Chapter 17. The Consumer Price Index (Updated 4-18-2019)

Note: To reflect new sample areas and pricing cycles effective with the geographic revision implemented in January 2018, appendices 1 and 4 have been updated. The entire CPI chapter of the *Handbook of Methods* is in the process of being updated and is expected to publish before the end of 2019. With the release of March 2019 data, the BLS expanded the methods used to obtain price data for the CPI to include more corporately transferred data. This is in addition to the traditional in-store and online website collection techniques. This, along with BLS research on current and future uses of alternative data sources, is discussed in more detail in the Big Data in the U.S. Consumer Price Index: Experiences and Plans draft paper posted on the National Bureau of Economic Research website and presented at the recent conference: Big Data for 21st Century Economic Statistics.

The Consumer Price Index (CPI) is a measure of the average change over time in the prices of consumer items—goods and services that people buy for day-to-day living. The CPI is a complex measure that combines economic theory with sampling and other statistical techniques and uses data from several surveys to produce a timely and precise measure of average price change for the consumption sector of the American economy. Production of the CPI requires the skills of many professionals, including economists, statisticians, computer scientists, data collectors and others. The CPI surveys rely on the voluntary cooperation of many people and establishments throughout the country who, without compulsion or compensation, supply data to the government's data collection staff.

Part I. Overview of the CPI

Three CPI series. The Bureau of Labor Statistics (BLS; the Bureau) publishes CPI data every month. The three main CPI series are

- CPI for All Urban Consumers (CPI-U)
- CPI for Urban Wage Earners and Clerical Workers (CPI-W)
- Chained CPI for All Urban Consumers (C-CPI-U)

The *CPI for All Urban Consumers, or CPI-U*, which BLS began publishing in January 1978, represents the buying habits of the residents of urban or metropolitan areas in the United States. *The CPI for Urban Wage Earners and Clerical Workers,* or *CPI-W,* the oldest of the series, covers a subset of the urban population.[1] The prices used for producing these two series are the same. The CPI-U and CPI-W differ only in

[1]Specifically, the CPI-U (all-urban) population consists of all urban households in Metropolitan Statistical Areas (MSAs) and in urban places of 2,500 inhabitants or more. Nonfarm consumers living in rural areas within MSAs are included, but the index excludes rural nonmetropolitan consumers and the military and the institutional population. The urban wage earner and clerical worker (CPI-W) population consists of consumer units with clerical workers, sales workers, protective and other service workers, laborers, or construction workers. More than one-half of the consumer unit's income has to be earned from these occupations, and at least one of the members must be employed for 37 weeks or more in an eligible occupation.

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the consumer spending weights used to combine, or average together, basic indexes.[2]

The *Chained CPI for All Urban Consumers (or C-CPI-U)*, also represents the urban population as a whole. BLS began publishing this series in August 2002 with data beginning in January 2000. The prices used in the C-CPI-U are the same as those used to produce the CPI-U and CPI-W, but the C-CPI-U uses a different formula and different weights to combine basic indexes. The formula used in the C-CPI-U accounts for consumers' ability to achieve the same standard of living from alternative sets of consumer goods and services. This formula requires consumer spending data that are not immediately available. Consequently, the C-CPI-U, unlike the other two series, is published first in preliminary form and is subject to scheduled revisions.

CPI populations. A consumer price index measures the price-change experience of a particular group called its *target population*. The CPI uses two target populations for its main series:

- All Urban Consumers (the "CPI-U" population)
- Urban Wage Earners and Clerical Workers (the "CPI-W" population)

Both the CPI-U and the C-CPI-U target the CPI-U population. The CPI-U population, which covers about 88 percent of the U.S. population, covers households in all areas of the United States except people living in rural nonmetropolitan areas, in farm households, on military installations, in religious communities, and in institutions such as prisons and mental hospitals.

The CPI-W population, the target of the CPI-W, is a subset of the CPI-U population. The CPI-W population consists of all CPI-U population households for whom 50 percent or more of household income comes from wages and clerical workers' earnings. The CPI-W's share of the total U.S. population has diminished over the years; the CPI-W population is now about 28 percent of the total U.S. population. The CPI-W population excludes households of professional and salaried workers, part-time workers, the self-employed, and the unemployed, along with households with no one in the labor force, such as those of retirees.

CPI concepts and scope

The CPI provides an estimate of the price change between any two periods. The CPI follows the prices of a sample of items in various categories of consumer spending—such as food, clothing, shelter, and medical services—that people buy for day-to-day living. The monthly movement in the CPI derives from weighted averages of the price changes of the items in its sample. A sample item's price change is the ratio of its price at the current time to its price in a previous time. A sample item's weight in this average is the share of total consumer spending that it represents. The algebraic formulas used for this averaging are called *index number formulas*.[3]

A unifying framework for dealing with practical questions that arise in the construction of the CPI is provided by the concept of the cost-of-living index (COLI)[4]. As it pertains to the CPI, the COLI for the current month is based on the answer to the following question: *"What is the cost, at this month's market prices, of achieving the standard of living actually attained in the base period?"* This cost is a hypothetical expenditure—the lowest expenditure level necessary at this month's prices to achieve the base-period's living standard. The ratio of this hypothetical cost to the actual cost of the base-period consumption basket in the base period is the COLI. Unfortunately, because the cost of achieving a living standard cannot be observed directly, in operational terms a COLI can only be approximated. Although the CPI cannot be said to equal a cost-of-living index, the concept of the COLI provides the CPI's measurement objective and is the standard by which we define any bias in the CPI. BLS long has said that it operates within a cost-of-living framework in producing the CPI.[5] That framework has guided, and will continue to guide, operational decisions about the construction of the index.

Because the COLI is not directly observable, the CPI employs index number formulas that offer approximations to the measurement objective. The CPI-U and the CPI-W use a Laspeyres formula to average the price changes *across* categories of items. It is sometimes said that the Laspeyres formula provides an "upper bound" on the COLI index. The C-CPI-U uses a Törnqvist formula to average price changes across item categories. This formula belongs to a class of formulas called superlative because, under certain assumptions, they can provide close approximations to a COLI. Since 1999, the CPI program has used the geometric mean formula to average price change *within* most item categories. Under certain assumptions that are likely to be true within most categories, an index based on the geometric mean formula will be closer to a COLI than will a Laspeyres index.

[2] Until 1982, BLS maintained separate (but overlapping) samples of outlets and specific items for the CPI-U and CPI-W populations. Given little variance in the movements between the CPI-U and CPI-W, BLS dropped the separate samples for the CPI-W population. The CPI-U converted to rental equivalence effective with the indexes for January 1983; the CPI-W moved to rental equivalence 2 years later. Since January 1985, the movements of all CPI-W basic indexes have been identical to those of the CPI-U.

[3] For a review of index number formulas, their properties, and their relationship to economic theory, see W. E. Diewert, "Index numbers," in J. Eatwell, M. Malgate, and P. Newman eds., *The new Palgrave: a dictionary of economics*, vol. 2 (London: The MacMillan Press, 1987), pp. 767–780.

[4] For more information on the cost-of-living index concept, see the technical references at the end of this chapter.

[5] On the use of a cost-of-living index as a conceptual framework for practical decision making in putting together a price index, see Robert Gillingham, "A conceptual framework for the revised Consumer Price Index." *Proceedings of the American Statistical Association,* Business and Economic Statistics Section (Alexandria: VA, American Statistical Association, 1974), pp. 46–52.

Scope

The cost of maintaining a standard of living is affected by phenomena that go beyond the traditional domain of a consumer price index—changes in the cost of consumer goods and services. The broadest form of a COLI, which is called an *unconditional* COLI, would reflect changes in non-price factors such as crime rates, weather conditions, and health status. The objective of the CPI, by contrast, is to provide an approximation to a *conditional* COLI that includes only the prices of market goods and services or government-provided goods for which explicit user charges are assessed. Free goods, characteristics of the environment (such as air and water quality), the value of leisure time, and items that governments provide at no cost are not in scope, although they undeniably can have an impact on the cost of living as broadly defined.

Excluded goods and services. The CPI covers the consumption sector of the U.S. economy. Consequently, it excludes investment items, such as stocks, bonds, real estate, and business expenses. Life insurance also is excluded for this reason, although health, household, and vehicle insurance are in scope. Employer provided in-kind benefits are viewed as part of income. Purchases of houses, antiques, and collectibles are viewed as investment expenditures and therefore excluded. Gambling losses, fines, cash gifts to individuals or charities, and child support and alimony payments also are out of scope. Changes in interest costs or interest rates are now excluded from the CPI scope, although some were in the CPI for many years. And, for practical reasons, the CPI excludes illegal goods and services and the value of home-produced items other than owners' equivalent rent.

Taxes. Both the CPI and the conditional COLI measure changes in expenditures—including the effect of changes in sales taxes and similar taxes that are part of the final price of consumer products—needed to achieve the base-period standard of living. Neither the CPI nor the COLI, however, measures the change in before-tax income required to maintain the base-period living standard. For this reason, neither the COLI nor the CPI is affected by changes in income and other direct taxes. For certain purposes, one might want to define price indexes that include, rather than exclude, income taxes.[6] The CPI does include the effects of changes in sales taxes and other indirect taxes. As previously noted, however, these are included as part of the price of consumer products. No attempt is made to reflect changes in the quantity or quality of government services paid for through taxes.

[6]One could develop an index along these lines. Such an index (sometimes called a *tax-and-price index*) would provide an answer to a different question (along the lines of "*At current prices, what is the least before-tax income needed to buy...*") from the one that is relevant to the CPI. It would be appropriate for different uses. For a research measure of a consumption index inclusive of income taxes and Social Security contributions, see Robert Gillingham and John Greenlees, "The impact of direct taxes on the cost of living." *Journal of Political Economy*, August 1987, pp. 775–796.

Government-provided and government-subsidized items. The CPI treats as price changes any changes to fees that the government charges for items, such as admission to a national park. The CPI also counts the price of subsidized items that are available to the general public. For example, governments may subsidize local transit operation. If the subsidy is cut and the fare is raised, the CPI will reflect this price increase. On the other hand, the CPI does not reflect changes to means-tested (dependent on the recipient's income) subsidies, such as the Supplemental Nutrition Assistance Program or Section 8 housing allowances. Changes in such subsidies are treated as changes to the recipient's income and, therefore, out of scope.

CPI structure and publication

Calculation of price indexes

In the CPI, the urban portion of the United States is divided into 38 geographic areas called index areas, and the set of all goods and services purchased by consumers is divided into 211 categories called item strata. This results in 8,018 (38 × 211) item–area combinations.

The CPI is calculated in two stages. The first stage is the calculation of basic indexes, which show the average price change of the items *within* each of the 8,018 CPI item–area combinations. For example, the electricity index for the Boston CPI area is a basic index. The weights for the first stage come from the sampling frame for the category in the area. At the second stage**,** aggregate indexes are produced by averaging *across* subsets of the 8,018 CPI item–area combinations. The aggregate indexes are the higher level indexes; for example, the all-items index for Boston is an average of all of the area's 211 basic indexes. Similarly, the aggregate index for electricity is an average of the basic indexes for electricity in each of the 38 index areas. The U.S. city average All-items CPI is an average of all basic indexes. The weights for the second stage are derived from reported expenditures from the Consumer Expenditure Survey (CE).

