Measuring Trends in the Structure and Levels of Employer Costs for Employee Compensation

The ECI is the preferred measure of trends in compensation cost levels because it measures pure wage rate and compensation cost changes. Cost levels, however, provide information on compensation cost trends not available from the ECI, and generally are a better measure of changes in the welfare of workers because, for example, if compensation cost levels increase less rapidly than the ECI, that suggests that there has been a shift in employment toward relatively low-paying industries and or occupations.

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The Bureau of Labor Statistics has published data on Employer Costs for Employee Compensation (ECEC or cost levels) for March of each year since 1987.[1] These cost levels, derived from data collected in the Employment Cost Index (ECI) survey, are designed to provide a snapshot of the structure of compensation at points in time—that is, the distribution of employer costs among the components of compensation (wages and salaries and employee benefits such as vacations, health insurance, and Social Security), and among industries and occupations. This article first reviews trends in the structure of compensation costs, 1986 to 1996.

Trends in the level of Employer Costs for Employee Compensation are also reviewed in this article. When used to show trends, the cost levels measure something fundamentally different from what the ECI measures. Cost levels measure the *change in average* compensation costs rather than the *average change* in compensation costs. This article describes how the two measures are constructed, compares their trends, and explains observed differences. To aid in the analysis, new measures of the precision of estimates of cost level changes are presented.

Finally, some important uses of cost level data are illustrated. The key findings of the analysis are:

Trends in the ECI and ECEC

This article and the following one, "Explaining the Differential Growth Rates of the ECI and the ECEC" by Michael K. Lettau, Mark A. Loewenstein, and Aaron T. Cushner, focus on trends in the ECI and ECEC. The article presented here discusses trends in the distribution of employer costs among the components of compensation—wages and salaries and benefits—at points in time. The Lettau article delves into the reasons the ECI has increased much more rapidly in recent years than the ECEC.

For a more complete discussion of the scope of and methods used in the ECI and ECEC series, see *BLS Handbook of Methods*, Bulletin 2414, Bureau of Labor Statistics, September 1992, pp. 56-66, and "Estimation Procedures for the Employment Cost Index," *Monthly Labor Review*, May 1982, pp. 40-42.

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- Benefits made up 27.0 percent of total compensation in 1986, 28.9 percent in 1994, and 28.1 percent in 1996;

- Employee costs for insurance followed much the same pattern: 5.5 percent of total compensation in 1986, 7.2 percent in 1994, and 6.5 percent in 1996;

- The gap between low- and high-paying industries is wider for compensation costs than for wages and salaries, and has remained fairly constant over time;

- Over the period 1986-96, compensation costs in private industry rose 45.0 percent as measured by the ECI and 32.0 percent as measured by the cost levels; and

- Differences between the cost levels and ECI indexes in changes over time can be explained by differences in the way the two measures are constructed—the set of weights used and the way the data are linked from quarter to quarter.

Collecting compensation cost data

The ECI, the source of the data for both the indexes and the cost levels, is a quarterly survey of the cost to the employer for an hour of work. ECI data relate to payroll periods including the 12th of March, June, September, and December.[2] The wage and benefit data collected are used to estimate both indexes and cost levels; the two measures differ only in the way the data are combined across industries and occupations.

There are two separate steps in the data collection process: the initiation and the quarterly update. Initiation occurs the first time a trained field economist visits an establishment to collect data for the survey. The update occurs each subsequent quarter the establishment is in the ECI sample. Generally, an establishment is in the ECI sample for about 5 years before it is replaced by establishments from a new sample.

At initiation of each establishment, the field economist informs the respondent about the survey, randomly selects from 4 to 8 jobs—the number depending on the size of the establishment—to represent the establishment, and then obtains wage, benefit, and other information required to estimate the cost of the compensation package for each surveyed job. The jobs selected in each establishment at the time of initiation are the same ones for which data are collected in the quarterly updates; they are defined narrowly enough that all workers in the job carry out the same task at roughly the same level of skill.

Straight-time wage and salary rates are used as the wage measure. These include total earnings before payroll deductions, but exclude premium pay for overtime and for work on weekends and holidays, shift differentials, nonproduction bonuses, and lump-sum payments provided in lieu of wage increases. Production bonuses, incentive earnings, commission payments, and cost-of-living adjustments are included in straight-time wage and salary rates. Salaries are converted to an hourly rate by dividing by the number of paid hours.

To measure benefit costs, the field economist first identifies the ECI benefits existing for each surveyed job in the establishment, and then collects information required to estimate their cost per hour worked. Benefit costs are measured using a current cost approach—annual costs based on the current price of the benefit under current plan provisions.[3] Once the annual cost is determined, that cost is divided by annual hours worked, that is, the annual work schedule (for example, 34 hours per week times 52 weeks per year) minus annual hours for vacations, holidays, and other leave, plus annual overtime hours.

