The Employment Cost Index: what is it?

Understanding the characteristics of the Employment Cost Index aids in identifying the cost pressures measured by this important Government statistic— pressures that often lead to inflation in the price of goods and services

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The Employment Cost Index (ECI) is a quarterly measure of the change in the price of labor, defined as compensation per employee hour worked. Closely watched by many economists, the ECI is an indicator of cost pressures within companies that could lead to price inflation for finished goods and services. The index measures changes in the cost of compensation not only for wages and salaries, but also for an extensive list of benefits. As a fixed-weight, or Laspeyres, index, the ECI controls for changes occurring over time in the industrial-occupational composition of employment.

This article provides a broad overview of the ECI. Beginning with how the data for the index are collected and how the index is calculated, the discussion draws attention to some of the underlying challenges that are involved in calculating such a complex statistic: What types of data should, ideally, be collected? What data are collected under nonideal conditions? and How are infrequent payments handled? Then, the article addresses a variety of questions that have been raised about the behavior and efficacy of the ECI: How does the index behave over the business cycle? Is it, like the Consumer Price Index (CPI), affected by "substitution bias"? Does the ECI capture emerging forms of compensation, such as hiring and retention bonuses and stock options? and, finally, How does employer cost relate to employee value?

Collection of ECI data

The ECI is computed from compensation cost data collected from a sample of jobs within sampled business establishments and government operations. (In what follows, business establishments and government operations will collectively be called "establishments.") The data are weighted to represent the universe of establishments and occupations in the nonfarm private sector and in State and local governments. The ECI sample, and hence the estimates derived from it, exclude Federal, private-household, and unpaid family workers, as well as self-employed individuals and owners of establishments.

The ECI sample is currently drawn in three stages as part of the larger National Compensation Survey. First, sample geographic areas are selected by dividing the United States into primary sampling units.[1] Second, a sample of business establishments and State and local government operations is selected from within each primary sampling unit that is chosen. Third, a BLS data collector visits each establishment in the sample (the first visit is termed "initiation"), asks for a list of employees, and then collects a sample from this list, using predetermined rules. The employees making up the sample represent jobs that enter into calculations of the ECI. Techniques in which the probability of being selected for the sample is proportional to size are used at all stages of sampling, which means that larger geographic areas, larger establishments, and jobs with more employees have a higher probability of appearing in the survey. However, smaller areas, establishments, and jobs appear as well. For a fixed sample size, variances of estimates tend to be smaller under this kind of sampling than under simple random sampling.

Establishments and jobs within them remain in

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the ECI sample for approximately 5 years, contributing data every quarter for the pay period that includes the 12th day of the survey months: March, June, September, and December.[2] Data on the cost of compensation are collected for all employees in sampled jobs. After the initial personal visit, quarterly reports are normally collected by mail or telephone by economists located in BLS regional offices. During the time a job remains in the ECI sample, data are collected on all incumbents in the job, even through changes in incumbency. Because the ECI does not follow changes in compensation costs for individual workers, the average wage and salary of a job may vary over time as the composition of incumbents varies (for example, when the tenure of incumbents changes with the business cycle).

Due to business closings, the elimination of jobs, and the refusal of respondents to participate further in the survey, some establishments and some jobs drop out of the sample, an event termed "attrition." To reduce the burden on respondents, rebuild the attrition-depleted sample, and keep the sample current with the changing economy, establishments in the sample are replaced in a procedure termed "sample replacement." Replacement of ECI samples was begun in 1981, and the method for replacement has differed over time. From 1986 until 1997, all of the establishments within designated groups of industries were replaced at the same time, with different industry groups replaced in different years. This approach had the disadvantage that the samples for some industries were older than those for other industries, which was a problem because the sample of jobs can become unrepresentative over time.[3]

Since 1997, when the Bureau began integrating the ECI into the National Compensation Survey, replacement samples have become cross-area and cross-industry samples, meaning that each replacement sample is now nationally representative. The sample is divided into five approximately equal groups that are replaced every 5 years. Such a replacement scheme has an advantage over the previous scheme in respect of maintaining the currency of the sample. The new replacement-group data contain information about the changing workforce that may be used to adjust the sampling weights of the older, less representative, replacement groups. Alternatively, it may be possible to weight more heavily the data from the more recent and more representative replacement groups. The Bureau will conduct research to determine which approach holds more promise for maintaining an up-to-date survey.

The sample size at any time depends on the size of the initial sample, its age, the rate of sample attrition, and sample replacements. The size of the ECI sample has varied over time. Recently, the sample has begun to grow from a realignment of compensation survey resources. The sample is expected to continue to grow, both from this realignment and from a budget increase. As of June 2001, 7,365 private-industry establishments provided data on about 31,100 occupations, while 790 State and local government operations afforded data on about 3,800 occupa-

tions. Current plans call for expanding the gross sample to 18,000 units, although the usable sample is expected to be at least 25 percent smaller, as some units fail to respond and others are found to be out of business or out of the scope of the survey.

Collection of wage and benefit data

At least two approaches could be taken to measuring an employer's costs for employee compensation. One focuses on past expenditures—that is, the actual money an employer spent on compensation during a specified time, usually the past year. The other focuses on estimating current costs—current wages and salaries and the cost of benefits under current plan provisions and under participation in the plan at its initiation or at another point in time. BLS data collectors are instructed to capture data in accordance with the second approach (termed the "rate-and-usage" approach), although at times circumstances require the collection of data on past expenditures instead.

The ECI captures the change in employers' costs for wages, salaries, and 20 different benefits classed into six categories. Wages and salaries are defined as the hourly straight-time wage rate or, for workers not paid on an hourly basis, straight-time earnings divided by the corresponding scheduled hours. Straight-time wage and salary rates are total earnings before payroll deductions, including production bonuses, incentive earnings, commission payments, and cost-of-living adjustments. Other supplemental cash payments are considered benefits.

The benefits covered by the ECI include the following:

- Paid leave—vacations, holidays, sick leave, and other leave;

- Other supplemental cash payments—premium pay for work in addition to the regular work schedule (for example, overtime pay and pay for working weekends and holidays), shift differentials, and nonproduction bonuses, such as lump-sum payments provided in lieu of wage increases;

- Insurance benefits—life, health, short-term disability, and long-term disability insurance;

- Retirement and savings benefits—employers' payments into defined-benefit and defined-contribution plans, including Employee Stock Ownership Plans (ESOP's);

- Legally required benefits—Social Security, Federal and State unemployment insurance, workers' compensation insurance, and Medicare;

- Other benefits—severance pay and payment into supplemental unemployment plans.

All costs of benefits are converted to an hourly basis by dividing the annual cost of benefits by annual hours worked.

The information needed to calculate the cost of benefits according to rate and usage depends on the specific benefit plan. The discussion that follows shows how rate and

usage information is used to calculate costs.

Vacations. To calculate the cost of vacations, at initiation data are collected on (1) vacation provisions by length of service, (2) the distribution of workers in the sampled occupation by length of service, and (3) the number of paid hours per vacation day. For example, suppose that there are 10 workers in a sampled job and that 5 have fewer than 5 years of service with the company and 5 have more than 5 years. Suppose further that the company's vacation plan allows 10 days of vacation for workers with under 5 years of service and 15 days of vacation for those with 5 or more years of service. Suppose also that each vacation day has 8 hours and is paid at the straight-time rate of $10 per hour. Finally, suppose that the total hours worked equal 2,000 per worker. Then the average number of vacation days taken by all workers in the sampled job is 12.5, and the cost of vacations is[4]

$$\frac{12.5 \text{ days} \times 8 \text{ hours} \times \$10}{2,000} = \$0.50 \text{ per hour worked.}$$

In contrast to vacation time, the calculation of which is based on assuming that all vacation hours are taken, the cost of sick leave is based on actual usage at the time of initiation.