CPI publication

Indexes. Each month's index value displays the average change in the prices of consumer goods and services since a *base period*, which currently is 1982–84 for most indexes. For example, the CPI-U for July 2013 was 233.596. One interpretation of this is that a representative set of consumer items that cost $100 in 1982–84 would have cost $233.60 in July 2013.

Percent change. Rather than emphasizing the level of the index in comparison to the base period, the monthly CPI release stresses the CPI's percent change from the previous month and from the previous year. The most commonly reported monthly percent changes are the one-month *seasonally adjusted* percent change, and the 12-month not seasonally

adjusted percent change. For example, the July 2013 CPI was 233.596 and the July 2012 CPI was 229.104, so the CPI increased 2.0 percent (not seasonally adjusted) from July 2012 to July 2013.

CPI area indexes and CPI item indexes. BLS publishes a large number of additional CPI index series. (See appendix 1.) For the CPI-U population areas—the broadest geographic coverage—detailed item indexes for most categories of consumer spending are published every month. Also every month, BLS publishes all-items indexes, along with a limited set of detailed indexes, for the three largest metropolitan areas and for the major geographic areas. In addition, detailed food, energy, and shelter indexes are published monthly for all CPI publication areas. Bimonthly or semiannually, all-items indexes for selected metropolitan areas are published along with the limited set of detailed indexes.

The primary reason for publishing CPI area-item detail indexes is to aid in analysis of movements in the national all-items CPI. Decisions on which detailed indexes to publish depend, in part, on the reliability of their estimates[7]. CPI area indexes and CPI item detail indexes use only a portion of the CPI sample; this makes them subject to substantially greater sampling error than the national CPI. **For this reason, BLS strongly urges users to consider the U.S. city average all-items CPI for use in escalator clauses.**

CPI area indexes. BLS calculates and publishes separate area indexes for

- Four geographic regions (sometimes called *census regions*): Northeast, Midwest, South, and West
- Three population-size classes: large metropolitan areas, small metropolitan areas,[8] and nonmetropolitan urban places
- Selected region-size classes—regions cross-classified by population size (for example, large metropolitan areas in the Northeast)
- Selected metropolitan areas

Comparing the CPI for an area with the U.S. CPI or with the CPI for another area gives an indication of differences among the areas' rates of price change. In other words, such a comparison indicates whether, over time, prices of items that consumers in one area tend to buy have risen more or less rapidly than the prices of items that consumers in another area tend to buy. It *does not indicate* whether the average level of prices in an area is higher or lower than the average level in another area.

CPI item indexes. BLS classifies the CPI market basket of consumer goods and services into a hierarchy of categories. The top levels of the item category hierarchy consist of

- The eight major groups
- Other groups
- Expenditure classes
- Item strata

For the U.S. CPI, BLS publishes all levels down to item strata. BLS publishes less item detail for the CPI area indexes.

Special aggregations. BLS also calculates and publishes indexes for special aggregations, such as energy items, that cut across the preceding classification scheme. Some users consider the series *All items less food and energy* to measure the 'core' rate of inflation. Food and energy are two of the most volatile components of the CPI. For this reason, many analysts regard the measure of core inflation as more useful for their purposes.

The C-CPI-U. The Chained CPI-U uses a superlative index formula which reflects consumers' behavior in response to changes in relative prices. Unfortunately, this requires current expenditure data, and expenditure data become available only after a significant lag. Consequently, C-CPI-U index values, unlike the values of the CPI-U and CPI-W, are not final when first published. Before 2015, BLS issued two annual preliminary estimates before issuing final C-CPI-U data.[9] Starting in 2015, BLS intends to issue four preliminary estimates of the C-CPI-U. The "initial" values will come out every month concurrent with the CPI-U and CPI-W. In each of the following four quarters, "interim" values will replace the initial values. One year later, the interim values will be replaced with the final C-CPI-U. For example, in February 2016, the BLS is scheduled to release the January 2016 CPI-U, the CPI-W, and the initial C-CPI-U. For the next three quarters (i.e., April, July, and October of 2016), BLS will publish updated interim C-CPI-U indexes. With the fourth revision in January 2017, the January 2016 C-CPI-U will be issued as final.

Seasonally adjusted indexes and percent changes. In addition to the originally computed indexes and percent changes, which are called *unadjusted indexes* and *unadjusted percent changes*, BLS calculates and publishes *seasonally adjusted* series. The unadjusted numbers reflect the change in price resulting from all causes, including normal seasonal price movement due to regular changes—resulting, for example, from weather, harvests, the school year, production cycles, model changeovers, holidays, or sales—that recur every year. For economic analysis and for other purposes, it is useful to

[7] Steven Grandits, "Publication strategy for the 1998 revised Consumer Price Index," *Monthly Labor Review*, December 1996, pp. 26–30, **http://stats.bls.gov/opub/mlr/1996/12/art4full.pdf**.

[8] Prior to January 1998, the CPI published data for medium and small metropolitan areas, which have been combined to form a single class.

[9] The first release of C-CPI-U data took place on Aug. 16, 2002. At that time, final data for the 12 months of 2000, interim data for the 12 months of 2001, and initial data for the first 7 months of 2002 were issued.

remove the estimated seasonal effects from the original indexes and percent changes. To produce the *seasonally adjusted indexes and percent changes*, BLS uses *seasonal adjustment techniques* that remove these effects. BLS seasonally adjusts only those CPI series that pass certain statistical criteria and for which there is an economic rationale for observed seasonality. For example, while the unadjusted CPI for All items was unchanged from June 2013 to July 2013, the seasonally adjusted 1-month percent change in the CPI was 0.2 percent. Seasonally adjusted indexes are subject to annual revision and therefore are not recommended for use in escalation contracts. Seasonal adjustment is done only at the national level for the U.S. city average CPI-U and CPI-W. Presently, the C-CPI-U does not have sufficient historical data to permit calculation of stable seasonal factors.

Average prices. For some food, beverage, and energy items, the CPI samples contain enough observations of unique items to make possible the computation and publication of meaningful average retail prices. A list of what is covered in the published average price series is shown in appendix 2.

Correction policy. The CPI, unlike many other statistical series, does not rely on respondents to transmit data to the national office. CPI data collectors collect almost all data needed for the CPI-U and CPI-W, so that routine revisions to account for late-arriving data are not necessary. Virtually all data are received in time for the calculation of indexes for the appropriate month. In rare cases, however, when we discover that we made an error collecting or compiling information, BLS issues corrections to the CPI series in accordance with BLS policy and CPI practices.

Corrections to the CPI-U and CPI-W. These series are final when issued. The CPI-U and CPI-W are commonly used in escalation agreements and to adjust pensions and tax brackets; consequently, revisions can be costly for the users of these indexes. For this reason, there is a presumption in BLS policy and practice against revisions to the CPI that extend back over lengthy periods. When a mistake is discovered, CPI staff evaluates the error in the context of BLS guidelines for issuing corrections to previously published CPI data.

Corrections to the C-CPI-U. As previously noted, C-CPI-U indexes are not final when first issued. They are routinely revised, and are not final until the publication of data for the second January after initial publication. If the CPI-U and CPI-W series are corrected, the C-CPI-U series will be corrected as well. Corrected C-CPI-U indexes will be issued for all series affected by the error, as far back as the previous 5 years.

How to interpret the CPI

Movements of the indexes from one month to another usually are expressed as percent changes rather than changes in index points. The level of the index (relative to its base period) affects index point changes, but it does not affect percent changes. The following tabulation shows how to compute percent changes:

Index point change

CPI	222.742
Less CPI for previous period	221.317
Equals index point change	1.425

Percent change

Index point difference	1.425
Divided by the previous index	222.742
Equals	0.006
Results multiplied by	0.006 × 100
Equals percent change	0.6

Percent changes for periods other than 1 year often are expressed as annualized percentages. Annualized percent changes indicate what the change would be if the CPI continued to change at the same rate each month over a 12-month period. These are calculated using the standard formula for compound growth:

$$\mathrm{PC}_{\mathrm{annual}} = \left[\left(\mathrm{IX}_{t+m} / \mathrm{IX}_t\right)^{12/m} - 1\right] \times 100 ,$$

where

IX_t is the index in month t,
IX_{t+m} is the index m months after month t, and
PCannual is the annualized percent change.

Uses of the CPI

The CPI affects virtually all Americans because of the many ways in which it is used. Its major uses are as follows:

- ***As an economic indicator***. As the most widely used measure of retail inflation, the CPI is a major indicator of the effectiveness of Government economic policy. The President, the Congress, and the Federal Reserve Board use the movement of the CPI to help formulate and monitor the effect of fiscal and monetary policies. Business executives, labor leaders, and other private citizens also use the index as a guide in making economic decisions.

- ***As a means of adjusting income payments***. The index directly affects the income of almost 80 million people. Social Security[10] benefits and military and Federal

[10] Specific information on the Social Security use of the CPI can be found on the Social Security Administration website, **http://www.socialsecurity."gov/cola/."**

Civil Service pension payments are all indexed by the CPI. In the private sector, many collective bargaining agreements tie automatic wage increases to the CPI. Some private firms and individuals use the index to keep rents, alimony, and child support payments in line with changing prices.

- ***As a means of preventing inflation-induced tax changes***. Federal (and some state) income tax brackets and other parameters are adjusted by the CPI. This prevents inflation from automatically increasing taxes, a phenomenon called *bracket creep.*

- ***As a deflator of other economic series***. Other statistical programs use the CPI or its components to adjust for price changes and produce inflation-free versions of their series. Examples of CPI-adjusted series include components of the U.S. Department of Commerce National Income and Product Accounts (such as gross domestic product and personal consumption expenditures) and retail sales measures and the BLS hourly and weekly earnings series.

Limitations of the index

The CPI covers a wide variety of items that all urban consumers purchase, but—because most individuals concentrate spending on a relatively small fraction of the total number of items available in the market—it contains items that a given individual does not purchase. The CPI must represent a composite consumer, and it does not necessarily represent the price-change experience of any one individual, household, or family. Similarly, the CPI may not be applicable to all questions about price movements for all population groups.

As previously noted, CPI indexes cannot be used to determine relative living costs. The CPIs for various geographic areas of the United States do not indicate the differences in price level among them. The change in the CPI for an individual area measures the degree to which prices have changed over time within that particular area. It does not show whether prices or living costs are higher or lower in that area relative to another area or to the United States as a whole. Comparing indexes between one area and another indicates which area has experienced more rapid price change—not which area has a higher price level or higher living costs.

Sampling and non-sampling error. The CPI is estimated from a sample of consumer purchases; it is not a complete measure of price change. Consequently, the index results may deviate slightly from those that would be obtained if all consumer transactions were covered. This is called *sampling error*. These estimating or sampling errors are statistical limitations of the index.

A different kind of error in the CPI can occur when, for example, a respondent provides BLS economic assistants with inaccurate or incomplete information. This is called *nonsampling error*. BLS attempts to minimize these errors by obtaining prices through personal observation whenever possible, and by correcting errors immediately upon discovery. The economic assistants, technicians, and commodity specialists who collect, process, and analyze the data are trained to watch for deviations in reported prices that might be due to errors.