The quarterly update is usually done by a combination of mail and telephone. Forms are sent to each respondent describing previously reported wage and salary rates and benefit provisions for each surveyed occupation, and the respondent is asked to identify changes. A change in wages and salaries occurs if average wages change, regardless of whether it is due to pay increases, longevity payments, changes in commissions, or changes in the workers in the occupation.

As defined by the ECI, benefit costs in an establishment can change for any of the following reasons: (1) the cost for an unchanged benefit plan may increase or decrease (for example, the cost of a 2-week vacation after 5 years of service increases because of a wage-rate increase, or an insurance carrier raises premiums); (2) a benefit plan may be added or eliminated (for example, a dental plan may be added to a medical policy); (3) the provisions of a benefit plan may be modified (for example, the type of work covered by a dental plan is enhanced); or (4) usage of the benefit may change because of changes in the plan (for example, more employees elect health insurance because of improved dental benefits).

Specifically excluded from the measure of benefit cost change are changes in the usage of a benefit, such as additional overtime hours, not related to changes in the plan provisions. Because some changes in benefit costs are specifically excluded from the quarterly updates and because at any given point in time establishments have been in the ECI sample an average of 2½ years, estimates of average cost levels in a given quarter may not be the same as would be the case if each establishment were initiated each quarter.

However, analysis has shown that the effect on cost levels of not picking up complete current information each quarter is small.

Because the ECI sample is replaced over a 5-year period, in any given quarter about 1/20th of the sample of establishments is new. Consequently, another potential source of changes over time in cost levels is change in the sample.

Estimating published cost levels

Once the wage and benefit data for each establishment are collected and converted to a cost per hour worked, aggregate cost levels are estimated. Estimation of cost levels is essentially a two-step process. First, the average compensation cost is calculated for each industry/occupation category defined for the survey. Second, these average costs are weighted and aggregated.

The industry and occupation categories defined for cost levels are the same as those defined for the ECI. The industry structure of the ECI is based on the 1987 Standard Industrial Classification (SIC) system, as defined by the U.S. Office of Management and Budget. For the ECI, most industry categories for the private sector are specified at the 2-digit SIC level, such as textile manufacturing or personal services. The industry categories for State and local governments vary from specific 3-digit SIC's, such as elementary and secondary schools, to broader major industry divisions, such as public administration.

The occupational categories for the ECI are those used for the Census of Population. The census defines about 440 detailed jobs within the scope of the ECI. Each surveyed job in the ECI is placed in one of those census jobs, which, for index and cost level estimation, are then mapped into 10 major occupational groups, such as professional specialty and precision production, craft, and repair occupations.

The first step in the process of estimating cost levels—computing the average compensation cost in each industry/occupation category—uses virtually the same set of establishments and jobs as is used to calculate the ECI indexes for the corresponding quarter.[4] The weights used to compute the averages reflect the probability of selection of the establishment and job.

The second step in the process of estimating cost levels—aggregating the industry/occupation average compensation costs—uses current employment counts as weights. The March 1996 compensation cost levels, for example, were calculated using the March 1996 employment counts for each industry category defined for the ECI from the Bureau's Current Employment Statistics (CES) program benchmarked[5] to the 1995 universe of all establishments (the unemployment insurance or UI ES-202 data file). The employment data for these industries were then distributed to major occupational groups (such as executives, administrators, and managers or machine operators, assemblers, and inspectors) using the relative importance of the groups as estimated by the ECI sample. Because, as noted above, the ECI establishment sample is completely replaced, industry by industry, on about a 5-year cycle,[6] the major occupational group employment counts from the ECI are, on average, 2½ years old. However, comparisons of cost level estimates showed that differences of a few years in the age of the occupational employment data within industries have a negligible impact on the estimates.

Changes over time in the structure of compensation costs

The relative importance of wages and salaries and selected benefit categories for private industry workers by year, 1986-96, is shown in table 1.[7] Benefits made up 27.0 percent of compensation costs in

Table 1. Employer costs for employee compensation as a percent of total compensation costs, by benefit category, March 1986-96