Health insurance. Suppose that a health insurance plan is offered to all employees in the sampled job, but only 9 of 10 participate in the plan at initiation. The monthly premium, paid entirely by the company, is $120 per participating employee. Each employee works 2,000 hours. The annualized current cost per employee is the monthly premium, times 12 months, times 0.9. (Recall that one employee does not participate.) The annualized current cost is divided by 2,000 to yield the current cost per hour:

$$\frac{12 \times \$120 \times .9}{2,000} = \$0.65 \text{ per hour worked.}$$

For vacations and health insurance, information on eligibility and participation in benefit plans is collected at initiation. The information includes the distribution of workers by length of service (used to determine the average number of vacation days taken by employees) and the fraction of workers participating in health insurance. When costs per hour worked for these benefits are calculated in subsequent quarters to measure the change in the cost of the benefits, the same eligibility and participation rates are assumed as at initiation. Holding these values constant for a sampled job eliminates the effects of shifts in the composition of the workforce on the measurement of cost changes. (For example, it eliminates the effect of a changing distribution of length of service, as might occur over a business cycle.)

The policy of holding usage of benefits fixed over the period that a job remains in the ECI extends to all benefits for which rate and usage data are collected.[5] In particular, the policy applies to overtime, so that the ECI is calculated on the assumption that a fixed number of overtime hours are worked in each quarter (equal to the amount observed in the initiation quarter). The implications of this policy with respect to overtime are discussed in a later section.

In only one instance is usage information updated when the cost of benefits is based on rate and usage data: when the benefit plan changes. For example, if a new set of health insurance plans were offered, or if the provisions of existing plans were changed, then new information would be collected on the number of participants in each plan, and the cost of health insurance would be calculated on the basis of the price of the new plans and the new distribution of participation. Another example of a change in benefit plan in which new information on usage of benefits would be collected is when the overtime premium changes. In this case, new information would be collected on overtime hours worked.

The two data collection approaches

As stated in the previous section, the Bureau has a preference for collecting ECI data in the form of rate and usage over data collected as expenditures. There are several reasons for this preference:

- The aim of the ECI is to measure the current cost of hiring labor services. Past expenditures may reflect different wages or benefit plans than currently exist.

- The ECI seeks to hold benefit usage constant when plan provisions remain constant. Usage is probably not held constant in expenditure data.

- The rate-and-usage approach usually permits the calculation of separate costs for each occupation in an establishment. An expenditure may yield just one cost for the establishment, requiring the costs to be prorated among occupations. Note, however, that it may be possible to obtain expenditure data for the specific jobs sampled.

- Expenditures may include unwanted costs that can be difficult to exclude from the survey because the respondent does not know whether they are included and what the amounts may be. For example, a life insurance expenditure might include life insurance costs for retirees.

The presumption, then, is that collecting data in the form of rates and usage renders the data more likely to be specific to the sampled job and to pertain to the current period. In reality, BLS data collectors sometimes cannot obtain rate and usage information for the sampled job. In that case, they must either fall back on rate and usage information for a broader occupational group or obtain expenditure data for the job or for a broader occupational group.

Often, a data collector may be able to obtain some rate or usage information for a benefit at the job level, but must gather other information for calculating the benefit's cost for an aggregation higher than the job. In the case of benefits that are available on a companywide basis, obtaining costs per hour from an aggregation higher than the job may be perfectly reasonable. Other times, applying higher level information to the sampled job is a necessary approximation. As an illustration of these points, consider an establishment that offers just one health insurance plan. The cost per participant for the plan probably does not vary across jobs in the establishment, so that the costs per participant at the company level are the same as they would be for the workers in a sampled job. What may differ, however, is the level of participation in different jobs. A data collector might not be able to obtain this usage information for the sampled job and might instead need to rely on participation rates for the company as a whole.[6]

Tables 1 and 2 show the sources of data in the ECI for March 2000 for several major types of benefit. The tables are based on an unedited code designating the source of the data, so the estimates should be accepted cautiously. Nevertheless, the tables give a sense of the source of data. Table 1 shows that there were about 30,300 sampled jobs in the database, including refusals and instances in which the plan exists, but costs are unavailable. Refusals accounted for about 5 percent of all sampled jobs on a weighted basis, while the percentage of jobs for which the plan existed, but costs were unavailable, ranged from about 9 percent to 23 percent. For the benefits listed in the table, costs were collected or there was no plan (which we know with certainty had zero cost) between 72 percent and 86 percent of the time (weighted).

For those jobs for which cost data were collected, table 2 shows how often rate and usage information was available for the specific job, how often rate and usage information was available for an aggregation of jobs, and how often some other source of data was used. When data elements from several different sources are used to generate a benefit cost for a job, the "poorest" of the data elements indicates the source. That is, for

a given job, if rate and usage data for that job were mixed with expenditure data for an aggregation of jobs, then the benefit cost would be coded as coming from expenditure data. The category titled "other sources of data" includes both cases in which data were "estimated" and a small percentage of cases in which the data source was not recorded.[7] "Estimated" data represent situations in which at least one data element used to calculate a cost had to be estimated by the respondent. "Estimated" data may still be high in quality, as hard data might account for the majority of the elements in a cost calculation.

Table 2 also shows that rate and usage data for the specific job were most often available for holidays (93.0 percent) and vacation leave (85.9 percent). In contrast, rate and usage data for the specific job were available only 33.7 percent of the time for sick leave, which often comes from other sources. A closer examination of the data indicates that sick leave data are often "estimated."

The central point is that BLS data collectors attempt to obtain cost information that is as close to the sampled job and as close to the reference period as possible. However, limitations in the data available from the respondent necessitate compromises in what is collected.

Infrequent payments

Many forms of compensation are paid out relatively smoothly over time or exist as part of a well-specified benefit package, so that their costs can be easily associated with the reference period. The most obvious example of this is hourly wages, which are paid for labor services in the reference period. Even a schedule of paid holidays (which are not necessarily taken during the reference period) can be viewed as part of a compensation package that exists during the reference period, and its annualized hourly costs can be attributed to that period. But some components of compensation, such as bonuses, are paid infrequently (less than quarterly), and whether and how much will be paid in the future is uncertain. This uncertainty raises the question of how these payments should

Table 1.	Cost data collected in the ECI, by type of benefit, March 2000					
[In percent]						
Cost data	Defined-contribution pension	Defined-benefit pension	Health insurance	Holiday leave	Vacation leave	Sick leave
Number of sampled jobs (unweighted)	30,269	30,269	30,269	30,269	30,269	30,269
Total	100.0	100.0	100.0	100.0	100.0	100.0
No plan	51.3	59.1	22.8	16.9	20.9	23.2
Cost data collected	30.1	26.9	54.2	68.3	58.5	49.1
Plan exists, cost unavailable	13.4	8.9	18.1	10.2	16.0	22.8
Refusals	5.1	5.1	5.0	4.7	4.6	4.9

NOTE: Percentages are based on weighted data.