A full discussion of the varieties and sources of possible error in the index is presented in part III of this chapter, "Precision of CPI Estimates."

Experimental indexes

Population subgroups. The CPI also calculates and publishes some indexes on an experimental basis only. For example, the program provides experimental indexes for the elderly. Comparing indexes for such subgroups does not indicate whether the prices they pay are higher or lower than the prices other groups pay; this comparison indicates only whether prices of their items have risen faster or slower than those for other groups. Indexes for subgroups of the population are more difficult to construct than indexes for the whole. In particular, making sure that samples refer to only part of the population may be difficult or impractical. Moreover, making subgroup indexes as precise as the national CPI would require that the sample sizes be as large.

The experimental CPI for Americans 62 Years of age and older (CPI-E). BLS occasionally issues a report on its experimental index for the elderly. This index, sometimes referred to as the CPI for the elderly or *CPI-E*, is calculated monthly and is available on request. It should be emphasized that the CPI-E is merely a reweighting of the CPI basic indexes using expenditure weights from households headed by someone 62 years of age or older. There is no attempt to recalculate the basic indexes themselves so that they represent the retail outlets and consumption items of older consumers.[11]

CPI research series. Over the years, BLS has made many improvements to the CPI. When BLS changes its methods, it always announces them in advance and, if possible, estimates the impact the change would have had in recent periods. BLS does not, however, revise previously published CPI data to reflect the new methods. This practice means that the movement of the CPI reflects not only price change over time but also changes to CPI methods. To assist users who wish to use the CPI over long periods, BLS publishes the CPI-U Research Series Using Current Methods (CPI-U-RS). It provides estimates, for the period since 1977, of what the CPI would have been had the most current methods been in effect. Each time there are new methods introduced into the CPI, the CPI-U-RS is revised from 1978 forward.[12]

[11] For more information, see *Consumer Price Index Detailed Report* (U.S. Bureau of Labor Statistics, February 2000), pp. 5–7..

[12] Kenneth J. Stewart and Stephen B. Reed, "CPI research series using current methods, 1978–98," *Monthly Labor Review*, June 1999, pp. 29–38.

History of the CPI, 1919 to 2002

The CPI was initiated during World War I, when rapid increases in prices, particularly in shipbuilding centers, made such an index essential for calculating cost-of-living adjustments in wages. To provide appropriate weighting patterns for the index, so that it would reflect the relative importance of goods and services purchased by consumers, studies of family expenditures were conducted in 92 industrial centers in 1917–1919. Periodic collection of prices was started and, in 1919, BLS began publication of separate indexes for 32 cities. Regular publication of a national index, the U.S. city average, began in 1921, and indexes were estimated back to 1913.[13]

Since its inception, the CPI has been comprehensively revised on several occasions to implement updated samples and weights, expanded coverage, and enhanced methodologies. For example, the 1998 revision introduced more timely consumer spending weights; updated geographic and housing samples; a revised item classification structure; a new housing index estimation system; computer-assisted price collection; and a new Telephone Point-of-Purchase Survey (TPOPS). BLS also has made important improvements to the CPI beyond the major revision processes, an example being the introduction of the geometric mean formula in January 1999. Exhibit 1 provides a chronology of revisions and improvements to the CPI, and appendix 3 displays historical changes in base period, population coverage, and other index characteristics.

The improvements introduced over the years have reflected not only the Bureau's own experience and research, but also the criticisms and investigations of outsiders. For example, in undertaking the 1940 comprehensive revision of the CPI, BLS acted on recommendations made by an Advisory Committee appointed by the American Statistical Association. Major studies were conducted during World War II by the President's Committee on the Cost of Living[14] and in 1951 by the House Committee on Education and Labor.[15]

The 1961 report of the Price Statistics Review Committee (sometimes called the "Stigler Committee") provided impetus for subsequent changes in many aspects of the CPI, including the sampling of outlets and items, the treatment of quality changes in consumer durables, and the role of cost-of-living theory.[16] Recent studies include the 1996 report of the Advisory Commission to Study the Consumer Price Index (the "Boskin Commission")[17] and the 2002 report, *At what price? Conceptualizing and measuring cost-of-living and price indexes*, by a National Research Council panel of the National Academy of Sciences.[18] A continuing flow of articles in professional journals and books also has contributed to the assessment of the CPI's quality and of the ways in which it might be improved. For a list of published papers, see the Technical References at the end of this chapter.

[13] Collection of food prices back to 1890 had been initiated in 1903. During the course of the 1917–1919 expenditure survey, retail prices for other items were collected in 19 cities for December of each year back to 1914, and in 13 other cities back to December 1917 only. Retail prices of food and wholesale prices of other items were used to estimate price change from 1914 back to 1913.

[14] *Report of the president's committee on the cost of living* (Washington, Office of Economic Stabilization, 1945).

[15] C*onsumer Price Index, report of a special subcommittee of the committee on education and labor,* Subcommittee Report No. 2 (U.S. Congress, House of Representatives, 1951).

[16] *Government price statistics, hearing before the subcommittee on economic statistics,* U.S. Congress, 871. Part 1 (U.S. Congress Joint Economic Committee, January 24, 1961).

[17] *Final report of the advisory commission to study the Consumer Price Index* (The Boskin Commission Report) (U.S.Senate Committee on Finance, December 1996).

[18] Charles Schultze and Christopher Mackie, eds. *At what price? Conceptualizing and measuring cost-of-living and price indexes*. (Washington, DC: National Academy Press, 2002.

Exhibit 1. Chronology of changes in the Consumer Price Index

The Consumer Price Index to 1940

- Began publication of separate indexes for 32 cities (1919):
  Collected prices in central cities periodically
- "Developed weights from a study that BLS conducted in 1917–1919 of family expenditures in 92 industrial centers, reflecting the relative importance of goods and services purchased by consumers"
  Reflected the relative importance of goods and services purchased by consumers
- Collected prices for major groups: Food, clothing, rent, fuels, house furnishings, and miscellaneous
- Limited pricing to items selected in advance to represent their categories
- Began regular publication of a national index, the U.S. city average (1921):
  Based index on an unweighted average of the city indexes
  Estimated U.S. city average back to 1913, using food prices only

The 1940 CPI revision: the first comprehensive revision

- Used weights based on 1934–1936 study of consumer expenditures
- Collected prices in the 34 largest cities

Implemented a weighted average of cities for the U.S. city average CPI

Improvements made between the 1940 and 1953 revisions

- During World War II:
  Discontinued the pricing of unavailable items, such as new cars and household appliances

Increased the weight of other items, including automobile repair and public transportation in 1951:

Adjusted weights in seven cities, using a 1947 and 1949 survey of consumer expenditures
Adjusted weights for the 1950 Census
Adjusted rent index to remove "new unit bias" caused by rent control
Added new items to the list of covered items, including frozen foods and televisions

The 1953 CPI revision: the second comprehensive revision

- Used weights from a 1950 expenditure survey conducted in central cities and attached urbanized areas
- Refined the target population to include urban wage earner and clerical worker families
- Added a sample of medium and small cities
- Updated the list of items that the index covered, adding restaurant meals
- Added new sources of price data
- Improved pricing and calculation methods

The 1964 CPI revision: the third comprehensive revision

- Based weights on 1960–1961 expenditure patterns in metropolitan areas
- Added single-person households to target population: urban wage earner and clerical worker households
- Extended pricing to the suburbs of sampled metropolitan areas
- Updated the sample of cities, goods and services, and retail stores and service establishments

Improvements made between the 1964 and 1978 revisions

- Made quality adjustments for new vehicles at model changeover
- Improved treatment of seasonal items

The 1978 CPI revision: the fourth comprehensive revision

- Added a new Consumer Price Index: the CPI for All Urban Consumers, or the CPI-U

Exhibit 1. Chronology of changes in the Consumer Price Index—continued

- Renamed the older CPI [as] the CPI for Urban Wage Earners and Clerical Workers, or the CPI-W
- Used weights from a 1972–1973 survey of consumer expenditures and the 1970 census
- Expanded the sample to 85 areas
- Increased minimum pricing frequency from quarterly to bimonthly
- Implemented monthly pricing in five largest areas
- Introduced probability sampling methods at all stages of CPI sampling
- Introduced checklists that define each category of spending
- Developed estimates of the CPI's sampling error and optimal sample allocation to minimize that error

Improvements made between the 1978 and 1987 revisions

- Began systematic replacement of outlets and their item samples between major revisions (1981):
  - Implemented new Point-of-Purchase Survey (POPS)
  - Selected retail outlets with probability proportional to consumer spending therein
  - Eliminated reliance on outdated secondary-source sampling frames
  - Began rotating outlet and item samples every 5 years
  - Began rotating one-fifth of the CPI pricing areas each year
- Introduced rental equivalence concept (January 1983 for the CPI-U; January 1985 for the CPI-W)

The 1987 CPI revision: the fifth comprehensive revision

- Used weights from the 1982–1984 Consumer Expenditure Survey and the 1980 Census
- Updated samples of items, outlets, and areas
- Redesigned the CPI housing survey
- Improved sampling, data collection, data-processing, and statistical estimation methods
- Initiated more efficient sample design and sample allocation
- Introduced techniques to make CPI production and calculation more efficient

Improvements made between the 1987 and 1998 revisions

- Improved housing estimator to account for the aging of the sample housing units
- Improved the handling of new models of vehicles and other goods
- Implemented new sample procedures to prevent overweighting items whose prices are likely to rise
- Improved seasonal adjustment methods
- Initiated a single hospital services item stratum with a treatment-oriented item definition
- Discontinued pricing of the inputs to hospital services

The 1998 CPI revision: the sixth comprehensive revision

- Weights from the 1993–1995 Consumer Expenditure Survey and the 1990 census
- Updated geographic and housing samples
- Extensively revised item classification system
- Implemented new housing index estimation system
- Used computer-assisted data collection
- Added the Telephone Point-of-Purchase Survey (TPOPS):
  - Allows rotation of outlet and item samples by item category and geographic area, rather than by area alone

Improvements since the 1998 Revision

- Initiated a new housing survey based on the 1990 census (January 1999):
  - Estimated price change for owners' equivalent rent directly from rents
  - Began using a geometric mean formula for most basic indexes (January 1999):
  - Mitigates lower level substitution bias

Exhibit 1. Chronology of changes in the Consumer Price Index—continued

- Reflects shifts in consumer spending with item categories as relative price change
- Extended the use of hedonic regression to estimate the value of items changing in quality
- Directed replacement of sample items in the personal computer and other categories, to keep samples current
- Implemented 4-year outlet rotation to replace 5-year scheme
- Began within-outlet item rotation for prescription drugs and other item categories
- Implemented biennial weight updates starting January 2002
- Increased sample size of the Consumer Expenditure Survey, so that CPI weights could be based on just 2 years of data

Added the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) (August 2002)

- Uses more advanced "superlative" index formula (the Törnqvist formula)
- Corrects upper-level substitution bias
- Expanded collection of price data to all business days of the month (Before 2004, prices were collected the first 18 business days of the month for the first 10 months of the year and the first 15 business days for November and December.)
- Began publishing indexes to three decimal places (January 2007)

Part II. Construction of the CPI

Sampling: areas, items, and outlets

The smallest geographic areas in which pricing is done for the CPI are called primary sampling units (PSUs). Within these areas, sales outlets are chosen where people shop and live. The selected nonshelter outlets are matched to a sample of items that these consumers buy. Appendix 4 lists the 87 PSUs selected for the 1998 revision and the counties contained therein. Prices from these were introduced into CPI index calculation with the release of the January 1998 index.