Compensation component	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Wages and salaries	73.0	73.2	72.7	72.7	72.4	72.3	71.8	71.3	71.1	71.6	71.9
Benefit costs	27.0	26.8	27.3	27.3	27.6	27.7	28.2	28.7	28.9	28.4	28.1
Paid leave	7.0	6.9	7.0	7.0	6.9	6.8	6.8	6.6	6.5	6.4	6.4
Supplemental pay	2.3	2.4	2.4	2.4	2.5	2.3	2.4	2.5	2.6	2.8	2.8
Nonproduction bonuses	0.7	0.9	0.8	0.8	1.0	0.9	1.0	1.1	1.2	1.3	1.3
Insurance	5.5	5.4	5.6	6.0	6.1	6.5	6.9	7.2	7.2	6.7	6.5
Health insurance	*	*	*	*	*	6.0	6.3	6.6	6.7	6.2	5.9
Retirement and savings	3.8	3.6	3.3	2.9	3.0	2.9	2.9	2.9	3.0	3.0	3.1
Legally required	8.4	8.4	8.8	8.9	9.0	9.1	9.1	9.3	9.4	9.3	9.1
Social security	5.6	5.6	5.9	5.9	6.0	6.0	6.0	5.9	5.9	6.0	6.0
Workers' compensation	1.5	1.6	1.7	1.9	2.1	2.1	2.2	2.3	2.4	2.3	2.3

* Data not available .

Table 2. Benefit costs as a percent of total compensation for major industry and occupational categories in private industry, March 1986, 1994, and 1996

Industry and occupational category	March 1986	March 1994	March 1996
Private industry workers	27.0	28.9	28.1
Goods-producing industries	30.0	33.5	32.4
Service-producing industries	25.4	26.9	26.3
White-collar workers	25.6	27.3	26.8
Blue-collar workers	30.3	33.2	31.9
Service workers	24.0	24.5	24.1

Table 3. Selected benefit categories as a percentage of total compensation costs, private industry, by major industry and occupational categories, March 1986, 1994, and 1996

Benefit, industry, and occupation category	March 1986	March 1994	March 1996
Insurance			
Private industry workers	5.5	7.2	6.5
Goods-producing industries	6.4	8.9	7.8
Service-producing industries	5.1	6.5	5.9
White-collar workers	5.0	6.7	6.1
Blue-collar workers	6.5	8.6	7.8
Service workers	5.0	5.6	5.2
Retirement and savings			
Private industry workers	3.8	3.0	3.1
Goods-producing industries	4.3	4.1	3.7
Service-producing industries	3.5	2.6	2.9
White-collar workers	4.0	2.9	3.1
Blue-collar workers	3.8	3.7	3.6
Service workers	1.8	1.4	1.5
Legally required			
Private industry workers	8.4	9.4	9.1
Goods-producing industries	8.9	10.0	9.8
Service-producing industries	8.1	9.1	8.8
White-collar workers	7.2	7.9	7.8
Blue-collar workers	10.0	11.4	11.0
Service workers	10.5	11.7	11.6

March 1986, 28.9 percent in March 1994, and 28.1 percent in March 1996. Insurance, mainly health, made up 5.5 percent of compensation costs in 1986, 7.2 percent in 1994, and 6.5 percent in 1996. For retirement and savings plans, these percentages were 3.8, 3.0, and 3.1, respectively.

The same general pattern in benefit costs as a percent of compensation found for all private industry workers is evident for all of the major industry and occupational categories, as shown in table 2. The table also shows that the substantial differences among industries and occupations in the proportion benefits make up of total compensation have remained roughly constant over time. For example, in March 1986, benefits were relatively important for blue-collar workers and in goods-producing industries, and that continues to be the case.

Does this pattern of consistency over time hold up for individual benefits? Information for three benefit categories—insurance, retirement and savings, and legally required benefits—is provided in table 3.

Generally, as was true for benefits as a whole, for benefit categories the relationship among industries and occupations in the relative importance of a benefit has remained the same over time. For example, insurance was relatively more important for goods-producing industries and blue-collar workers than for service-producing industries or white-collar or service workers in 1986, and the same is true in 1996. A major exception to this pattern is retirement and savings plans for blue-collar workers, which are nearly as important in 1996 as in 1986, despite the general decline in the importance of those benefits.

Another way of looking at the data is to compare the relative pay of private sector major industry groups over time. For example, are industries that were relatively high paying in 1987[8] also relatively high paying in 1996, and is the relationship the same for wages as for total compensation costs? Table 4 provides indexes of compensation and wage and

salary costs to illustrate this point.

Several things are evident: In both 1987 and 1996, the gap between the high- and the low-paying industries was greater for compensation costs than for wages and salaries. Also, for both measures, industries that were high-paying in 1987 were high-paying in 1996, those low-paying in 1987 were low-paying in 1996, and there was no consistent tendency for the gap between the high and the low to widen or narrow. One of the more dramatic movements between 1987 and 1996 was for transportation and public utilities, where the compensation cost advantage dropped from 50.8 percent above the private industry average to 38.5 percent above.[9] It is also interesting to note that in every industry shown, the wage and salary relative moved in the same direction as the compensation cost relative between 1987 and 1996.

Table 5 provides a similar review of the compensation cost structure by occupation in 1987 and 1996. It shows the same general pattern as for industries, except there is not the same consistent pattern of the gap between the high- and low-paying being wider for compensation costs than for wages and salaries.