Table 2.	Type of cost data collected in the ECI, by type of benefit, March 2000					

[In percent]

Type of cost data	Defined-contribution pension	Defined-benefit pension	Health insurance	Holiday leave	Vacation leave	Sick leave
Number of sampled jobs with cost data collected (unweighted)	11,256	9,108	17,407	21,224	17,549	14,237
Total	100.0	100.0	100.0	100.0	100.0	100.0
Rate and usage for—						
Specific job	44.8	58.2	51.5	93.0	85.9	33.7
Agreggation of jobs	7.8	1.9	10.7	.3	1.6	9.9
Expenditures for—						
Specific job	.3	.7	.4	.0	.0	.0
Aggregation of jobs	31.4	32.9	23.3	.9	1.7	2.5
Other sources of data	15.7	6.3	14.1	5.9	10.7	53.9

NOTE: Percentages are based on weighted data.

be incorporated into the ECI.

One approach is to associate infrequent payments solely with the quarter in which they are paid. For example, holiday bonuses paid in December could be associated with the ECI covering the December quarter. To the extent that infrequent payments tend to be made by most employers around the same time (such as the end of the year), this treatment creates spikes in the non-seasonally adjusted index. However, these spikes could be removed in the seasonally adjusted ECI. In that case, only unusual bonus payments would move the seasonally adjusted index.

The ECI treats infrequent payments differently. Costs for an infrequent payment are included in the quarter in which the payment is made and in each subsequent quarter, until a new payment is made. For example, if a $500 bonus were paid in December 2000 and a $600 bonus were paid in December 2001, then $500 would appear in the ECI data for December 2000 and March, June, and September of 2001, and $600 would appear in the December 2001 data.

One rationale for the ECI approach to infrequent payments applies the logic used for costing holidays. Bonuses are part of a total compensation package that an employee anticipates receiving and an employer anticipates paying. So the future costs of bonuses are associated with the reference quarter in the same way that the costs of holidays are annualized and associated with each quarter. But what makes the case of a bonus more difficult is that the amount of the payment may not be the same in the future, nor might an employee even be given a bonus at all. Accordingly, using the past bonus amount in each future quarter might be viewed as substituting a proxy for the uncertain future payment.

The ECI approach of carrying the bonus amount forward eliminates the spikes that would be induced if these payments were incorporated into the ECI only in the quarter in which they were paid. Thus, the approach obviates the need for seasonal adjustment. In the early years of the survey, this approach may have served as a means of seasonally adjust-

ing the data, when available time series were insufficient to allow the analyst to use formal seasonal adjustment techniques. Such a rationale is no longer applicable, as there are now ample quarters of data to permit seasonal adjustment. A disadvantage of the ECI approach is that it is more difficult to attribute cost increases to the quarter in which they occur. As noted earlier, the approach also implicitly assumes that infrequent payments will persist into the future when, in fact, they may not. Which way is the best to incorporate infrequent payments into the index is currently under review.

Calculating the ECI

In calculating the national ECI for compensation costs, as well as many of the ECI's subindexes, the myriad wage and compensation cost quotes for individual jobs must be aggregated into a single number. The aggregation process involves two key steps. The discussion that follows describes the process in general terms; mathematical details appear in Appendix A, and a numerical example is given in Appendix B.[8]

Each private-sector establishment surveyed for the ECI is placed within 1 of 72 industry groupings (largely two-digit Standard Industrial Classification (SIC) industries), and each job surveyed is placed within 1 of 10 major occupation groups, forming 720 private-sector cells.[9] Further, 19 State and local industry groups form 190 public-sector cells (19 industries times 10 major occupational groups). Each job quote in the survey falls within exactly 1 of these 910 cells. The first step in the calculation of the ECI involves aggregating the data for all of the job quotes within a cell in order to obtain an average for each cell. The second step involves aggregating across cell averages to obtain the ECI.

Consider first the second step in the calculation. The ECI is designed to indicate how the average compensation costs of employers would have changed over time if the industrial-occupational composition of employment had not changed from a designated base period. Thus, the ECI is calculated as

the weighted sum of the changes in compensation costs for all industry-occupation cells, where the weighting factor for each cell is its share of total labor compensation in the base period. An index calculated with the use of base-period weights in this fashion is termed a Laspeyres index. Since March 1995, 1990 employment counts from the BLS Occupational Employment Survey have been used to calculate the base-period weights for ECI cells.[10]

Now consider the first step in the calculation of the ECI, namely, the estimation of the mean change in compensation costs for each industry-occupation cell. The simplest way to estimate this change for any cell between period 0 (the base period) and period *t* (the reference period) would be to compare average compensation for that cell in the base and reference periods. But because the ECI sample changes over time due to replacement, this involves comparing averages across jobs that might not be strictly comparable. For example, a given cell in the base period might include compensation costs for an urban planner, while the same cell in the reference period might include compensation costs for an economist who replaced the urban planner in the sample.

Accordingly, to ensure that changes in compensation costs are compared across comparable jobs, the ECI takes an approach different from that mentioned in the previous paragraph. To start, the mean change in a cell's compensation cost between period 0 and period 1 is estimated as the ratio of the average compensation for that cell's jobs in period 1 to that in period 0. Average compensation in each period is calculated as the weighted arithmetic average of compensation costs for each job in the cell, where the weights are sampling weights that are roughly equal to the inverse of the probability of being selected for the sample. To ensure that this estimate is not affected by a change in the sample, only those jobs that are in the sample in both periods are used in the calculation. A similar procedure is utilized to calculate the mean change in compensation between periods 1 and 2, between periods 2 and 3, and so on. The change in mean compensation from period 0 to period *t* for a given industry-occupation cell is then calculated as the product of the individual per-period changes.

Alternative index formulas

The Laspeyres formula used to calculate the ECI is but one index formula that could be used to measure employment cost changes. Previous research on the CPI—also a Laspeyres index—suggests that the form of the index may matter. Thus, an important question is whether the estimated growth of employment costs depends on the particular index formula chosen or whether the ECI is largely insensitive to the form of the index. Research suggests that the latter is the case.

Before discussing alternatives to the Laspeyres formula, it is important to stress that the current ECI is not a pure

Laspeyres index. An important feature of Laspayres indexes is that they hold constant the market basket of commodities (labor in the ECI, goods and services in the CPI) at the base period. Over time, market baskets change in composition, so that the fixed base-period market basket becomes less relevant in describing the current period. The ECI deals with this issue by updating the base-period employment distribution infrequently.[11] In June 1986 and March 1995, new employment distributions were used to calculate current employment cost changes. The new distributions were introduced into the calculation of the index by taking the previous period's index value, calculated with the use of the old base-period employment distribution, and multiplying it by the reference-period cost change, calculated with the use of the new employment distribution. This new distribution becomes the source of new base-period weights for all future quarters, until yet another employment distribution is introduced.

Rather than constructing indexes by means of base-period weights, other indexes can be calculated by using other weighting schemes. A Paasche index, for example, uses reference-period quantities to aggregate the price changes for cells. Thus, if the ECI were computed as a Paasche index, it would be calculated as the weighted sum of the changes in compensation costs for all of the industry-occupation job cells, where the weighting factor for each cell is the cell's share of total compensation in the reference period. A Paasche index for employment costs answers the question, "How would employment costs have risen over time if employment had always been distributed among industries and occupations as they are in the reference period?"

It would make no difference whether reference- or base-period employment distributions were used to calculate an employment cost index if the pay of all jobs rose at the same rate. But this is not the case, so which index rises faster depends on which index weights jobs with faster compensation cost growth more heavily. Economic theory predicts the relative sizes of the Laspeyres and Paasche indexes. Consider first an example from consumer theory. Suppose that consumers consume both hamburger and steak, and suppose that the price of steak rises faster than that of hamburger. Then economic theory predicts that consumers will consume more hamburgers and less steak over time. That is, they will tend to substitute hamburger for steak. This substitution effect implies that in the reference period a Laspeyres index of price increase will tend to be larger than a Paasche index, because the base-period consumption pattern (used for the Laspeyres index) is more heavily weighted toward the commodity (steak) whose price is rising the fastest. By contrast, the Paasche index weights the price increase for hamburger (the price of which has risen more slowly) more heavily.