Area sample

For the purpose of selecting the 1998 CPI PSU sample,[19] the entire United States was divided into PSUs. First, BLS used the U.S. Office of Management and Budget (OMB) definition of Metropolitan Areas (MAs)[20] to divide the country into metropolitan and nonmetropolitan areas. The PSUs within the metropolitan area are, with five exceptions, always OMB-defined MAs.[21] In the nonmetropolitan areas, BLS defined the PSU boundaries. In general, a PSU is delineated by county borders (with some exceptions in New England) and can comprise several counties.

Each PSU was first classified by its size. All PSUs with populations larger than 1.5 million were declared to be self-representing and given the size type of A.[22] The remaining non-self-representing PSUs, metropolitan and nonmetropolitan, are called B and C PSUs, respectively.[23] (To avoid confusion, it is important to recognize the distinction between the naming conventions for PSUs and those for CPI size-class indexes. In general, prices collected in B PSUs are used to compute the B/C CPI indexes, and prices in C PSUs are used in the computation of the D CPI indexes. The exceptions are the Anchorage and Honolulu metropolitan areas, which are A PSUs but included in the B/C size class indexes.)

The second classification variable for PSUs is census region. The next phase of the area selection was to stratify (group) PSUs in each region-size class; for example, South B into strata (groups) of similar PSUs based on their scores on several factors (called stratifying variables). Each A PSU is in a stratum by itself, thus, the name "self-representing." Selection of the stratifying variables was based on linear regression modeling of price change (sequentially finding sums of a constant and a constant times each of a subset of 1990 census and geographic PSU variables that best explain CPI price change over different periods). The variables (called geographic variables) used in all stratifications except that for the South B PSUs were percent urban, the normalized latitude and longitude of the PSU's geographic center, and normalized longitude squared. In the stratification of the South B PSUs, percent urban and variables used in the 1987 Revision—namely, mean interest and dividend income per consumer unit (CU), mean CU wage and salary income, percent housing units (HUs) heated by electricity, percent HUs heated by fuel oil, percent owner-occupied HUs; percent black CUs, and percent CUs with retired person—were used. The program employed to do the stratifications was a modified version of the Friedman-Rubin clustering algorithm, which puts PSUs in the same stratum based on their similarities on the stratification variables, while keeping the population sizes of the strata approximately equal.

A program was used to select one PSU per stratum so that the selected PSUs were well-distributed over the States and there were many 1988-sample PSUs among the newly selected ones.[24] Prices from the 36 newly-selected non-1988-sample PSUs were introduced into CPI index calculations in 1998.

Since 1998, indexes have been published monthly for the New York, Los Angeles and Chicago Consolidated Metropolitan Statistical Areas (CMSAs). Indexes for the Washington-Baltimore CMSA, along with the next 10 largest A

[19] A more detailed description of the 1998 revision area sample selection is contained in Janet Williams, Eugene F. Brown, and Gary R. Zion, "The challenge of redesigning the Consumer Price Index sample," *Proceedings of the Survey Research Methods Section*, American Statistical Association, Business and Economic Statistics Section (Alexandria, VA: American Statistical Association, 1993), pp. 200–205; and Janet L. Williams, "The redesign of the CPI geographic sample." *Monthly Labor Review*, December 1996, pp. 10–17, **http://www.bls.gov/opub/mlr/1996/12/art2full.pdf**.

[20] MAs are Metropolitan Statistical Areas (MSAs), Primary Metropolitan Statistical Areas (PMSAs), or Consolidated Metropolitan Statistical Areas (CMSAs). For more information, see the Statistical Policy Office of the U.S. Office of Management and Budget, Attachments to OMB Bulletin No. 93-05, *Metropolitan areas 1992*, Lists I–IV..

[21] The five PSU exceptions are the Los Angeles suburbs PSU, the three PSUs that together form the New York–Northern New Jersey–Long Island CMSA, and the Washington, DC, PSU.

[22] Anchorage and Honolulu are A PSUs with smaller populations.

[23] When planning began for the 1998 revision of the CPI, one potential change envisioned was the publication of a Consumer Price Index for the total U.S.population (called the CPI-T). To accommodate this expanded CPI, a larger number of PSUs was selected to cover the population living in rural areas outside the metropolitan area.

[24] In case the CPI-T was judged too costly, a selection was made from nonmetropolitan PSUs that would have their urban parts included in the CPI-U. Candidate PSUs had to contain some urban population. From these candidates, a probability (proportional to the urban population of their stratum) sample for the CPI-U was selected in each region except the Northeast. Long after the selection of the PSUs, a decision was made not to publish a CPI-T because of its increased cost. At that time, 18 of the previously selected PSUs were dropped from the CPI sample and its increased cost. At that time, 18 of the previously selected PSUs were dropped from the CPI sample and designated as "Consumer Expenditure Survey only" PSUs.

PSUs (not including those contained in the aforementioned CMSAs), are published bimonthly. Beginning in January and July, semiannual indexes are published for the 12 smallest A PSUs. Indexes are also published for the U.S. total as well as for region and size class totals, with the exception of the D indexes in the Northeast and West. Beginning in 2002, semiannual indexes have been published for Phoenix.

Replicates, which are used in variance calculation, are assigned to each A PSU based on population, with each A PSU having either two or four replicates. B and C PSUs are paired in each region, with each pair containing a PSU on the even and odd monthly pricing cycles, except for single PSU pairs in the region-size classes in which the number of PSUs is not a multiple of 4. Publication of a region-size class requires at least four PSUs (two replicates). The actual allocation of replicates is provided in the next section, along with the allocation of replicate panels.[25]

Item and outlet samples

Commodities and services other than shelter

Item structure and sampling. The CPI item structure has four levels of classification. The eight major groups are made up of 70 expenditure classes (ECs), which in turn are divided into 211 item strata. Major groups and ECs do not figure directly in CPI sample selection, although ECs are used in smoothing item stratum expenditure estimates during composite estimation. Within each item stratum, one or more substrata, called entry-level items (ELIs), are defined. ELIs are the ultimate sampling units for items as selected by the BLS national office. They represent the level of item definition from which data collectors begin item sampling within each sample outlet. (See appendix 5 for a complete list of consumer ECs, item strata, and ELIs.)

To enable the CPI to reflect changes in the marketplace, new item and outlet samples are selected each year, on a rotating basis, for approximately 25 percent of the item strata in each PSU. Each year, four regional item universes are tabulated from the two most recent years of CE data. Independent samples of ELIs are selected from the corresponding regional item universe for each item stratum PSU-replicate scheduled for rotation that year. Within each sample PSU-replicate, each item sample is based on a systematic probability-proportional-to-size (PPS) sampling procedure, in which each ELI has a probability of selection proportional to the CPI-U population expenditures for the region for the ELI within its stratum.

Item and outlet sample design. The CPI uses two separate sample designs, one for rent and owners' equivalent rent, and one for all other commodities and services. The methodology used to determine the commodities and services item and outlet sample design is presented here in brief. The design for the rent and owners' equivalent rent indexes is described later.

[25] For the A PSUs, the number of replicate panels (or groups) is the same as the number of replicates. Each non-self-representing PSU is allocated one replicate panel.

The primary objective of the Commodities and Services (C&S) sample design is to determine an allocation of individual item and outlet selections, by item stratum and by PSU, replicate, and POPS category (see list that follows), that minimizes the sampling variance of price change measured by the all-cities C&S CPI, subject to certain budgetary and sample size constraints. Models are used to project the sampling variance and data collection costs in terms of the decision variables for the sample design. For these models, all commodities and services item strata are grouped into 13 major groups:

- Food at home—non meat staples
- Food at home—meat, poultry, fish
- Food at home—fruits and vegetables
- Other food at home, plus beverages (alcoholic and nonalcoholic)
- Food away from home
- Fuels and utilities
- Household furnishings and operations
- Apparel
- Transportation less motor fuel
- Motor fuel
- Medical care
- Education and communication
- Recreation and other commodities and services

In brief, the C&S sample allocation methodology is as follows: First, a variance function that projects the variance of price change as a function of the preceding variables for the commodity and service components is modeled. Second, a cost function that predicts the total annual cost of the commodity and service components of the CPI is modeled. Third, values for all coefficients of the two functions, including estimates of outlet sample overlap, are estimated. Fourth, nonlinear programming techniques are used to determine approximately optimal sizes for the item and outlet samples needed to minimize the CPI variance under varying assumptions of annual price change subject to cost constraints.

The variance and cost functions for the CPI are modeled for 15 PSU groups:

PSU group name

- New York City
- New York City suburbs
- Los Angeles City
- Los Angeles suburbs
- Chicago
- Philadelphia and San Francisco
- Detroit and Boston
- Other large self-representing PSUs
- Small self-representing PSUs
- Medium-sized PSUs, Census Region 1
- Medium-sized PSUs, Census Region 2
- Medium-sized PSUs, Census Region 3
- Medium-sized PSUs, Census Region 4
- Small PSUs, Census Regions 1–4
- Anchorage and Honolulu

A detailed discussion of the sample allocation methodology is provided in appendix 6. The allocation is resolved with each C&S sample rotation, which occurs twice each year, and allocations change as sample frames are refreshed and rotated. For ongoing pricing, about 27,000 outlets are visited each month, with prices collected for about 83,400 commodities and services.

Outlet and price surveys. BLS economic assistants collect prices monthly for food at home, energy, and selected other commodity and service item strata in all PSUs. Items that are priced monthly typically are those with more volatile and variable price movement. Commodities and services priced monthly in all PSUs is given in exhibit 2. Prices also are collected monthly for all commodity and service item strata in the three largest publication areas: New York, Los Angeles, and Chicago. Prices are collected bimonthly in the remaining PSUs for the C&S item strata not cited in the list. Those are assigned to either even- or odd-numbered months for pricing.

Exhibit 2. Consumer Price Index (CPI) items priced monthly everywhere

- All food at home items
- Housing at school, excluding board
- Other lodging away from home, including hotels and motels
- Tenants' and household insurance
- Fuel oil
- Propane, kerosene, and firewood
- Electricity
- Utility (piped) gas service
- Used cars and trucks
- Gasoline (all types)
- Other motor fuels
- Tires
- Vehicle accessories other than tires
- State and local registration, license, and motor vehicle property tax
- Parking and tolls
- Newspapers and magazines
- Recreational books
- Postage
- Delivery services
- Land line telephone services
- Wireless telephone services
- Cigarettes
- Tobacco products other than cigarettes

Telephone Point-of-Purchase Survey (TPOPS). The U.S. Census Bureau conducts the TPOPS for BLS. The survey furnishes data on retail outlets from which metropolitan and urban nonmetropolitan households purchased defined groups of commodities and services to be priced in the CPI. Commodities and services are grouped into sampling categories, called POPS categories. (See appendix 7.) These categories are based on ELIs as defined in the CPI classification structure. Some POPS categories consist of only one ELI, while others consist of multiple ELIs. ELIs are combined into a single POPS category when the commodities or services generally are sold in the same outlets.