Changes over time in cost levels

Cost levels from the ECI were not designed to measure the rate of change in the cost of hiring a fixed set of labor services. Cost levels can change either because workers in particular jobs are paid at a higher rate, or because there has been a shift in employment toward higher- or lower-paying industries and occupations. Because cost level changes result from a variety of factors, they are difficult to interpret, but they are better indicators of changes in worker welfare than are fixed weight indexes.

The pattern of compensation cost and wage and salary change by industry and occupational group over the entire period for which data are available for most industries and occupations is shown in table 6. Very dramatic differences among both industries and occupations are evident: Among industry groups the change in compensation costs ranged from 19.7 percent for transportation and public utilities to 39.2 percent for services. Among occupational groups, the change ranged from 22.6 percent for transportation and material moving occupations to 47.3 percent for professional specialty and technical occupations.

The pattern of changes in compensation costs and wages and salaries year-to-year for private industry workers is shown in table 7. In addition, as an aid to interpreting the findings, measures of precision —standard errors—are included.[10] The standard error can be used to define a range (confidence interval) around the cost estimate. For the ECI, the confidence interval normally includes 2 standard errors. If all possible samples were selected to estimate the population value (in this case, the cost per hour worked figure), the interval formed by computing 2 standard errors on each side of the mean from each sample would include the true population value approximately 95 percent of the time.[11]

An example will help to illustrate the use of standard errors. Consider the change in compensation costs between March 1995 and March 1996. In March 1995, compensation costs of private industry workers averaged $17.10. In March 1996, they averaged $17.49, an increase of $0.39. That would suggest that compensation costs increased 2.4 percent. However, since the standard error on that estimated change is $0.086, we can be 95 percent confident only that the "true" increase was somewhere between $0.22 and $0.56 ($.39 plus or minus two times $.086), that is, the percent increase was between 1.3 percent and 3.4 percent.

Comparison of cost-level changes with index changes

Although compensation cost changes can be calculated from the cost levels, for most purposes the preferred measure of those changes is the ECI. How do the two measures compare?

Year-to-year changes in the ECI and in the cost levels are shown in table 8. Research is underway to estimate the significance of the differences between the year-to-year change in these two measures. Over the long-term, however, comparisons between the two measures can be made. This is because almost invariably the ECI change has been larger than the cost level change, so that over periods spanning several years (say 5 years) the difference between the two measures is large enough to be statistically significant because the magnitude of the economic change overwhelms the sampling error.

From March 1986 to 1996, private industry compensation costs rose 45.0 percent as measured by the ECI and 32.0 percent as measured by cost levels. For wages and salaries, the numbers were 39.5 and 30.1 percent, respectively, while for benefits they were 59.2 and 37.2 percent, respectively. Thus, over the past decade the ECI rose substantially more than the cost levels: a third more for compensation costs, a quarter more for wages and salaries, and half again as much for benefit costs.

Explaining the differences in trends

To help explain why changes in the cost levels differ from changes in the ECI indexes, it is necessary to describe the method used to derive the indexes and compare it with the procedure used to calculate the cost levels.

As was the case for cost levels, there are essentially two steps in the process of estimating changes in the ECI.[12] First, within each industry/occupation category, the mean

Table 4. Indexes of compensation costs and wages and salaries, by industry category, March 1987 and March 1996.

(All private industry workers=100)

Industry	Compensation costs		Wages and salaries	
	March 1987	March 1996	March 1987	March 1996
Private industry workers	100.0	100.0	100.0	100.0
Goods-producing industries	118.2	121.6	113.1	114.3
Manufacturing	115.6	120.0	109.6	112.3
Durable goods	124.8	128.6	117.1	118.6
Nondurable goods	102.2	107.9	98.9	103.6
Service-producing industries	92.5	93.1	94.5	95.5
Transportation and public utilities	150.8	138.5	140.1	131.2
Wholesale trade	112.9	108.9	114.3	111.1
Retail trade	58.5	54.5	61.7	59.6
Services	92.0	98.2	95.0	101.4

Table 5. Indexes of compensation costs and wages and salaries, by occupational group, March 1987 and March 1996.

(Private industry workers=100)

Occupational group	Compensation costs		Wages and salaries	
	March 1987	March 1996	March 1987	March 1996
Private industry workers	100.0	100.0	100.0	100.0
White-collar workers	115.9	120.6	118.1	122.7
Professional specialty and technical	147.6	166.9	149.1	168.9
Executive, administrative, managerial	177.4	189.4	181.7	191.3
Administrative support, clerical	81.5	85.4	80.5	85.0
Blue-collar workers	100.1	97.4	95.4	92.3
Precision production, craft, repair	125.6	126.5	121.3	120.0
Machine operators, assemblers, inspectors	92.7	88.5	85.9	81.2
Transportation and material moving	103.1	97.0	98.2	92.4
Handlers, equipment cleaners, helpers, laborers	73.1	69.0	70.5	67.4
Service occupations	47.9	49.2	50.5	51.9