Theoretically, substitution bias may also affect the relative values of Laspeyres and Paasche indexes for compensation costs. Suppose that a hospital hired both nursing aides and

nurses, and suppose further that the pay of nurses increased faster than that of nursing aides. Then the hospital might tend to substitute nursing aides for nurses, using the aides to perform the less technical duties formerly conducted by the nurses. Because fewer nurses and more nursing aides are employed in the reference period than in the base period, the Paasche index will give greater weight to the group of workers with the slower growing compensation costs. Thus, the Paasche index will indicate slower compensation cost growth than the Laspeyres index, due to a substitution effect. By ignoring this substitution effect, the Laspeyres index will tend to overstate employers' labor costs in the *reference* period, while the Paasche index, weighting the cells with slower rising compensation costs more heavily, will tend to overstate employers' labor costs in the *base* period.[12]

Because economic theory predicts that the Laspeyres index tends to overstate increases in labor costs, whereas the Paasche index tends to understate them, it might seem sensible to take an average of the two indexes. In fact, the Fisher ideal does precisely that, being a geometric average of the Laspeyres and the Paasche indexes.[13] Another index similar in spirit is the Törnqvist index. In the context of employment costs, it is a weighted geometric mean of cell cost changes, where the weights are the average shares of spending on the various types of labor in the base and reference periods. (See Appendix A for a mathematical treatment of all of these indexes.)

What is the empirical evidence regarding the impact of substitution effects on indexes? Ana Aizcorbe and Patrick Jackman's research on the CPI suggested that, by ignoring the substitution effect, the CPI overstated the annual increase in the cost of living by about 0.2 percent per year for the period 1982–91.[14] But the evidence for compensation cost growth is very different. A study by Michael Lettau, Mark Loewenstein, and Aaron Cushner showed that the ECI is *not* very sensitive to the choice of index.[15] Furthermore, contrary to the predicted impact of substitution, the growth in compensation costs for the Paasche index was slightly higher than for the Laspeyres (0.12 percent per year over the period from September 1981 to December 1994).

The explanation for the apparently contradictory result for compensation costs is that factors other than a substitution effect are at work. One hypothesis is that over the period studied by Lettau, Loewenstein, and Cushner—the 1980s and the first half of the 1990s—employment in goods-producing industries (particularly manufacturing) declined, while employment in service-producing industries increased. At the same time, pay in service-producing industries grew faster than in goods-producing industries. The movement in pay and employment in favor of the service sector reflects a growing demand for labor in that sector relative to the goods-producing sector. The Paasche index, which gives greater weight to service sector employment, weights the faster growing service sector pay more heavily than the Laspeyres index does.

While the research of Lettau, Loewenstein, and Cushner does show this interesting pattern, it also shows that the ECI is relatively insensitive to the method of weighting changes in compensation costs and, hence, the particular index that is used. This insensitivity is probably due to the fact that employment shares change slowly over time, so that the weights of the various indexes are not dramatically different.

In response to interest from users, the Bureau intends to release a variety of indexes in addition to the Laspeyres index.

Variable pay and stock options

Some analysts believe that compensation practices are undergoing marked changes, with a growing emphasis on more variable forms of pay.[16] This trend purportedly includes greater reliance on bonuses and stock options. If there is such a trend, how is it reflected in the ECI?

The ECI captures many forms of variable pay that supplement straight-time wages and salaries, including overtime pay, shift differentials, and cash bonuses. The latter are classified as either production or nonproduction bonuses. Production bonuses are cash payments that are linked to a worker's own production through a formula such as a sales commission or piecework rate. They are included in the wage and salary component of the ECI. Nonproduction bonuses include a wide variety of other cash payments: yearend or holiday bonuses, lump-sum bonuses paid in lieu of wage increases, profit-sharing bonuses, contract-signing bonuses, and bonuses paid to retain incumbent employees.[17] These payments, which in some cases can be relatively large, are included in the benefits component of the ECI. Until June 2000, the ECI excluded hiring bonuses paid to induce an individual to accept employment and referral bonuses paid to employees for recommending an applicant who is hired by the company. The ECI now includes these bonuses as well.

The ECI currently excludes compensation in the form of stock options. Traditionally, the incidence of payment in the form of stock options has been low, and stock options were not believed to have the potential to affect the ECI greatly. However, in light of the apparent growing use of this form of compensation, the Bureau fielded a nationally representative survey to determine the incidence of new stock option grants in 1999. The survey, of about 2,100 establishments, was fielded between February and June of 2000.

The results of the survey showed that 1.7 percent of all private-industry employees and 5.3 percent of employees in publicly held companies received new stock option grants in 1999. As expected, grants were more prevalent among higher paid employees (12.9 percent of all employees earning $75,000 or more), larger establishments, and certain industrial sectors—the highest being publicly held durable-goods-manufacturing establishments (14 percent of employees) and publicly held companies in finance, insurance, and real estate (13.9

percent of employees). While the generally low incidence of stock option grants suggests that the overall ECI might be little affected by the omission of stock options, the same might not be the case for high-incidence sectors. Among current BLS research projects is a study examining the feasibility of conducting a survey of employers' costs of stock options.

Capturing the cost of stock options in the ECI is problematic, as they do not lend themselves to easy measurement with currently available data. In the United States, two major types of stock options have emerged: incentive stock options and nonqualified stock options. These two types of options differ in tax treatment and, therefore, also in whether and, if so, when they are captured in administrative data systems. The most prevalent stock option is the nonqualified one. When such an option is exercised, an employee incurs a tax liability equal to the difference between the market and exercise prices. For tax purposes, this difference is reported as wages and salaries. At the same time, the company takes a tax deduction of the same magnitude for employee compensation. The company does not need to report this deduction on its financial statements.

In contrast to nonqualified stock options, income to workers derived from incentive stock options is taxable as capital gains rather than ordinary income. Incentive stock options have tax advantages over nonqualified options to the employee, because the long-term capital-gains tax rate is generally lower than the employee's ordinary income tax rate. But companies cannot deduct incentive stock options for tax purposes and are subject to a limit of $100,000 on the value of stock on the date on which it was granted (a limit that does not apply to nonqualified stock options).

Because exercising stock options generates a taxable event, it would seem feasible, from a data availability standpoint, to value stock options when they are exercised.[18] But, conceptually, it is not clear that that would be the appropriate time to do so. The problem is that the ECI measures the cost of compensation to employers, and, arguably, the employer realizes the cost of stock options before they are exercised. Ultimately, the exercise of stock options is covered by the employer either through its own stock purchases or through the issue of new stock. The employer's costs associated with the former are explicit, while there are implicit costs associated with issuing new stock in the form of stock dilution, which affects the stock's price and hence the ability of the company to raise capital through the stock market. Regardless of the way the company covers stock option exercises, the market anticipates the cost of the options long before they are exercised, thus affecting the company's cost of capital in advance of exercising the options.

The preceding discussion suggests that it might be appropriate to value stock options for the ECI when they are granted. The limited availability of data and the complex nature of the required economic model, however, will pose challenges. In its Statement 123, the Financial Accounting Standards Board re-

quires public companies to disclose the "fair value" of stock option grants by using an "option-pricing model," such as the Black-Scholes model. This model requires a variety of information, including the price of the stock when options are granted, an assumed risk-free rate of interest, a measure of the long-run variability of the company's stock, and an indication of how long the options are to be held before they are exercised. Companies are responsible for determining the economic and financial assumptions necessary for the model. However, Statement 123 allows companies to continue to use Accounting Principles Board Opinion 25 to determine net income, which frequently results in no expense being recorded. If this method is used to determine net income, companies must report stock option costs under the "fair-value" method in footnotes to their financial statements.