TPOPS uses random-digit dialing to select households for participation in the survey. Within each PSU, banks of landline telephone and cell phone numbers containing at least some residential phone numbers are identified. Among these identified banks, numbers are then randomly dialed. Inevitably, some of the dialed numbers such as nonworking, ring-no-answer, business, and FAX machine telephone numbers are ineligible for TPOPS interviewing. Some numbers belong to ineligible households, such as military households.

Eligible respondents include all civilian, noninstitutional persons residing in regular residences, boarding houses, student or worker housing, mobile home parks, and permanent-type living quarters in hotels and motels, as well as staff residing in institutions. Not all of the eligible telephone numbers are productive, however, as respondent refusals are unavoidable.

BLS specifies a target number of completed TPOPS interviews for each PSU. In the small and medium-sized PSUs, that target number is 110 completed interviews. For most of the self-representing PSUs, the target number of completed interviews ranges from 200 to 400. In New York City and Chicago, the target number of completed interviews is 460. In Los Angeles, the specified goal is 500.

Upon first contact and after determining the eligibility and willingness of the household, a Census Bureau interviewer asks a variety of administrative and demographic questions. This information allows BLS to monitor how well the selected households represent the overall population, as well as to analyze the shopping patterns of various segments of the population.

Any given responsive household is called once a quarter for four successive quarters. Each time, the interviewer administers the survey to the original respondent, if possible. During each interview, the respondent is asked whether the household had expenditures for a set of POPS categories over a duration of time called a "recall period." Recall periods are POPS-category-specific and vary from 1 week to 5 years. The recall period for a specific POPS category is defined to produce a sufficient, but not excessive, number of outlets for sampling purposes. For instance, because households tend to purchase gasoline frequently, a 1-week recall period is used. In contrast, people tend to purchase cars and funeral services infrequently; therefore a 5-year recall period is assigned. If the respondent reports expenditures for a particular POPS category, the interviewer prompts the respondent for the outlet name, location, and amount spent. At the end of each quarter of interviewing, the Census Bureau sends the TPOPS outlet frame data to BLS for processing. BLS

processes TPOPS data two quarters at a time. The primary objective of BLS processing of TPOPS data is to select a sample of outlets at which specific items ultimately will be priced for inclusion in the CPI. The expenditure amounts reported in TPOPS are used as outlet selection probabilities.

TPOPS employs a quarterly rotating-panel sample design. On a quarterly basis, every PSU is assigned 1 of 16 TPOPS questionnaires. Each questionnaire consists of up to 16 POPS categories. In a particular quarter and for a particular PSU, the selected TPOPS respondents are asked about expenditures made for some or all of the POPS categories on the assigned questionnaire. During each subsequent quarter of TPOPS interviewing, the given PSU is administered a different questionnaire until each of the 16 questionnaires has been administered. It takes 4 years of quarterly interviewing to rotate through all 16 questionnaires. After the 4 years, the cycle for the PSU starts over again. In this manner, all TPOPS samples are refreshed once every 4 years. This practice is repeated for each PSU. The quarterly pattern of assigned POPS categories varies from PSU to PSU in a strategic fashion to ensure that every POPS group is assigned to at least a few PSUs every quarter.

Outlet sampling procedures. The design for TPOPS provides for the rotation of approximately one-quarter of the items in each sample PSU during the course of each year. With each rotation, item samples and outlet samples are selected for the designated items and corresponding POPS categories.

In self-representing PSUs, sample households for each TPOPS rotation are divided into two or more independent groups. This process defines two or more frames of outlets per category-PSU for outlet selection. The principal purpose of constructing these independent groups, or replicate panels, is for variance estimation. A single subset of independently selected ELIs and outlets for all item strata within a PSU is called a replicate. The number of replicates per PSU group and the number of PSUs in each PSU group are given in table 1.

Reported expenditures for each outlet within the frame for each POPS category and PSU-replicate are edited prior to sample selection. Sometimes, a purchase is reported for an outlet but the amount of expenditures is not reported; to ensure a chance of selection for the outlet in those cases, the mean expenditure for outlets for the POPS category-PSU-replicate is assigned to the outlet. Large expenditure totals for an outlet are edited, in some cases, to be no greater than 25 percent of the total expenditure reported for the POPS category-PSU-replicate. In cases in which there are more than 20 outlets reported for a POPS category-PSU-replicate, the largest reported expenditures are trimmed to be no greater than 10 percent of the total reported for that POPS category-PSU-replicate.

Table 1. Construction of replicate panels

PSU group	Number of PSUs	Number of replicate panels
1. New York City	1	4
2. New York City suburbs	2	4
3. Los Angeles City	1	4
4. Los Angeles suburbs	1	2
5. Chicago	1	4
6. Philadelphia and San Francisco	2	4 (2 each)
7. Detroit and Boston	2	4 (2 each)
8. Other large self-representing PSUs	7	14 (2 each)
9. Small self-representing PSUs	12	24 (2 each)
10. Medium-sized PSUs, Census Region 1	8	8
11. Medium-sized PSUs, Census Region 2	10	10
12. Medium-sized PSUs, Census Region 3	22	22
13. Medium-sized PSUs, Census Region 4	6	6
14. Small PSUs, Census Regions 1–4	10	10
15. Anchorage and Honolulu	2	4 (2 each)

Source: U.S. Bureau of Labor Statistics.

Outlet samples are selected independently for each PSU, replicate, and POPS category using a systematic PPS sampling procedure. Each outlet in a frame has a probability of selection proportional to the total expenditures reported for the outlet in the POPS category in the TPOPS survey. In each PSU-replicate, all ELIs selected in the item sampling process are assigned for pricing to each sample outlet selected from the frame for the corresponding POPS categories. When multiple selections of a sample outlet occur, a commensurate increase is made in the number of quotes priced for the outlet.

Outlet sampling procedures for commodities and services not included in the TPOPS. Some commodity and service items are excluded from the TPOPS, either because existing sampling frames are adequate or because it became apparent that the TPOPS would not yield an adequate sampling frame. (See appendix 8.) For each of these items (non-POPS), BLS either constructs the sampling frame or acquires it from another source. Each non-POPS item has its own sample design. The frames consist of all outlets providing the commodity or service in each sample area. A measure of size is associated with each outlet on the sampling frame. Ideally, this measure is the amount of revenue generated by the outlet from the item for the CPI-U population in the sample area. Whenever revenue is not available, an alternative measure of size, such as employment, number of customers, or sales volume, is substituted. All samples are selected using systematic sampling techniques with probability proportional to the measure of size.

The source of the sampling frame, the definition of the sampling unit, the measure of size employed, and the final pricing unit for each non-POPS item are presented in appendix 8.

Merging item and outlet samples. Item and outlet samples, which are selected independently, must be merged before data collection. A concordance that maps ELIs to POPS categories allows each sampled ELI to be assigned for price collection to the outlet sample selected for the POPS category that contains it. The number of price quotes for an ELI in each outlet thus equals the number of times the ELI was selected for pricing in the PSU- replicate during the item sampling process. The item-outlet sample merge determines the number of price quotes assigned for collection in each sample outlet. In the outlet sampling process, outlets with large expenditure reports may be selected more than once from the frame for a given POPS category. An outlet also may be selected from the frame for more than one POPS category. If an outlet is selected multiple times for a given POPS category, the same multiple of price quotes is assigned for collection for each sample ELI matching the category. If an outlet is selected for more than one POPS category, price quotes are assigned for collection for all ELIs selected in each category.

Selection procedures within outlets. A BLS economic assistant visits each selected outlet. For each ELI assigned to the outlet for price collection, the economic assistant uses a multistage probability selection technique to select a specific item from among all the items the outlet sells that fall within the ELI definition. The economic assistant first identifies all of the items included in the ELI definition and offered for sale by the outlet. When there are a large number of items in the ELI, the assistant groups them by common characteristics, such as brand, size, or type of packaging. With the assistance of the respondent for the outlet, the economic assistant assigns probabilities of selection to each group.

The probabilities of selection are proportional to the sales of the items included in each group. The economic assistant may use any of the following four procedures, listed in order of preference, for determining the proportion of sales:

- Obtaining the proportions directly from a respondent
- Ranking the groups by importance of sales as indicated by the respondent, and then obtaining the proportions directly or using assigned proportions
- Using shelf space to estimate the proportions, where applicable
- Using equal probability

After assigning probabilities of selection, the economic assistant uses a random-number table to select one group. The economic assistant then identifies all items included in the selected group, forms groups of those items based on the in-common characteristics, assigns probabilities to each group, and uses a random number table to select one. The economic assistant repeats this process through successive stages until reaching a unique item. The economic assistant describes the selected unique item on a checklist for the ELI. Checklists contain the descriptive characteristics necessary to identify the item among all items defined within the ELI.

These selection procedures ensure that there is an objective and efficient probability sampling of CPI items other than shelter. They also allow broad definitions of ELIs, so that the same unique item need not be priced everywhere. The wide variety of specific items greatly reduces the within-item component of variance, reduces the correlation of price movement between areas, and allows a substantial reduction in the number of quotes required to achieve a given variance. Another important benefit from the broader ELIs is a significantly higher likelihood of finding a priceable item within the definition of the ELI in the sample outlet.

This selection process is completed during the visit to the outlet to obtain the price for the selected item. Subsequently, personal visits or telephone calls are made, either monthly or bimonthly, to ascertain that the item is still sold and to obtain its current price.

Computer-assisted data collection for commodities and services. A computer-assisted data collection (CADC) system has been used in the C&S survey since September 2002. The data collection instrument is composed of two main modules. The interactive electronic checklists of item specifications allow the data collector to identify the same item upon returning to an outlet, to substitute a similar item, or to initiate a new item for pricing. Each ELI is subdivided into clusters, with each cluster having its own set of specifications. Checklists contain descriptive information about items, including features of the items themselves and components of the item that might affect the price. A checklist can be a straightforward list of specifications, or it can be fairly complex, with hierarchical dependencies among specifications and complicated mathematical formulas. The interactive electronic checklist enforces rules regarding patterns of specifications that may be necessary to identify an item. The checklist also prevents inconsistencies.

The other module of the C&S CADC collection instrument comprises some screens that make up the pricing form and various functions pertaining to the task of data collection. For instance, some screens enable the economic assistant to organize his or her work at the level of the outlet or the quote, while some allow review of collected data or information about the outlet and respondent. An economic assistant selects an action, such as substituting a new item for one that is unavailable (only options that are appropriate for that action are offered in the collection instrument). The pricing screens allow the economic assistant to enter the price of the item as well as relevant information about it, such as quantity, size, unit of size, sales tax, and seasonality; the economic assistant can also see the previous price and other data relevant to the quote.

Electronic data collection improves data quality in part by activating important rules at the moment the data are being collected. For instance, a suspiciously large price change can

be noted immediately, rather than after data have been sent to Washington, DC and examined by commodity analysts. The collection instrument contains multiple edits which either warn the economic assistants about some important aspect of a quote or prevent them from entering invalid information.

