ratio of an occupation's 1998 mean wage rate to its 1997 inflation adjusted mean wage rate less one. Note that all histograms in the table are grouped in increments of 10 percent.

The histogram centered at 0 accounted for 97.1 percent of all state government workers. This indicates that the 1998 mean wage rates for State 88's government workers are not markedly different from mean wage rates in 1997 after adjusting for inflation.

For the years 1998-1997, 41 states (including State 88) had most of their government workers lie within the histogram centered at 0. For the years 1997-1996, 43 states had most of their government workers lie within the histogram centered at 0.

Table 2B is a frequency distribution of the occupation difference for State 51 where "occupation difference" is the ratio of an occupation's 1998 mean wage rate to its 1997 inflation adjusted mean wage rate less one. As with Table 2A, all histograms in this table are grouped in increments of 10 percent.

The histogram centered at 0 accounted for 20.3 percent of all state government workers while the histograms centered at –10 and -20 collectively accounted for 71.6 percent of all workers. These histograms indicate that the 1998 mean wage rates for State 51's government workers were noticeably different from mean wage rates in 1997 after adjusting for inflation. And perhaps of even more concern to the government workers in this state, the histograms suggest that their wage rates in 1998 may not have kept pace with inflation. We will explore this discrepancy further to determine the cause of this downward shift.

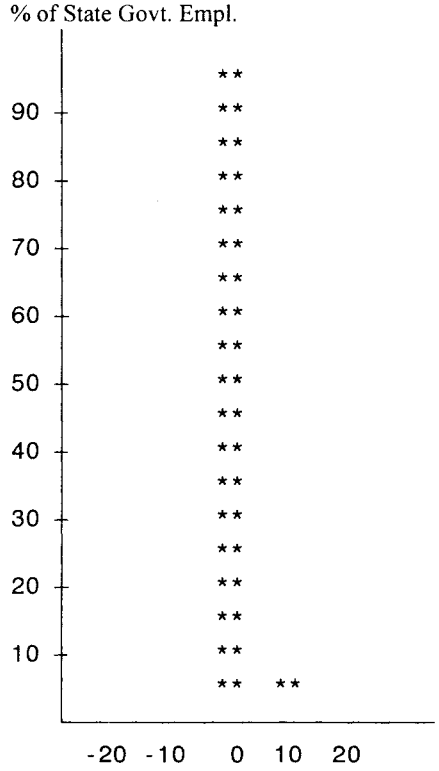
For the years 1998-1997, aberrant distributions like the one shown in Table 2B were found in 13 states. For the years 1997-1996, aberrant distributions were found in 8 states.

[1] Mean wage rates for state government workers between the years t and t-1 are considered to be "noticeably" different *when* 20 percent of all state government workers have an occupation difference greater than the absolute value of 0.15 or *when* most state government workers do not lie in the histogram centered at 0.

Table 2A

Freq. Distr. of Occupation Differences[2/]

State 88
% of State Govt. Empl.

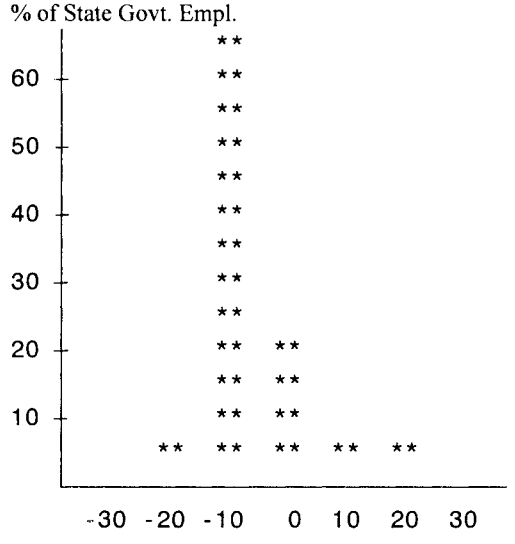


Occupation Difference Midpoints

Table 2B

Freq. Distr. of Occupation Differences

State 51
% of State Govt. Empl.



Occupation Difference Midpoints

2/ {= [(1998 Mean Wage Rate / 1997U Mean Wage Rate) - 1] x 100}

7. Summary and Conclusions

Our research showed that the occupational staffing pattern of state government workers for most states changed between the years 1998-1997 and 1997-1996. Factors explaining the cause of these staffing pattern shifts are varied and difficult to quantify without further research. Some data analysts, however, have conjectured that the staffing pattern shifts in state government are due primarily to measurement error and that if we were able to isolate and correct for the error, we would find that state government staffing patterns are in reality quite stable from year to year. Although isolating and correcting measurement error is an important part of the standard survey process, it is also time consuming and costly. Meausurement error notwithstanding, our research suggests that the OES survey should continue to take a census of state government workers annually in order to gauge trends in state government occupational staffing patterns.

Furthermore our empirical study of the mean wage rate estimates for state government workers shows that for most states, the mean wage rates of these workers in 1998 were not noticeably different from mean wage rates in 1997 after adjusting for inflation. Likewise similar results were found when comparing state government mean wage rates between the years 1997-1996. For a small number of states, 13 in the years 1998-1997 and 8 in the years 1997-1996, we found notable differences in the mean wage rates. The causes of these differences are under investigation.

The opinions expressed in this paper are those of the authors and do not reflect the opinions or policy of the Bureau of Labor Statistics.

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