An additional complication arises in valuing stock options before they are exercised. Because stock options typically offer some employee discretion regarding when they are exercised, options could involve an investment decision as well as a compensation component. Employees may exercise their options as soon as they are vested. Arguably, one could view the value of stock options when they become vested as an accrual of wages and salaries over the period from the date the stocks are granted to the vesting date and consider that value to be disbursed at the time of vesting. Then, any additional return from holding the options beyond the vesting date could be viewed as a return on investment. If correct, this view suggests that only the compensation component of stock option values should be attributed to the ECI. However, splitting the two components will be difficult, because tax data and company financial information are insufficient to effect the split.

The Bureau is conducting research into the feasibility of costing stock options. A number of questions will be addressed: In what ways are stock options similar to the uncertain liabilities employers incur when they promise retirement benefits? Do these similarities have implications for the treatment of stock options in the ECI? Given constraints imposed by the data, is valuing stock options when they are granted consistent with ECI concepts? Is it relevant to the calculation of the ECI whether options have both a compensation and an investment component, and if so, how is the compensation component incorporated into a costing algorithm? With regard to valuing stock options when they are granted, is sufficient information provided by financial statements under the standard promulgated by the Financial Accounting Standards Board, or will supplementary information be required from respondents or other public sources? Is it appropriate to rely on company-made choices about the option-pricing model and the parameters of that model, or should the Bureau assume a standard model, make standard assumptions about certain parameters, such as the risk-free interest rate, and rely on company information for the other parameters? How will stock options be

valued for privately held companies? Given that stock options are relatively infrequently granted, is the ECI the appropriate survey vehicle to capture their costs, or is a special survey required which disproportionately surveys sectors that grant their options more often? Finally, with what frequency should stock options be valued?

Business cycles and the ECI

Certain features of the ECI tend to make its wage and compensation indexes less variable over the business cycle than other measures of compensation, such as those which measure average hourly earnings. These features do not all work in the same direction.

First, during business cycle upswings, hours worked per week tend to increase through the use of more overtime. The average hourly rate of pay for straight-time work does not change, but because overtime is paid at a higher rate for hourly workers (who are not exempt from the provisions of the Fair Labor Standards Act), the average hourly pay for all hours worked increases.

Second, sectors of the economy differ in their cyclicality. Goods-producing industries tend to be more procyclical than do service-producing sectors. In addition, jobs within an industry may differ in cyclicality. For example, blue-collar jobs traditionally have been more cyclical than white-collar jobs. To the extent that these sectors and jobs differ in average pay, the average pay for all workers will tend to vary over the cycle as the composition of the workforce varies.

Third, traditionally, the employment of lower paid, less experienced workers has tended to be more procyclical than that of more experienced workers. During business cycle downturns, less experienced workers may be laid off first (so average pay would tend to go up, everything else being equal), while during upswings, less experienced workers are the last to be rehired. This factor would tend to make an average hourly earnings series move less cyclically than it would otherwise.

Fourth, some components of compensation display joint cyclical or countercyclical behavior. For example, incentive pay and nonproduction bonuses both tend to increase during cyclical upturns. Further, business cycle downturns are associated with slackening labor markets, during which compensation tends to rise less than during upturns, everything else being equal. In contrast, new workers who are hired during upswings may be eligible for fewer vacation days, lowering the average cost of vacations and dampening increases in average compensation costs.

The way the ECI is currently constructed tends to dampen some, but not all, of these movements. As mentioned previously, the ECI generally holds overtime usage constant within a job at the level observed in the initiation quarter. New information on overtime hours is not collected for the job, except in the

unlikely event that there is a change in the overtime premium. Hence, the benefit component of the ECI does not currently reflect variations in the usage of overtime over the business cycle.[19] The policy of holding overtime usage constant is under review. One option being considered is to use current overtime information that will be available from each cross-industry, cross-area replacement panel to update overtime for all sample units, generating an ECI that allows overtime to vary.

Another factor that tends to dampen movement of the ECI over the business cycle is the index's Laspeyres formulation. Because the ECI holds constant the distribution of employment across industries and across occupations, it is not influenced by the differing cyclicality of employment across jobs and sectors.

The ECI may, however, be influenced by employment changes in the experience profile of jobs. Data are collected every quarter on the average straight-time wage rate for jobs in the sample. As mentioned previously, these data are the average wages of all incumbents in the job. To the extent that the identity of the incumbents varies over the business cycle, the average wages may move cyclically. During downturns, less experienced, lower paid incumbents may be the first to be laid off. If so, the composition of incumbents would then shift toward those who are more highly paid, raising the average straight-time pay. Thus, ECI measures of average hourly straight-time pay, as well as measures of benefits, such as overtime premiums, that are tied to average straight-time pay, may contain a countercyclical component.

Another job-composition feature of the ECI suggests that it will be less procyclical than a measure of average earnings. Recall that the index collects data on a sample of company-defined jobs within each establishment. Whenever a worker in an ECI-sampled job is promoted to a higher level job, that worker moves out of the group of workers providing cost data for the lower level job. Thus, the ECI does not capture the worker's increase in pay. Further, if the worker was one of the higher paid workers in the lower level job, the average pay of the remaining workers in the sampled job will actually drop, everything else being equal. Consequently, to the extent that promotions occur more frequently during business upswings, a measure of average pay will tend to be more cyclical than will the ECI. (Note that it is conceptually appropriate in a quality-constant Laspeyres index not to measure the increase in pay stemming from a promotion, to the extent that the promotion is associated with an increase in the worker's productivity.)

The ECI does capture some cyclical components that are due to variations in compensation costs. Thus, declines in incentive pay and nonproduction bonuses during downturns are reflected in the index. The impact of slack labor markets, in the form of slower growing compensation costs for a fixed bundle of labor, also are captured. However, the ECI's approach to holding con-

stant the length-of-service distribution for calculating the cost of vacations means that the index does not vary as the length-of-service profile changes over the business cycle.

Employer cost and employee value[20]

Some forms of compensation are provided not as cash, but as noncash benefits. The ECI has developed methods for estimating the costs of these benefits to employers. But how do the costs relate to the value that employees attach to noncash compensation? For several reasons, it turns out that employer cost does not necessarily equal employee value.

Economists generally use the "cash-equivalent" approach to defining the value of noncash benefits. The cash-equivalent value is defined as "the minimum amount of additional cash compensation an individual would require to become just as well off as that individual would be if he or she received the noncash good."[21]

In a competitive labor market, one might expect that, for the "marginal worker" (the last worker hired), the cost of a non-legally required benefit would equal its value. Employers can compensate workers either in cash or in noncash benefits and would be indifferent between spending a dollar on the one or the other. Absent factors discussed next, in a competitive market where workers can negotiate over pay and benefits, the marginal worker would demand a mix of pay and non-legally required benefits that would equalize the value of the last dollar spent on each benefit with a dollar of cash compensation. For if this equality did not hold, employers could reallocate dollars between pay and benefits in such a way as to increase the value of the compensation package to the worker at no cost to themselves.[22] In the perfectly competitive situation just described, the cost of the benefit is equal to its value.