CPI data collection is scheduled in terms of business days (that is, weekdays excluding holidays). Before 2004, data collection covered three pricing periods, each comprising 6 business days in most months and 5 days in November and December. Consequently, the last scheduled data collection was usually the 18th business day of the month. Beginning with data for January 2004, the three pricing periods now are of variable length and end on the last business day of the month.

Shelter

The CPI housing unit sample is the source of the data on residential rents used to calculate changes in rents for the rent of primary residence (rent) index. The housing survey also uses these rent data in calculating changes in the rental value of owned homes for the owners' equivalent rent of primary residence (OER) index. These two shelter indexes account for approximately 30 percent of the total CPI weight.

Weighting during segment sample selection. In the 1999 Housing Sample, segments were selected with probability proportional to size, the size measure being estimated expenditures. In the segment selection process, the segments are ordered within each PSU by county and then by segment rent level within county. Because the segment selection is systematic, this guarantees that not all high-rent or low-rent segments are chosen and that the segments will be geographically distributed within the PSU.

Each segment, s, was assigned a probability of selection, P, within the PSU, which is the ratio of the cost of housing in the segment relative to the cost of housing in the PSU times the number of segments selected. Therefore,

$$P_s = \left(\mathrm{TC}_s \Big/ \sum_{s \in \mathrm{PSU}} \mathrm{TC}_s \right) \times n_{\mathrm{PSU}},$$

where

n_{PSU} = number of segments chosen in the PSU,

and

TC_s is as defined in the next paragraph.

Each segment also has a weight W_s, which is the reciprocal of the probability of selection. Therefore,

$$W_s = 1/P_s.$$

The total cost of housing in the segment, TC is the cost of rented housing in the segment, RC_s, plus the cost of owned housing in the segment, OC_s. RC_s is the number of rented housing units in the segment R_s times the average rent value within the segment (RR_s). (OC_s) is the number of owned housing units in the segment times an estimated average owner equivalent rent value within the segment, IR_s. This gives segments with higher valued units (higher rent levels) a higher probability of selection and a lower segment weight:

$$\mathrm{TC}_s = \mathrm{RC}_s + \mathrm{OC}_s = R_s \times \mathrm{RR}_s + O_s \times \mathrm{IR}_s.$$

The number of owned housing units, the number of rented housing units, and the average rent value were taken from the decennial census. The estimated average owner equivalent rent value was determined by a linear regression on Consumer Expenditure Survey property value, income, and number of rooms. The resulting regression coefficients were applied to decennial census values for the same independent variables to estimate the average owner's equivalent rent for each segment.

The following is the nonlinear regression that was used:

$$\text{oerval} = b_0 + (b_1 \times \text{propval}) + (b_2 \times \text{propval}^2) + (b_3 \times \text{income}) + (b_4 \times \text{rooms}).$$

In this equation,

oerval = the value the home would rent for,

propval = the market value of the home,

income = the income of the consumer unit, and

rooms = the number of rooms in the house.

The actual regression coefficients were determined uniquely for each index area.

Because rents are not volatile, the housing sample is divided into panels; one panel is priced each month and each panel is priced twice a year. For example, panel 1 is priced in January and July, panel 2 in February and August, and so on through panel 6. The segments within the strata are assigned to these panels. These assignments are made such that each panel has a representative subsample of the PSU. Because each panel is representative of the entire sample, there is never an off-cycle month for the housing survey, a panel of data provides sufficient information for monthly publication of the rent and rental equivalence (REQ) indexes. Segments were selected within the PSUs in multiples of 6, so that each panel had the same sample size within a PSU.

About 10,000 segments were selected in the PSUs. The housing sample is designed to consist of approximately 50,000 rental units. Sampling rates were computed for each segment so that the sample design would be realized after the sampling and screening processes described next were completed.

Sample allocation to PSUs. BLS allocated the sample to PSUs based on the estimated total housing expenditure in each PSU. The estimated total housing PSU expenditure is the sum of the total cost of housing, previously defined, across all segments:

$$\text{PSU expenditure} = \sum_{s \in S} TC_s .$$

There are six collection panels. It was desired that the segment sample size be equal within each collection panel. Thus, the segments were allocated in blocks of 6 segments, with a minimum of 72 segments per PSU. For PSUs with multiple replicates, it was desired to have at least 36 segments per replicate and an equal sample size in each replicate. It was determined that a minimum of 108 segments was needed to support publication in areas that were published semiannually and that a minimum of 180 segments was needed for areas that are published bimonthly. The one exception was Baltimore, which received 108 segments but is published bimonthly as part of the Washington–Baltimore CMSA. As the sample size was previously about 10,000 segments and the budget for housing data collection was comparable, multiples of 6 segments were chosen so that the total would be near 10,000 segments.

Sampling housing units. After segments have been chosen for each PSU, housing units are chosen for collection within each segment. Lists of housing units are obtained for each segment and an equal probability sample is chosen. In most cases, the target number of rental units from each segment is five. Prior to sampling, the housing units are ordered by address and the sample taken is systematic, ensuring a geographic spread of housing units selected within the segment. The sampling rate varies from segment to segment, depending on the expected percentage of rental and owned units within the segment.

Collection. Collection includes the *screening* of the selected housing units to determine if the units are in scope for the housing sample. If the unit is in scope, it is initiated. *Initiation* is the initial collection of rent data, which consists of the rent paid and the specific housing services that are associated with the unit and the rent paid. These data are the basis for all calculations of rent change that occurs during the life of the unit in the housing sample. After initiation, the housing unit is priced on panel every 6 months. Pricing is very similar to the initiation process, but some previous answers are provided. The collection of the housing data, and particularly the rent data, is independent. That is, the field staff collects the data without giving the respondent the previous answer. Previous answers for some non-rent data are provided, so that the field staff can confirm certain changes with the respondent. Inherent in all of the structured housing questionnaires (screening, initiation, and pricing) are various flow determinations (skip patterns), such that the answer to one question determines the next question that must be asked/answered.

The CADC instrument. The CADC instrument receives the screening/initiation schedules electronically. Even though the schedules have been assigned to specific panels, the field staff has several months to collect the screening/initiation schedules. This is referred to as the non-monthly period. The field staff obtains answers to various (screening) questions (through observation and through direct questioning of eligible respondents) that determine whether an address is in scope for the housing sample. The screening criteria consist of tenure (whether the unit is renter or owner occupied) and other criteria, such as not being in public housing projects, being a primary residence, and the tenant not being a relative of the landlord. With the computer, the skip patterns can be very efficient. Because the computer has stored all of the previously collected data, automated logic checks remove all redundant question patterns, thereby reducing the field staff's work and the respondent's burden. Automated data checking ensures that only correct data types are collected, other automated logic checks ensure that collected data are consistent, and the instrument informs the field staff if any required data have not been collected. These data checks are being performed at the time of collection, so errors and inconsistencies can be corrected while the respondent is present. The result is that the data that are sent to Washington are as accurate as possible. (The collection instrument also automatically determines appropriate "scope status": permanently out of scope, temporarily out of scope, incomplete, or complete and in scope).

If the housing unit is found to be out of scope for some reason that is not likely to change, the collection instrument assigns a scope status of "permanently out of scope" and the unit is never visited again. (An example of this would be units in public housing projects.) If the housing unit is found to be out of scope for some reason that might change, its status is "temporarily out of scope," and another screening/initiation attempt is made after a specified waiting period. (An example of this might be when the unit is not the primary residence for the current tenant, but may become the primary residence for some future tenant.) If the screening was incomplete, the housing unit is assigned a scope status that results in another screening/initiation attempt in 6 months. Selected addresses that pass the screening criteria are considered in scope for the housing sample and are eligible for the next stage of the process, *initiation*.

Initiation. The CADC instrument automatically moves the interviewer into the initiation portion of the instrument when the instrument has determined that the screening is complete and the housing unit is in scope. As previously mentioned, the collection instrument handles the skip patterns, the automated data and consistency checks, the schedule completion checks, and the final initiation status. The screening and initiation data are then electronically transmitted to the housing database in Washington, DC.

Pricing. During the non-monthly period, the screening/initiation may have occurred off-panel (or not at all). Therefore, the housing units will have to be priced (or perhaps screened/initiated) on panel. There must be two on-panel prices before the unit can be considered usable. The field staff receives, electronically, the housing units to price from the Washington, DC, database. The CADC collection instrument automati-

cally moves the interviewer into the pricing portion of the instrument and, as mentioned, the collection instrument handles the skip patterns, the automated data and consistency checks, the schedule completion checks, and the final schedule status. The pricing data are electronically transmitted to Washington, where they are reviewed and corrected as necessary.

These data, along with the initiation or pricing data from 6 months earlier, are used in the housing pricing relative calculation (PRC) described in the section titled "Estimation of price change for shelter." Occasionally situations occur during pricing that affect the unit's scope status and, on a scheduled but infrequent basis, additional questions are asked to ensure that the housing units are still in scope for the housing sample. If changes occur, the units are treated as indicated in the section titled *Initiation*, on the basis of their new scope status.

Estimation of price change in the CPI

As stated earlier, the CPI is calculated in two stages. In the first stage, *basic indexes* are calculated for each of the 8,018 CPI item–area combinations. For example, the electricity index for the Boston CPI area is a basic index. The weights for the first stage come from the sampling frame for the category in the area. Then, at the second stage, *aggregate indexes* are produced by averaging across subsets of the 8,018 CPI item–area combinations. The aggregate indexes are the higher-level indexes; for example, the all-items index for Boston is the average of all its 211 basic indexes. Similarly, the aggregate index for electricity is the average of the basic indexes for electricity in each of the 38 index areas. The U.S. city average All items CPI is the average of all basic indexes. For the CPI-U and CPI-W, the weights for the second stage are the base-period expenditures on the item category/areas from the CE.

Estimation of price change for commodities and services other than shelter

The C&S survey is the CPI's primary source of price change data. Of the 209 C&S item strata, 185 are priced strata. The other 24 C&S strata, all of which have very small weights, are, for a variety of reasons, *unsampled* or truncated from pricing. The price movements of unsampled strata are imputed from related priced strata.

For most priced C&S strata, the C&S survey is the *primary* source, meaning that information on price change comes from samples that the survey maintains. A few C&S strata, including those for airline fares, intercity train fares, and used vehicles, use *secondary* sources of data on prices for their samples.

Price relatives. Each month, the processing of the C&S survey data yields a set of *price relatives* (a price relative is a measure of short term price change) for all basic indexes. The CPI uses an index number formula to obtain an average price change for the items in each basic index's sample. Prior to January 1999, all CPI price relatives used a modified Laspeyres index number formula. This is a ratio of a weighted arithmetic mean of prices in the current period to the same average of the same items' prices in the previous period, with estimated quantities of the items purchased in its sampling period serving as weights. In January 1999, most of the item strata converted to the geometric mean index formula, which is a weighted geometric mean of price ratios (an item's current price divided by its previous price) with weights equal to expenditures on the items in their sampling periods. Calculations for a limited number of strata, including the two shelter strata, continue to use the Laspeyres formula, as shown in the following list: [26]

1. **Selected shelter services** (rent of primary residence; owners' equivalent rent of primary residence; and housing at school, excluding board)
2. **Selected utilities and government charges** (electricity; residential water and sewerage maintenance; utility (piped) gas service; State vehicle registration and driver's license)
3. **Selected medical care services** (physicians' services; hospital services; dental services; services by other medical professionals; and nursing homes and adult day care.)