Table 6. Compensation costs and wages and salaries for selected industry and occupational groups in private industry and the percent changes, March 1987 and March 1996

Industry or occupation	Compensation costs			Wages and salaries		
	March 1987	March 1996	Percent change	March 1987	March 1996	Percent change
All private industry workers	$13.42	$17.49	30.3	$9.83	$12.58	28.0
Industry group						
Goods-producing industries	15.86	21.27	34.1	11.12	14.38	29.3
Manufacturing	15.51	20.99	35.3	10.77	14.13	31.2
Service-producing industries	12.41	16.28	31.2	9.29	12.01	29.3
Transportation and public utilities	20.24	24.22	19.7	13.77	16.51	19.9
Wholesale trade	15.15	19.04	25.7	11.24	13.98	24.4
Retail trade	7.85	9.54	21.5	6.07	7.50	23.6
Services	12.34	17.18	39.2	9.34	12.76	36.6
Occupational group						
White-collar workers	15.56	21.10	35.6	11.61	15.44	33.0
Professional specialty and technical	19.81	29.19	47.3	14.66	21.25	45.0
Executive, administrative, managerial	23.81	33.12	39.1	17.86	24.07	34.8
Administrative support, clerical	10.94	14.93	36.5	7.91	10.69	35.1
Blue-collar workers	13.43	17.04	26.9	9.38	11.61	23.8
Precision production, craft, repair	16.85	22.12	31.3	11.92	15.10	26.7
Machine operators, assemblers, inspectors	12.44	15.48	24.4	8.44	10.22	21.1
Transportation and material moving	13.83	16.96	22.6	9.65	11.62	20.4
Handlers, equipment cleaners, helpers, laborers	9.81	12.07	23.0	6.93	8.48	22.4
Service occupations	6.43	8.61	33.9	4.96	6.53	31.7

Table 7. March-to-March changes in compensation costs, wages and salaries, and benefit costs, and associated standard errors, private industry workers, 1986-96.

March to March	Compensation costs		Wages and salaries		Benefit costs	
	Estimate of change	Standard error	Estimate of change	Standard error	Estimate of change	Standard error
1986-87	$0.17	$0.208	$0.16	$0.160	$0.02	$0.056
1987-88	.37	.142	.19	.113	.17	.036
1988-89	.49	.080	.36	.058	.13	.027
1989-90	.68	.108	.46	.079	.23	.037
1990-91	.44	.086	.30	.062	.14	.034
1991-92	.74	.115	.44	.082	.28	.043
1992-93	.56	.086	.32	.071	.25	.026
1993-94	.38	.077	.24	.055	.14	.031
1994-95	.02	.136	.11	.101	-.09	.047
1995-96	.39	.087	.33	.068	.06	.029

Table 8. Comparison of 12-month percent changes in compensation measures from the Employment Cost Index (ECI) and Employer Costs for Employee Compensation (cost levels), private industry workers, 1987-96

Year ended March	Measure	Compensation costs	Wages and salaries	Benefit costs
1987	ECI	3.2	3.1	2.8
	Cost levels	1.3	1.7	0.6
1988	ECI	3.8	3.3	5.9
	Cost levels	2.8	1.9	4.7
1989	ECI	4.6	4.2	5.4
	Cost levels	3.6	3.6	3.4
1990	ECI	5.2	4.2	7.2
	Cost levels	4.8	4.4	5.9
1991	ECI	4.4	4.0	5.8
	Cost levels	2.9	2.8	3.4
1992	ECI	4.2	3.4	6.3
	Cost levels	4.8	3.9	6.6
1993	ECI	3.5	2.7	5.6
	Cost levels	3.5	2.8	5.5
1994	ECI	3.3	2.9	4.4
	Cost levels	2.3	2.0	2.9
1995	ECI	2.9	2.9	2.9
	Cost levels	0.1	0.9	-1.8
1996	ECI	2.7	3.2	1.6
	Cost levels	2.3	2.7	1.2

compensation cost (wages plus total benefit cost) is calculated. Second, these means are combined across the categories using the appropriate weights.

Step two in the process, applying the weights to combine industry/occupation categories,[13] is the more straightforward and is discussed first. As noted above, the weights for the ECI are fixed. Currently, they are employment counts for 1990, largely from the Bureau's Occupational Employment Survey.[14] These weights are applied to both the current survey month and the prior survey month (say, March 1996 and December 1995) average compensation costs by industry and occupation category. These weighted compensation costs are then combined across industry/occupation categories to obtain indexes and percent changes for broader groups of industries and occupations. The potential impact of the use of fixed rather than current weights is illustrated by the example in the box.