For several reasons, the idealized equality of employer cost and employee value does not hold for benefits that are not legally required. One reason is that some benefits are not subject to income taxes.[23] Because of this exemption, the marginal worker is expected to demand noncash benefits up to the point where the last dollar spent on benefits equals one dollar after taxes.[24] In that event, more of the benefit will be offered to the employee than would be the case without taxes, and as a result, employer cost will overstate the value of the benefit to the employee.

Another reason for the lack of equality between employer cost and employee value relates to the relatively uniform provision of some benefits to all workers in an establishment. For example, firms tend to provide only a limited range of choices of health insurance plans. In part, this uniformity stems from the aim of nondiscrimination, whereby tax rules stipulate that benefits are tax deductible only if they do not favor higher paid workers.

Still, while many benefits tend to be provided uniformly, employees will tend to value them differently. First, higher income workers will demand more of "normal" goods than will lower income workers.[25] Hence, because benefits are believed to be normal goods, higher income workers will tend to value a given amount of benefits more highly than lower income workers will. In contrast, two-earner families may receive duplicative health insurance that is valued less than it would be in one-earner families. Similarly, young, single individuals may value life insurance less. The diversity of values attached to benefits and the relative uniformity of the provision of some benefits imply that at least for some workers, employee value will not equal employer cost.

If the foregoing factors drive a wedge between employer cost and employee value for non-legally required benefits, the situation is exacerbated for legally required benefits. Workers and employers can at least negotiate over non-legally required benefits, so that, accounting for taxes, employer cost and employee value may not be greatly different. But legally required benefits are set outside this negotiating framework and tend to be uniform across workers, meaning that it is less likely that value equals cost for these benefits.

Other measures of compensation

The Bureau of Labor Statistics publishes two other measures of compensation costs that can be contrasted with the ECI. The Employer Costs for Employee Compensation (ECEC) series measures the cost, in cents per hour, of compensation items by major industry, occupation, region, size of establishment, full-time or part-time employment, and bargaining status. The reference period for these costs is the pay period that includes March 12. Unlike the ECI, which measures changes in compensation costs, the ECEC measures the level of compensation costs at a point in time. The same data that are used to produce the ECI are used to produce the ECEC, except that the ECEC is calculated with the current distribution of employment. The ECEC has the same scope of coverage as the ECI, in terms of benefits and workers surveyed. While comparisons of ECEC data can be made over time, the central purpose of that measure is to show how costs per hour distribute among wages, salaries, and benefits at a point in time.

The BLS Office of Productivity and Technology produces another measure of compensation costs, termed compensation per hour. This quarterly measure is reported as both an index of compensation costs and a percent change for U.S. business, nonfarm business, manufacturing, and nonfinancial corporations. Unlike the ECI (but similar to the ECEC), compensation per hour is calculated with the current distribution of employment. Hence, the measure can be affected by shifts in employment between industries and occupations.

Compensation per hour is calculated by dividing an estimate of aggregate compensation by an estimate of hours

worked. The numerator and denominator come from a variety of sources. Compensation costs in the numerator come largely from the national income accounts of the Bureau of Economic Analysis, supplemented with BLS imputations for the payment of labor services of proprietors. Hours-worked estimates in the denominator are derived from a variety of sources, including the BLS Current Employment Statistics program, Current Population Survey, and Hours at Work Survey.

The scope of compensation per hour is slightly broader than that of the ECI in terms of coverage of workers and compensation items. First, compensation per hour includes the self-employed (proprietors) and workers employed in Federal Government enterprises (agencies of the Federal Government that cover a substantial proportion of their operating costs by selling goods and services to the public and that maintain their own separate accounts; the U.S. Postal Service is one such agency). Second, compensation per hour includes tips and a measure of the value of realizations of stock options (that is, the income derived from the exercise of such options).[26] In contrast, the ECI does *not* include stock option costs to employers.

THE QUARTERLY EMPLOYMENT COST INDEX (ECI) measures the change in the price of labor. The ECI's Laspeyres formula holds the distribution of labor constant at a point in the past termed the base period. Research on the Consumer Price Index (CPI) indicates that a Laspeyres formulation overstates increases in the cost of living by failing to account for substitution effects. Because the ECI is constructed in a manner similar to the way the CPI is, one might ask whether the ECI, too, suffers from an upward bias, in its case in measuring the growth of labor costs. Research concludes that this is not the case. Alternative indexes—Passche, Fisher ideal, and Törnqvist—indicate similar compensation cost increases.

The ECI treats infrequent (less than quarterly) payments by including them in the quarter in which they are paid and in each subsequent quarter until a new payment is made. A rationale for this treatment is that infrequent payments are part of a total compensation package that an employee anticipates receiving and the employer anticipates paying. The past amount that is used serves as a proxy for the unknown future payment. But such a treatment spreads the impact of infrequent payments over many quarters, making it difficult to attribute the increase in cost to the quarter in which it occurs. Further, the assumption that future infrequent payments will persist may be questioned. The ECI policy with respect to the treatment of infrequent payments is under review.

The ECI captures the costs of many forms of variable pay, but does not capture the value of stock options. An incidence survey fielded by the Bureau in the first half of 2000 obtained information on stock option grants issued in 1999. Overall, only 1.7 percent of private-industry employees received grants that year, but some sectors—most notably, higher paid

employees—were more likely to receive grants. The Bureau is researching approaches to estimating the costs of stock options in a manner consistent with the general philosophy underlying the calculation of the ECI. Data permitting, it is likely that stock options will be valued at the value they have at the time they are granted and that data will be collected in a special survey rather than in the ECI survey.

Certain features of the ECI tend to make its wage and compensation indexes less variable over the business cycle than are other measures of compensation, such as those which measure average hourly earnings. ECI features that tend to dampen cyclical movements in the index include holding both overtime usage and the distribution of employment constant. Further, the ECI does not pick up increases in pay from promotions that may be more prevalent during business cycle upswings. However, because the ECI tracks the average wage of workers in sampled jobs, it may be influenced countercyclically by cyclical changes in the experience profile of those jobs. During downturns, lower paid workers with lower tenure are likely to be laid off first, raising the average wages of jobs sampled in the ECI. Finally, as with average hourly earnings, the ECI is influenced procyclically by changes in wage pressures due to fluctuations in the demand for labor. These pressures affect both wage and salary increases, as well as the size of incentive pay and nonproduction bonuses.

The ECI measures employer costs for employee benefits. In an unconstrained market, the quantities of benefits offered to different employees would vary in such a way as to equate each employee's marginal benefit to the employer's marginal cost. For several reasons, however, employer costs are *not* equal to employee value. One reason is that some benefits (for example, health insurance) are not subject to income taxes. For these benefits, the cost to the employer is expected to exceed the value to the employee. Another reason is the relatively uniform provision of benefits to all workers in an establishment (due in part to nondiscriminatory tax rules). Adjustments in benefit amounts to each worker (to equalize marginal cost with marginal benefit) are not possible, resulting in different valuations of the benefits package by different workers. Finally, the equality of employer cost and employee value may not hold for legally required benefits.

The Bureau produces two other measures of compensation costs that may be contrasted with the ECI. The Employer Costs for Employee Compensation (ECEC) uses ECI data to measure the cost, in cents per hour, of compensation items by industry, occupation, and other worker and establishment characteristics. Unlike the ECI, the ECEC is calculated with the current distribution of employment. The BLS Office of Productivity and Technology produces another measure of compensation costs, termed compensation per hour. This quarterly measure is reported as both an index of compensation costs and a percent change for U.S. business, nonfarm business, manu-

facturing, and nonfinancial corporations. Unlike the ECI (but similar to the ECEC), compensation per hour is calculated with the use of the current distribution of employment.