Since January 1999, most item strata have used an expenditure-share-weighted geometric average ${}_{a,i}R^{G}_{[t;t-1]}$. The other strata use the Laspeyres formula average, ${}_{a,i}R^{L}_{[t;t-1]}$, which all strata used prior to 1999. The Laspeyres is a base-period, quantity-weighted arithmetic average. Every month, the C&S survey system uses the following formulas to compute price relatives for each item–area combination (a,i):

$$ {}_{a,i}R^{G}_{[t;t-1]} = \prod_{j\varepsilon\, a,i} \frac{P_{j,t}}{P_{j,t-1}}^{\left(W_{j,\mathrm{POPS}} \Big/ \sum_{k\varepsilon a,i} W_{k,\mathrm{POPS}}\right)} , $$

$$ {}_{a,i}R^{L}_{[t;t-1]} = \frac{\sum_{j\varepsilon\, a,i} (W_{j,\mathrm{POPS}} / P_{j,\mathrm{POPS}}) P_{j,t}}{\sum_{j\varepsilon\, a,i} (W_{j,\mathrm{POPS}} / P_{j,\mathrm{POPS}}) P_{j,t-1}} , $$

In these equations,

${}_{a,i}R^{G}_{[t;t-1]}$ and ${}_{a,i}R^{L}_{[t;t-1]}$, are, respectively, the geometric and Laspeyres price relatives for area-item combination, a,i, from the previous period, $t-1$, (either 1 month or 2 months ago), to the current month,

$P_{j,t}$ is the price of the jth observed item in month t for area-item combination a,

$P_{j,t-1}$ is the price of *the same item* in time $t-1$,

$P_{j,\mathrm{POPS}}$ is an estimate of the item j's price in the sampling period when its POPS was conducted,

and

[26] See "Planned change in the Consumer Price Index formula," **http://stats.bls.gov/cpi/cpigm02.htm**.

$W_{j,\text{POPS}}$ is item j's weight in the POPS and is defined in detail next.

The product in the geometric mean formula and sums in the Laspeyres formula are taken over all usable quotes in area-item combination a,i. It is important that the price of each quote be collected (or estimated) in both months in order to measure price change.

Quote weights. For each individual quote, the weight $W_{j,\text{POPS}}$ is computed as

$$W_{j,\text{POPS}} = AEfg\eta/BN,$$

where

- A is the proportion of the total dollar volume of sales for the ELI relative to the entire *POPS* category within the outlet (called the outlet's *percent of POPS* for the ELI),
- E is an estimate of the total daily expenditure for the POPS category in the PSU by people in the U-population (called the *basic weight)*,
- f is a *duplication factor* that accounts for any special subsampling of outlets and quotes,
- g is a *geographic factor* used to account for differences in the index area's coverage when the CPI is changing from an area design based on an old decennial census to a design based on a more recent census,
- η is the number of planned quotes for collection in the ELI – PSU, which is also the sum of duplication factors for all quotes in the ELI – PSU;
- y is the sum of duplication factors for uninitiated quotes in an ELI – PSU;
- N is $1 + (y/(N - y))$, which is essentially the ratio of planned quotes to quotes with usable prices in both periods $t - 1$ and t for the ELI – PSU;

and

- B is the proportion of the item stratum's expenditure accounted for by the ELI in the region.

POPS-period prices. In the Laspeyres formula, the item expenditure weight is divided by an estimate of the item's price in the sampling period to convert the expenditure into an estimated quantity. An item's POPS period occurred sometime before its outlet's initiation, so that one cannot observe its POPS price directly. Instead the price is estimated from the item's price at the time the sample was initiated and the best estimates of price change for the period from the POPS period to the initiation period. The formula is

$$P_{j,\text{POPS}} = \text{P}_{j,0}/[\text{IX}_{j,0}/\text{IX}_{j,\text{POPS}}],$$

where

- $\text{P}_{j,0}$ is the price of the jth item at time 0 (when it was initiated or chosen for the sample),
- $\text{IX}_{j,0}$ is the value of the price index most appropriate for the jth item in period 0, the time it was initiated,

and

- $\text{IX}_{j,pops}$ is the value of the same price index in the POPS period POPS).

Item replacement and quality adjustment

One of the more difficult problems faced in compiling a price index is the accurate measurement and treatment of quality change due to changing product specifications and consumption patterns. The concept of the CPI requires a measurement through time of the cost of purchasing an unchanging, constant-quality set of goods and services. In reality, products disappear, products are replaced with new versions, and new products emerge.

When the data collector finds that he or she can no longer obtain a price for an item in the CPI sample (most commonly because the outlet permanently stops selling it), the data collector uses the *CPI replacement* procedure to find a new item. As explained earlier in the section on CPI item and outlet samples, each item stratum consists of one or more ELIs. CPI staff economists, called commodity analysts, in Washington, DC, have developed checklists that define further subdivisions of each ELI. When seeking a replacement in a retail outlet, the data collector first uses the checklist for the ELI to find the item the outlet sells that is "closest" to the previously priced one. Then the data collector describes the replacement item on the checklist, capturing its important specifications. The commodity analyst assigned to the ELI reviews all replacements and selects 1 of 3 methods to adjust for quality change and to account for the change in item specifications.

The following example describes the most common type of quality adjustment problem. Assume that in period t a data collector tries to collect the price for item j in its assigned outlet and is not able to do so because the outlet no longer sells the item. A price for item j was collected in period $t - 1$. Following the procedure, the data collector finds a replacement and collects a price for it. The replacement becomes the *new version* (version $v + 1$) of item j. The decision as to how the CPI treats the replacement is made by the commodity analyst assigned to the ELI to which item j belongs. The commodity analyst has the descriptions of the two versions of item j. In addition, he or she has the $t - 1$ price, $P^{v}_{j,t-1}$, for the earlier version (version v) and the period t price, $\text{P}^{v+1}_{j,t}$, of the replacement version $v + 1$. The following matrix displays the price information available to the commodity analyst:

Version	Period t-1 price	Period t price
Old version v	$P^{v}_{j,t-1}$	…
Replacement version $v + 1$	…	$P^{v+1}_{j,t}$

To use the item in index calculation for period t, we need an estimate of $P^{v+1}_{j,t-1}$, the price of the replacement version, $v + 1$, in period $t - 1$, or we need an estimate of $P^{v}_{j,t}$, the earlier version v, in period t. If there is no accepted way of estimating either $P^{v+1}_{j,t-1}$ or $P^{v}_{j,t}$, the observation for item j is left out of index calculation for period t, meaning that the observation is treated as a nonresponse handled by imputation (described shortly).

The commodity analyst chooses 1 of 3 methods to handle the replacement

- Direct comparison
- Direct quality adjustment
- Imputation

Direct comparison. If the new and old items are essentially the same, the commodity analyst deems them directly comparable, and the price comparison between the items is used in the index. In this case, it is assumed that no quality difference exists.

Direct quality adjustment. The most explicit method for dealing with a replacement item is to estimate the value of the differences. The estimate of this value is called a quality adjustment amount $QA_{j,t-1}$. In this case,

$$P^{v+1}_{j,t-1} = P^{v}_{j,t-1} + QA_{j,t-1}.$$

Chief sources of direct quality adjustment information are manufacturers' cost data and hedonic regression.

Imputation. Imputation is a procedure for handling missing information. The CPI uses imputation for a number of cases, including refusals, inability to collect data for some other reason (the item may be out of season), and the inability to make a satisfactory estimate of the quality change. Substitute items that can be neither directly compared nor quality adjusted are called *noncomparable.* For noncomparable substitutions, an estimate of constant-quality price change is made by imputation. There are two imputation methods: *Cell-relative* imputation and *class-mean* imputation.

Cell-relative imputation. If there is no reason to believe that price change for an item is different from those for the other items in its cell or basic index, the *cell-relative* method is the appropriate way to impute. This method is used for missing values because in that case we have no knowledge about the observation. For noncomparable substitutions, the cell-relative method is prevalent for food and service items. The price change between the old item and the noncomparable new item is assumed to be the same as the average price change of all similar items in 1 month for the same geographic area—that is, the same as the average price change for the cell for that ELI and PSU.

In this method, which is sometimes referred to as "linking," the item is effectively left out of the calculation for 1 month; the cell relative is computed without the observation. The price relative (either $R^{L}_{ai,t,t-1}$ *or* $R^{G}_{ai,t,t-1}$) is computed with one less useable quote.

When there is a new version of the item that is not comparable to the previous version, a price of the new version ($P^{v+1}_{j,t}$) is available. That price is not used in the calculations for period t but, in the subsequent period $P^{v+1}_{j,t}$, is used as the previous price. If, on the other hand, the reason for the imputation was that the item was temporarily missing (meaning that no price was collected), a period-t price must be estimated. For this purpose, the cell relative is used to estimate the period-t price:

$$P^{v}_{j,t} = R_{ai,t,t-1} \times P^{v}_{j,t-1}.$$

Class-mean imputation. The C&S uses class-mean imputation for many noncomparable replacements, primarily in the item strata for vehicles, for other durables including high-tech items, and for apparel. The logic behind the class-mean procedure is that, for many items, price change is closely associated with the annual or periodic introduction of new lines or models. For example, at the introduction of new model year vehicles, there are often price increases while, later in the model year, price decreases are common. The CPI uses the quality adjustment method as frequently as possible to handle item replacements that occur when vehicle product lines are updated. Class-mean imputation is employed in the remaining replacement situations. In those cases the CPI estimates price change from the price changes of other observations that are going through item replacement at the same time and were either quality adjusted directly or were judged directly comparable. For class-mean imputation, the CPI estimates $P^{v}_{j,t}$, which is an estimate of the current (t) price for the old version (v), and uses this estimated current price in the calculation of the price relative for period t. The estimated current-period price is the previous-period ($t - 1$) price of the old version times a specially constructed price relative for the class:

$$P^{v}_{j,t} = P_{j,t-1} \times cR_{[t;t-1]}.$$

$cR_{[t;t-1]}$ is computed with either the geometric mean or Laspeyres formula over the subset of observations in the ELI to which item j belongs. The subset is the class of interest—that is, all the comparable and quality-adjusted replacement observations in the same ELI and PSU.

Review and treatment of outlier price changes. All outlier price changes are reviewed by commodity experts. Outlier price changes, if accurate, are generally included in the calculation of price relatives. Extreme price changes are bounded, as the geometric mean formula performs poorly for zero and near-zero prices.

Estimation of price change for shelter

The rent and OER indexes measure the change in the cost of shelter for renters and owners, respectively. Price change

data for these two indexes come from the CPI housing survey. Each month, BLS economic assistants gather information from renter units on the rent for the current month and on what services are provided.

Rent. The rent estimates used in the CPI are "contract rents." They are the payment for all services the landlord provides in exchange for the rent. For example, if the landlord provides electricity, it is part of the contract rent. The CPI item expenditure weights also include the full contract rent payment. The CPI rents are calculated as the amounts the tenants pay their landlords plus any rent reductions tenants receive for performing services for the landlord (sometimes called "rent as pay") plus any subsidy payment paid to the landlord. Reductions for any other reasons are not considered part of the rent.