The Effects of Fixed Weights

The following example illustrates the effects of using fixed rather than current weights. Consider the case of an employer with two types of workers, electricians and janitors. In March 1995, the firm employs 10 electricians at $14 per hour and 10 janitors at $6 per hour. Both the average wage and the average wage rate are $10.

	NUMBER	x	WAGE RATE	=	AGGREGATE
Electricians	10	X	$14.00	=	$140.00
Janitors	10	X	6.00	=	60.00
	20				$200.00

$200.00 /20 = $10.00

In March 1996, both groups are given a 10-percent wage increase, but now only 5 janitors are employed. The average wage (without fixed weights) increases to $12.47:

	NUMBER	x	WAGE RATE	=	AGGREGATE
Electricians	10	X	$15.40	=	$154.00
Janitors	5	X	6.60	=	33.00
	15				$187.00

Average wage: $187.00/15=$12.47
Average wage change: $12.47/$10.00 = 1.247 or a 24.7-percent increase.

The increase in the average wage reflects the 10-percent increase in the wage rates and the relative decrease in the number of workers in the low-wage occupation of janitor.

But when fixed employment weights are used (that is, the number of janitors remains fixed at 10), the average change in wage *rates* is calculated, not the change in the average wage.

	NUMBER	x	WAGE RATE	=	AGGREGATE
Electricians	10	X	$15.40	=	$154.00
Janitors	10	X	6.60	=	66.00
	20				$220.00

Average wage rate: $220.00/20 = $11.00
Wage-rate change: $11.00 /$10.00 = 1.10, or a 10-percent increase.

In this case, the increase is 10 percent, the size of the wage-rate increase which was granted to both occupations.

Step one in the estimation of the ECI is calculation of the mean compensation cost in each industry/occupation category. Mean compensation in an industry/occupation category for a particular survey month is that category's compensation bill in the base period (June 1989) times the cumulative average compensation change in that category since the base period. The cumulative change in compensation costs is found each quarter by multiplying together the ratios of average compensation costs in the current survey month and the average compensation costs in the prior survey month. For example, if the cumulative change in compensation costs (expressed as a ratio) was 1.250 for a particular industry/occupation category as of December 1995, and compensation costs in that category averaged $16.80 in March 1996 and $16.00 in December 1995 (a 5-percent increase, or 1.05 expressed as a ratio), then the cumulative change as of March 1996 would be 1.3125 (1.25 times 1.05). Thus, the mean compensation reflects not only the current establishment and occupation sample, but all samples since the base period.

In calculating the average compensation costs for an industry/occupation category for the current and prior survey months, the effect of changes in the sample of establishments is largely removed by the use of "matched quotes." That is, the percent change in compensation costs between December 1995 and March 1996 is calculated from average compensation costs for those 2 months using data only from those establishment/occupations in the ECI sample in both months.

The use of matched quotes is especially important for the ECI because of the need to periodically replace the sample of establishments. In order to keep the sample current and to reduce the burden on individual respondents, the ECI completely replaces the establishment sample over about a 5-year period. That is, each year about one-fifth of the sample is replaced by a new set of establishments. (Until 1997 this was done industry-by-industry; currently it is done on a cross-industry, cross-area basis.) To further enhance the currency of the ECI, a sample of newly formed establishments ("births") is introduced each year. Matched quotes "chain out" the effects of changes in the sample of establishments and occupations. That is, if a new sample has lower compensation costs than the old sample, that would not be reflected in the ECI because the averages from the new sample are never compared to averages in the old sample in index calculation.

The differences between the cost levels and the indexes in index procedures are summarized in the table below.

This table suggests several possible explanations of why the ECI has consistently risen more rapidly than the cost levels.[15] Among these are the differences in the way data are linked from quarter to quarter and in the weights used for aggregation.

Lettau, Loewenstein, and Cushner attempted to determine which of the two steps in the estimation of indexes and cost levels accounted for their different rates of increase in compensation costs. To do this, they constructed hybrid indexes using two approaches. One approach mixed the first step in computing the cost levels with the second step in estimating the ECI. The second approach mixed the first step in calculating the ECI with the second step in estimating the cost levels.

When Lettau, Loewenstein, and Cushner estimated compensation cost indexes using the first approach, they found that the aggregation weights—the second step—accounted for about three-fifths of the difference between the two measures of compensation cost change. When they estimated the indexes using the second approach they found that the method used to calculate cell means—the first step—accounted for about two-thirds of the difference. The authors concluded that while the two approaches to decomposing the change in compensation costs yielded differing estimates of the proportion of the ECI-cost levels differential accounted for by the two stages in the estimation process, and while the results depended on the measure of compensation and the time period examined, it seems likely that each step accounts for at least a third of the differential.