The ECI is one of the U.S. Government's principal statisti-cal series for measuring inflation in the economy. Understanding its characteristics is helpful for interpreting how it measures cost pressures that may lead to inflation in the price of goods and services. □

Notes

[1] A primary sampling unit consists of a county or a number of contiguous counties. Thirty-three primary sampling units are selected with certainty. (That is, they would appear in *any* sample that was drawn.) Others are selected with a probability proportional to their employment. For more information about samples from the National Compensation Survey, see Kenneth J. Hoffman, "New sample areas selected for BLS National Compensation Survey program," *Compensation and Working Conditions*, spring 1997, pp. 27–31.

[2] In the late 1990s, many establishments remained in the ECI sample for more than 5 years, to accommodate a transition to a new sample design.

[3] A longitudinal panel becomes unrepresentative over time if it fails to pick up newly created jobs and establishments. Prior to the current cross-industry replacement scheme and in between sample replacement, the ECI sample was replenished with "birth samples"—that is, samples of newly created establishments. However, the ECI jobs were not replenished with birth samples of jobs within the establishments remaining in the sample, so the distribution of jobs in panels of establishments could become outdated.

[4] The average rate of usage of vacation time (12.5 days in this example) is calculated as a worker-weighted average, not an hourly weighted average.

[5] When expenditure data, rather than rate and usage data, are collected for a benefit, it is not possible to hold usage constant. Quarterly variations in the cost of benefits in expenditure data may occur even when usage of benefits is held constant. Also, note that while tenure profiles are held constant in calculating vacation costs, changes in average tenure within a sampled occupation may still move the average wage used to price the cost of vacation time.

[6] In some cases, the data collector can obtain cost information only for multiple benefits combined (for example, health and life insurance together). In those cases, the Bureau allocates aggregate costs among the individual benefit items.

[7] Consistent with quality concerns about the data source field, the jobs contributing to table 2 should never have a code which indicates that data are not available. Despite this, they do in a very small percentage of cases.

[8] The discussion that follows and Appendix A borrow heavily from Michael K. Lettau, Mark A. Loewenstein, and Aaron Cushner, "Is the ECI sensitive to the method of aggregation?" *Monthly Labor Review*, June 1997, pp. 3–11.

[9] Some groupings collapse two-digit SIC's (the finance, insurance, and real-estate (FIRE) industry is an example), others four-digit SIC's, and still others three-digit SIC's (health and education). Prior to March 1995, only nine major occupation groups were used.

[10] From June 1986 to December 1994, employment counts from the 1980 Census of Population were used as weights. Prior to June 1986, employment counts from the 1970 Census of Population were used.

[11] Similarly, the CPI updates its market basket of goods and services infrequently.

[12] Absent replenishment of the sample, the ECI holds employment distributions constant in two ways. Across the 910 industry-occupation cells, employment is currently held constant at the March 1995 employment distribution of the Occupational Employment Survey, as previously discussed. Within cells, absent both sample replenishment and attrition, the employment distribution is held constant by holding the sample weights fixed. Sample attrition may lead to some within-cell reweighting. Further, as samples are replenished, the within-cell weights may shift across jobs, reflecting a change in the employment distribution within cells. Thus, the ECI does reflect some within-cell substitution.

[13] That is, the Fisher ideal is the square root of the product of the Laspeyres and the Paasche indexes.

[14] Ana M. Aizcorbe and Patrick C. Jackman, "The commodity substitution effect in CPI data, 1982–91," *Monthly Labor Review*, December 1993, pp. 25–33.

[15] Lettau, Loewenstein, and Cushner, "Is the ECI sensitive."

[16] David Lebow, Louise Sheiner, Larry Slifman, and Martha Starr-McCluer, "Recent Trends in Compensation Practices," Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series no. 1999–32, working paper, 1999.

[17] Recently, the Bureau conducted a quality control review of the data on retention bonuses to confirm that data were being captured correctly.

[18] ECI data are collected from employers, so capturing exercise cost data might be easier in the case of the more prevalent nonqualified stock options.

[19] Recall that premium pay for overtime appears in the benefit portion of the ECI; the wage and salary measure includes only straight-time pay.

[20] This section borrows heavily from Melissa Famulari and Marilyn E. Manser, "Employer-provided benefits: employer cost versus employee value," *Monthly Labor Review*, December 1989, pp. 24–32.

[21] *Ibid.*, p. 25.

[22] That is, suppose that the value to the employee of the last dollar spent on a benefit was less than one dollar. Then the employer could reduce expenditures on the benefit by a dollar and give that dollar to the worker as cash compensation instead, making the worker better off.

[23] Taxation of benefits varies. Cash payments for paid leave, overtime, and nonproduction bonuses, included as benefits in the ECI, are generally taxable in the year in which they are paid. Contributions to retirement plans are generally tax deferred until payments are made to the employee upon retirement or some other kind of withdrawal from the labor force. Insurance premiums are generally not taxed.

[24] Suppose instead that the compensation package were such that the value of benefits equaled one dollar before taxes, and suppose that the tax rate were t. Then the employer could spend one less dollar on cash compensation (costing the employee only $1 - t$ dollars after taxes) and give the employee benefits equal to one additional dollar. The employee would then be better off. This substitution of benefits for cash continues as the value of additional dollars of benefits declines, to the point where the value of an additional dollar of benefits equals a dollar of pay after taxes.

[25] In economic theory, a "normal" good is defined as a good whose quantity demanded increases with income.

[26] Stock options are included in compensation to the extent that they are reported as wages for unemployment insurance tax purposes, a principal source of compensation income in the national income accounts.

APPENDIX A: Laspeyres and alternative index formulas

Let W_{it} denote the mean compensation paid to workers in category i in period t, and let E_{it} denote the number of workers in category i employed in period t. Let 0 denote the base period. Then the Employment Cost Index (ECI) in period t is calculated as

$$(1)\ \ \mathrm{ECI}_t = \sum_i \alpha_i^L \frac{W_{it}}{W_{i0}} \times 100,$$

where

$$(2)\ \ \alpha_i^L = \frac{E_{i0} W_{i0}}{\sum_i E_{i0} W_{i0}} \ .$$

Out of the ECI sample in period τ, let I_τ denote the subsample of jobs corresponding to labor category i. In addition, let $W_{ij\tau}$ denote the compensation in period τ for the jth job quote in cell i, and let $W_{ij\tau-1}$ denote the corresponding compensation in period $\tau - 1$. Finally, let $s_{ij\tau}$ denote the sample weight corresponding to the jth job quote in cell i in period τ. Then the proportionate change, $r_{i\tau}$, in the average compensation paid to workers in category i between period $\tau - 1$ and period τ is estimated from

$$(3)\ \ 1 + r_{i\tau} = \frac{\sum_{j \in I_\tau} s_{ij\tau} W_{ij\tau}}{\sum_{j \in I_\tau} s_{ij\tau} W_{ij\tau-1}} = \sum_{j \in I_\tau} s_{ij\tau}{}' \frac{W_{ij\tau}}{W_{ij\tau-1}},$$

where $s_{ij\tau}{}' = \dfrac{s_{ij\tau} W_{ij\tau-1}}{\sum_{j \in I_\tau} s_{ij\tau} W_{ij\tau-1}}$ is the implicit expenditure weight for

the jth job quote in cell i in period τ. The proportionate change in compensation for category i from period 0 to period t is then calculated as

$$(4)\ \ \frac{W_{it}}{W_{i0}} = (1 + r_{i1})(1 + r_{i2})...(1 + r_{it}) \ .$$

If the ECI were computed as a Paasche index, one would use an equation like (1), but with weights defined by

$$(5)\ \ \alpha_{it}^p = \frac{E_{it} W_{i0}}{\sum_i \mathrm{E}_{it} W_{i0}}$$

The Fisher ideal index is given by

$$(6)\ \ F_t = L_t^{1/2} P_t^{1/2} ,$$

where L_t is the Laspeyres index at time t and P_t is the Paasche index at time t. The Törnqvist index is

$$(7)\ \ T_t = \prod_{j=1}^{N} (W_{jt}/W_{j0})^{\alpha_j^T} \times 100,$$

where

$$(8)\ \ \alpha_j^T = (1/2) W_{j0} E_{j0} / \sum_{k=1}^{N} W_{k0} E_{k0} + (1/2) W_{jt} E_{jt} / \sum_{k=1}^{N} W_{kt} E_{kt} \ .$$

Current employment weights are obtained by allocating industry employment from the Current Employment Survey among occupations using ECI sample weights.

APPENDIX B: How to Calculate an ECI Index for Wages and Salaries

Glossary of selected terms used in this example
- *MOG* stands for major occupation group, a grouping of occupations with one or more similar attributes.
- *SIC* stands for the standard industrial classification code of a group of economic activities.
- The *estimation cell* is the nexus of employment in a major occupation group (MOG) and an industry group (SIC); that is, the estimation cell is an "item" in our "shopping basket of labor services."
- The *base-period employment weight* is the number of employees in any estimation cell estimated by the Occupational Employment Survey (OES) for the base period. The use of constant base-period employment weights is what makes the ECI a Laspeyres index construction.
- The *establishment selection weight* is the inverse of the sample establishment's chance of having been selected from the universe of establishments. (For example, if the chance of having been selected is 5 out of 20, or 5/20, the inverse is 20/5, for a weight of 4.)
- The *occupation sample interval* is the number of employees in the sampled establishment that is represented by each occupation quote sampled from the establishment; that is, the occupation sample interval is the establishment employment divided by the number of quotes selected.

- The *final weight* is the product of the establishment weight and the occupation sample interval.[1]

General calculation steps
1. Calculate the weighted average hourly wage rate for the estimation cell, using observed wage rates multiplied by final weights.
2. Calculate the wage "cost weight" for the estimation cell.
3. Sum the cost weights over all estimation cells in the ECI series.
4. Compute the index value for the series.
5. Compute measures of the 3-month and 12-month change for the series.

Goal, assumptions, and facts for this example
- Goal: calculate the ECI wage and salary series for blue-collar occupations in construction.

- Assume that only the following occupation groups and industries are in the universe:

  1. Craft and skilled trades occupations (MOG E) in special trades contracting (SIC 17).
  2. Transportation and material moving occupations (MOG G) in general building contracting (SIC 15).
  3. Nonfarm laborer occupations (MOG H) in special trades contracting (SIC 17) and in general building contracting (SIC 15).

- Assume that the OES base-period employment for these occupation groups and industries (or estimation cells) were the following for the base period:[2]

MOG	SIC 15	SIC 17
E	0	50,000
G	10,000	0
H	30,000	50,000

- The survey data include two establishment sample units from each SIC (for a total of four such units) and two occupation quotes sampled from each establishment (for a total of eight units). Note that in actual survey operations the number of establishments sampled and the number of quotes sampled from each establishment are larger. They are limited here for simplicity.

- Givens for the sample establishments in the base period:

Establishment number	SIC	Employment	Selection weight	Occupation sample interval
1	15	100	200.0	50
2	15	200	100.0	100
3	17	400	125.0	200
4	17	800	62.5	400

- Givens for the sample occupations in the base period:

Establishment number	Occupation number	MOG	Average hourly wage	Final weight
1	1	G	$20.00	10,000
1	2	H	10.00	10,000
2	1	G	15.00	10,000
2	2	H	7.50	10,000
3	1	E	25.00	25,000
3	2	H	10.00	25,000
4	1	E	20.00	25,000
4	2	H	11.00	25,000

- Givens for the occupations in the quarter following the base period:
  Occupation 1 in establishment 3 gets a $2.00/hr raise to $27.
  Occupation 2 in establishment 4 gets a $1.00/hr raise to $12.

Calculation steps

1. Calculate the weighted average hourly wage rate for the four (MOG-SIC) estimation cells in the base period, using observed wage rates, establishment selection weights, and occupation sample intervals:

   a. For each estimation cell, sum the products of each quote's average hourly wage and its final weight.

   b. For each estimation cell, sum the final weights over all quotes.

   c. For each estimation cell, divide a by b to get the average hourly wage.

Estimation cell	a	b	Average hourly wage
MOG G, SIC 15	$350,000	20,000	$17.50
MOG H, SIC 15	175,000	20,000	8.75
MOG E, SIC 17	1,125,000	50,000	22.50
MOG H, SIC 17	525,000	50,000	10.50

2. Calculate the wage "cost weight" for the estimation cell by multiplying the average hourly wage by the OES employment for the base period:

Estimation cell	Average hourly wage	OES employment	Wage cost weight
MOG G, SIC 15	$17.50	10,000	$175,000
MOG H, SIC 15	8.75	30,000	262,500
MOG E, SIC 17	22.50	50,000	1,125,000
MOG H, SIC 17	10.50	50,000	525,000

3. Sum the wage cost weights over all estimation cells in blue-collar occupations in construction: **$2,087,500**.

4. Calculate the weighted average hourly wage rate for each estimation cell in the quarter after the base period, thereby reflecting new wage rates (boldface type denotes a change from the base period):

Estimation cell	a	b	Average hourly wage
MOG G, SIC 15	$350,000	20,000	$17.50
MOG H, SIC 15	175,000	20,000	8.75
MOG E, SIC 17	**1,175,000**	50,000	**23.50**
MOG H, SIC 17	**550,000**	50,000	**11.00**

5. Calculate a new wage cost weight for each estimation cell by computing the percent change in the average hourly wage rate since the previous quarter and applying the percent change computed to the previous quarter's wage cost weight to get the current quarter's wage cost weight (in this example, the previous quarter just happens to be the base quarter):

Estimation cell	Percent change in average hourly wage	Previous quarter's wage cost weight	Current quarter's wage cost weight
MOG G, SIC 15	0.00	$175,000	$175,000
MOG H, SIC 15	0.00	262,500	262,500
MOG E, SIC 17	4.44	1,125,000	1,174,950
MOG H, SIC 17	4.76	525,000	549,990

6. Sum the wage cost weights for the current quarter over all estimation cells in blue-collar occupations in construction: **$2,162,440**.

7. Compute the current quarter's index to equal 100 × (current quarter's aggregate wage cost weight/base quarter's aggregate wage cost weight), rounded to 0.1: 100 × (2,162,440/2,087,500) = **103.6** for blue-collar occupations in construction.

8. Calculate the 3-month percent change equal to [(current quarter's index/previous quarter's index) − 1] × 100, rounded to 0.1 (in this example, the previous quarter just happens to be the base quarter): [(103.6/100.0) − 1] × 100 = **3.6**.

9. Calculate the 12-month percent change in a similar fashion.

The preceding methods work for each succeeding quarter if one follows steps 4–9.

Notes to Appendix B

[1] This description simplifies the calculation of the final weight in this example. In the actual ECI, the final weight is the product of the area weight, establishment weight, occupation sample interval, establishment nonresponse adjustment, occupation nonresponse adjustment, documentation factor, and rotation factor.

[2] In normal operations, there would never be estimation cells with zero OES base-period employment. These zeros appear only for simplicity in this example.