Since it has often been assumed that the main difference between the ECI and the cost levels is in the

Step	ECI	Cost levels
1. Compute mean cost in each industry/occupation cell.	Calculate average cost in base period, and then move, quarter by quarter, using ratios of current quarter to prior quarter costs for matched quotes.	Calculate average cost in the current quarter.
2. Aggregate costs across cells.	Aggregate current and prior quarter costs using fixed employment counts (currently 1990).	Aggregate current quarter cost using current employment counts.

second step—the weights used for aggregation—this finding that the first step has an important impact requires explanation. As noted above, in the first step only for the ECI is there a link between survey months. The link is important because of the continual sample replacement in the ECI. The ECI sample of establishments and occupations is replaced over about a 5-year period, so each year one-fifth of the sample is replaced. To minimize the effect of sample changes, the ECI uses matched quotes to estimate changes. That is, the change between March and June of a given year is computed from data from establishments for which data are available for both months. Similarly, the change between June and September is calculated from quotes which are available for both months. With cost levels, in contrast, there is considerable change in the sample from one March to the next—generally, less than about 80 percent of the observations will remain from one year to the next.

Adding to the volatility when there is no link between quarters is the fact that when the ECI sample is replaced the new samples consistently have lower compensation costs, especially benefits.[16] Why would new samples consistently have lower pay? We have no solid evidence that explains this trend, but several possibilities could account for the pattern.

One is that the characteristics of the new samples differ from those of the old sample. For example, the new samples might reflect recent changes in the economy, such as a higher proportion of part-time workers, nonunion establishments, or small establishments, characteristics associated with lower pay. While the ECI sampling method attempts to account for new business formations by studying a sample of establishment "births" each year, the ECI may not be fully effective in picking up births. Also, there are differential sample loss rates in the ECI; it may be that lower-paying establishments are more likely to drop from the sample, either from going out of business or refusing to cooperate in the survey. Finally, certain shifts in the composition of the work force that occur in old as well as new establishments could account for these differences. For example, if there is a shift toward part-time employment in old establishments, this would not be picked up because such changes are linked out.

Uses of historical cost levels data

A historical series on cost levels can be used for two main purposes: to show trends in the structure of compensation (the relative importance of individual employee benefits, and differences among industries and occupations), and to show trends in average compensation costs.

Showing trends in the structure of compensation is the main use of historical data on cost levels. These data show, for example, the dramatic growth in health insurance costs and subsequent slowing.

The ECI as a measure of trends in compensation cost levels, is not affected by changes in the employment distribution among industries and occupations with wage and compensation levels, that is, it measures pure wage rate and compensation cost changes.

Cost levels provide information on compensation cost trends not available from the ECI. They are generally a better measure of changes in the average welfare of workers because, for example, if compensation cost levels increase less rapidly than the ECI, that suggests that there has been a shift in employment toward relatively low-paying industries and or occupations.

Caution must be exercised when comparing trends in cost levels with trends in the ECI because over short periods of time the observed differences between the two measures are not likely to be statistically significant. Over the longer term—5 years or more—the difference may indicate change in the distribution of hourly compensation between relatively low and relatively high paying occupations and industries.

—ENDNOTES—

[1] In addition, data for March 1986 are now available. See pp. 112-117 of this issue of *Compensation and Working Conditions*.

[2] Although cost levels could be estimated for all four quarters of the year, only March estimates are published to avoid emphasizing trends in that series.

[3] See Felicia Nathan, "Analyzing Employers' Costs for Wages, Salaries, and Benefits," *Monthly Labor Review*, October 1987, pp. 6-7, for a more complete discussion of how benefit costs per hour worked are calculated.

[4] Beginning in 1996, establishment/occupation observations that had reported incorrect data in the previous quarter were used to estimate the cost levels, but not the indexes. The logic behind this distinction is that for indexes, both the current and prior quarter data must be correct since a ratio is calculated from the two, while for cost levels, only the current quarter data must be correct.

[5] Benchmarking uses the results of a census to improve the accuracy of a sample. In this case, employment counts from the Unemployment Insurance (UI) program are assumed to be the "truth" because virtually all establishments within the scope of the ECI are included. Consequently, the employment counts from the CES program are adjusted to be consistent with the UI counts.

[6] Beginning in 1996, the ECI sample is being replaced on a cross-industry basis, rather than industry by industry. That is, rather than replacing the sample for particular industries each year, one-fifth of the sample is replaced each year regardless of industry. The replacement cycle is still about 5 years, however.

[7] Note that the set of benefits collected in the ECI has changed somewhat over time, to reflect changing compensation practices. For example, beginning in 1995, data were collected for defined benefit and defined contribution pension plans, rather than for pension and savings and thrift plans. Also beginning in that year, data were collected for the Old Age Survivors Disability Insurance (OASDI) and Medicare separately, rather than only for the two combined, and for both long- and short-term disability insurance. At the level of benefit detail shown in this table, however, the benefit definitions are consistent over time.

[8] The analysis uses data for 1987 rather than for 1986, because data were of publishable quality for fewer industries in the earlier year.

[9] For a discussion of some of the factors affecting rates of pay increase in different industries, see Albert E. Schwenk, "Trends in the differences between union and nonunion workers in pay using the Employment Cost Index," *Compensation and Working Conditions*, September 1996, pp. 27-33.

[10] See the appendix for a description of how the standard errors of differences are calculated, and their interpretation. Note that while standard errors are available for cost levels, they usually are expressed as relative errors, the ratio of the standard error to the estimate. For analysis of changes in cost levels, use of standard errors makes the exposition simpler.

[11] Note that standard errors relate to differences that occur from sampling errors, but not from nonsampling errors. Sampling errors are differences that occur between the results computed from a sample of observations and those computed from all observations in the population. Nonsampling errors are not measured. They include such things as survey nonresponse, data collection errors, and processing errors. Survey nonresponse is due to sample members that are unable or unwilling to participate in the survey; data collection errors include incorrect data provided by the respondent or definitional difficulties; and processing errors include errors in recording, coding, and entering data. Although nonsampling error is not measured, many procedures for reducing such errors are in place primarily through quality assurance programs. These include data collection reinterviews, observed interviews, computer edits of the data, and systematic professional review of the reports on which the data are recorded. Extensive training of field economists is also conducted to maintain high standards in data collection.

[12] The procedure described here does not precisely reflect the mechanics of index construction, but is used to aid in the exposition by paralleling the procedure used to estimate cost levels.

[13] The industry and occupation categories defined for the indexes are identical to those for the cost levels.

[14] See Albert E. Schwenk, "Introducing 1990 Weights for the Employment Cost Index," *Compensation and Working Conditions*, June 1995, pp. 1-5.

[15] This section is based largely on Michael Lettau, Mark A. Loewenstein, and Aaron Cushner, "Explaining the Differential Growth Rates of the ECI and the ECEC," pp. 15-23 of this issue of *Compensation and Working Conditions*.

[16] For a more complete discussion of the effects of sample replacement on the ECI and the cost levels, see Michael K. Lettau and Mark A. Loewenstein, "Sample Replacement in the ECI," Research Report, Compensation Research and Program Development Group, Bureau of Labor Statistics, October 1996.

Appendix. Measuring the Precision of Cost Level Changes

Because cost levels are estimates from a probability sample, year-to-year changes are likely to differ from results that would be obtained from annual complete censuses of the employees within the scope of the survey (the survey population). The difference between an estimate calculated from a specific sample and an average for all samples that could be drawn from the survey population using the same methodology for the same statistic is the sampling error.

Calculating standard errors for year-to-year changes in cost levels involves two steps. First, standard errors and related information must be calculated for each of the pair of years. Then, the standard error of the difference is calculated. This second step takes account of the fact that there is a high correlation between the estimates for adjacent years, since about 80 percent of the sample is the same in the 2 years.

Estimating standard errors on each year's levels is difficult because the cost levels estimator, like estimators in most large-scale surveys, is a complex product of ratios. The standard error is estimated by a "balanced repeated replication" method.

Replication methods involve taking a subset of the sample selected under the original sample design, and estimating the statistic of interest using data only from the subset. This subset estimate is called a replicate. Other replicates are then computed by using different, possibly overlapping subsets of the whole sample. In the cost level program, 64 replicates are generally computed for each published estimate.

The standard error of a cost-level estimate is calculated by summing over the 64 replicates the squared differences between the replicate estimates and the estimate for the entire sample, dividing by 64, and then taking the square root. These standard errors are then used to calculate the standard errors on changes.

The standard error of the difference in cost levels between 2 years is calculated using the formula

$$\sigma_{(y96 - y95)} = \sqrt{\sigma_{y96} + \sigma_{y95} - 2\mathrm{cov}\,(y_{96}, y_{95})}$$

Once standard errors are calculated, they can be used to construct "confidence intervals," which provide an indication of the reliability of the estimates. The lower bound of a confidence interval is constructed by subtracting a multiple of the standard error from the published estimate. The upper bound of a confidence interval is constructed by adding the same multiple of the standard error to the published estimate.

Confidence intervals have the following properties: Suppose that samples are repeatedly drawn from the same population. The data from each sample are used to compute an average compensation cost (the survey estimate) and its estimated standard error. The confidence intervals from one standard error below each sample's estimate to one standard error above would include the value being estimated for approximately 68 percent of the samples. That is, we could say with 68-percent confidence that the "true" value of the measurement, which could be obtained only from a complete census of the population, falls within +/- one standard error of the sample estimate. Confidence rises to 95 percent if the intervals surrounding sample estimates are widened to +/- two standard errors.