Owners' equivalent rent (OER). The OER approach to measuring price change for owner-occupied housing started in the CPI-U in January 1983 and the CPI-W in January 1985. The OER index is designed to measure the change in the rental value of owner-occupied housing. In essence, OER measures the change in the amount a homeowner would pay to rent, or would earn from renting, his or her home in a competitive market. It is a measure of the change in the price of the shelter service provided by owner-occupied housing.

PRC for Housing. The housing and the C&S systems do not directly calculate indexes. Instead, they produce price relatives, and the index estimation system then uses the price relatives for basic index calculation. Price relatives are ratios of price change from the previous month ($t - 1$) to the current month (t), and basic index calculation updates the last month's indexes ($t - 1$) to the current month (t).

Weighting during the PRC. Each calculation begins with a segment weight (W_s) based on the probability of selecting the segment. (See earlier section titled "Weighting during segment sample selection.") To derive the renter weight in the segment (RW_s), the segment weight (W_s) is multiplied by the number of renters in the segment, divided by the number of renters sampled in the segment:

$$\mathrm{RW}_s = W_s \times \frac{R_s}{n_s}.$$

Similarly, the owners' equivalent rents weight (OW_s) is derived by multiplying the segment weight (W_s) by the number of owners in the segment divided by the number of renters sampled in the segment. Because the housing survey collects rents and not the implicit rents of owners, the ratio of average implicit rent to average rent in the segment is also included in the owner's equivalent rent weight:

$$\mathrm{OW}_s = W_s \times \frac{O_s}{n_s} \times \frac{\mathrm{IR}_s}{\mathrm{RR}_s}.$$

The rent and OER estimators. The rent estimator uses the change in the "economic rent," which is basically the "contract rent" adjusted for any changes in the quality of the housing unit. The OER estimator uses the change in the "pure rent," which excludes the cost of any utilities included in the rent contract.

The 6-month chained estimator. For the rent index, the current month's index is derived by applying the sixth root of the 6-month rent change to the index for the previous month. For the OER index, the current month's index is derived by applying the sixth root of the 6-month OER change to the index for the previous month.

The rent estimator uses the change in the "economic rent." Because of the panel structure used in the housing sample, the 6-month change in rent is based on sampled, renter-occupied units that have usable 6-month rent changes. The sum of the current (t) economic rents for each usable unit within a segment, weighted by the renter weight for that segment, is divided by the sum of the weighted economic rents six months earlier ($t - 6$). This ratio is used to represent the 6-month change in rent for all renter-occupied units in the segment.

In a parallel calculation, the sum of the current (t) pure rents for sampled, renter-occupied units within a segment, weighted by the owner weights, is divided by the sum of the weighted pure rents six months earlier ($t - 6$). This ratio is used to represent the 6-month change in the OER index for all owner-occupied units in the segment.

The functions of the PRC have been designed to make use of the parallel rent and OER computations. In general, the PRC aggregates the weighted rents for the units (i) in the Index Area (a) for the current period (t) and for 6 months previous ($t - 6$). When the PRC is run for rent, economic rents (ER_i) and renter weights (RW_s) are used:

$$\mathrm{REL}^{\mathrm{RENT}}_{t\text{-}6,t,a} = \frac{\sum_{i \in a} \mathrm{RW}_s \times \mathrm{ER}_{i,t}}{\sum_{i \in a} \mathrm{RW}_s \times \mathrm{ER}_{i,t\text{-}6}}.$$

When the PRC is run for OER, pure rents (PR_i) and owner weights (OW_s) are used. That is,

$$\mathrm{REL}^{\mathrm{OER}}_{t\text{-}6,t,a} = \frac{\sum_{i \in A} \mathrm{OW}_s \times \mathrm{PR}_{i,t}}{\sum_{i \in A} \mathrm{OW}_s \times \mathrm{PR}_{i,t\text{-}6}}.$$

The index estimation system needs a 1-month price relative, not a 6-month price relative; therefore, the 6th root of the $\mathrm{REL}_{t\ 6,t,a}$ is derived:

$$\mathrm{REL}_{t\text{-}1,t,a} = \sqrt[6]{\mathrm{REL}_{t\text{-}6,t,a}}$$

and then passed to the index estimation system for basic index computation for the rent and OER item strata.

Vacancy imputation. Vacant units that were previously occupied by renters are used in the calculation of $R_{t,t\text{-}1}$ and $R_{t,t\text{-}6}$. The vacancy imputation process incorporates several assumptions about the unobserved rents of vacant units. It is assumed that rents tend to change at a different rate for units that become vacant (and are, therefore, in the process of changing tenants) than for other units. The vacancy imputation model assumes that, after an initial lease period, expected rents change at a steady rate until the old tenant moves out of the unit. When there is a change in occupant or a unit becomes vacant, the rent is assumed to jump at some rate, referred to as the "jump rate." In markets with generally rising rents, this jump rate is usually greater than the average rate of change for occupied units. BLS estimates the jump rate based on non-vacant sample units in the PSU that have had a change in tenant between $t - 6$ and t. Rent changes for nonvacant units without a tenant change are used to calculate the average continuous rate of change. These values are used to impute rents for vacant units for period t from their rent in $t - 6$.[27] The imputed rent, $r_{i,t}$ of the ith vacant rental unit in t is

$$r_{i,t} = r_{i,t\text{-}1}\, J \text{ if the unit was not vacant in } t - 6$$

or

$$r_{i,t} = r_{i,t\text{-}1}\, C^6 \text{ if the unit was vacant in } t - 6,$$

where J is the 6-month jump rate calculated for the PSU, and C is the 1-month steady rate of change.

The imputation of vacant rents ensures that the unobserved rent change that occurs when a unit becomes vacant is reflected in the final rent index. The 6-month rent-change estimates capture these changes once the units become occupied.

Non-interview imputations. Units that were previously responding, not currently responding, and are not vacant are also imputed and used in the calculation of $R_{t,t\text{-}1}$ and $R_{t,t\text{-}6}$. All units within a PSU are broken up into high, medium, and low rent categories based on their rent level in $t - 6$. The rents of nonresponding, nonvacant units are imputed forward into t by using the average rent change of other housing units in their respective category.

Aging adjustment. The aging adjustment accounts for the small loss in quality as housing units age (or depreciate) between interviews. The aging adjustment factors can be thought of as $1/(1 - d)$ where d is the monthly rate of physical depreciation. BLS computes factors for each housing unit with regression-based formulas. The formulas account for the age of the unit and a number of structural characteristics.[28] The aging adjustment procedure was introduced into the CPI in 1988.

Special pricing and estimation procedures for medical care

Although third parties (mainly government agencies and employers) pay much of the cost of medical care on behalf of consumers, the medical care component of the CPI covers only that part of healthcare commodities, services and health insurance premiums that consumers pay for "out of pocket."[29]

Medical insurance premiums constitute the largest part of consumers' out-of-pocket spending for medical care. Unlike other forms of consumer insurance in the CPI, the data needed from insurers to hold the quality of the insurance policies constant are so extensive and so closely held that BLS has not been able to construct a constant-quality health insurance index. Consequently, the CPI has employed an indirect method for pricing health insurance. In short, the CPI allocates most of consumers' out-of-pocket expenditures on health insurance premiums to the weights for other healthcare services and commodities, placing the small remainder, which covers the insurance companies' costs and their profits, into a separate stratum.

Use of the indirect method for pricing health insurance has two important effects on the CPI. First, the relative shares of the weights for most of the other CPI medical care item strata are increased, because they include their portions of the reallocated consumer expenditure for health insurance premiums.[30] Second, the CPI approach to measuring price change for medical care items reflects the fact that these items are, for the most part, paid for by insurance companies and, therefore, the approach must take account of insurance arrangements such as type of reimbursement method.

Medical care items and their prices. The movement of CPI medical care indexes is based on the average change in the prices of a sample of items selected to represent them. The items are, for example, a prescription for a specific medicine or a visit of a specified duration to a doctor or a hospital. These are inputs to medical treatments addressing a specific

[27] For more information on vacancy imputation, see J.P. Sommers and J.D. Rivers, "Vacancy imputation methodology for rents in the CPI," *Proceedings of the American Statistical Association, Business and Economic Statistics Section* (Alexandria, VA: American Statistical Association, 1983).

[28] For further information, see Walter F. Lane, William C. Randolph, and Stephen A. Berenson, "Adjusting the CPI shelter index to compensate for effect of depreciation," *Monthly Labor Review*, October 1988, pp. 34–37.

[29] As a consequence, the medical care portion of the CPI is much smaller than its portion of the national accounts.

[30] See U.S. Bureau of Labor Statistics, "Direct pricing of health insurance in the Consumer Price Index." Paper presented at the Sixth Meeting of the International Working Group on Price Indices, Canberra, Australia, April 2001, **http://www.ottawagroup.org/Ottawa/ottawagroup.nsf/home/Meeting+6/$file/2001%206th%20Meeting%20-%20U.S.%20Bureau%20of%20Labor%20Statistics%20-%20Direct%20Pricing%20of%20Health%20Insurance%20in%20the%20Consumer%20Price%20Index.pdf/**. In that study, the share of the CPI weight for health insurance under direct health insurance pricing was 2.7 percent, compared with 0.3 percent under indirect insurance pricing. At the same time, the shares of the other medical care items were commensurately smaller (for example, for hospitals, 0.4 percent versus 1.4 percent).

medical condition.[31] The CPI data collectors, following CPI sampling procedures, select the sample items by working with respondents in pharmacies, doctors' offices, hospitals, and other outlets that provide medical care.

The CPI defines the transaction price for medical care items as all payments or expected payments received from eligible payers, including both the patient and appropriate insurers. In most cases, the field staff is able to collect transaction prices; if the respondent is unable or unwilling to provide transaction prices, then cash or self-pay prices are collected, except in the case of hospitals where "list prices," or so called charge master prices, are normally not collected unless associated with a self-pay patient.

CPI medical care indexes. The CPI medical care aggregate index covers medical care commodities, which consist of prescription and over-the-counter (OTC) drugs and supplies, and medical care services, which include professional services, hospital services, and medical insurance.

The professional medical services expenditure category serves as the umbrella for a series of stratum indexes: Physicians' services, dental care, eye care, and services by other medical professionals. The hospital and related services category includes item strata for hospital services, nursing home services, and adult day care. Medical insurance, for which the weight share is reduced due to indirect pricing, is the remainder of the medical care services category. Details on the more difficult pricing issues associated with these item strata follow.

Prescription drugs. In response to technological change and the complex marketing of prescription drugs, the CPI program has developed a series of techniques to show the effects of such trends. Field staff uses special procedures to handle the expiration of a drug's patent protection and the subsequent introduction of equivalent generic drugs, a prescription drug's conversion to OTC status, and the introduction of new pharmaceutical products into the market place.

Brand vs. generic. Since 1995, a method has been in place allowing generic versions of prescription drugs coming off patent to have a chance for inclusion in the CPI. Typically, 6 months after the expiration of the patent for a particular prescription drug, the CPI economic assistant (data collector) disaggregates among all the FDA-designated therapeutically equivalent versions of the medicine, including the brand name, that are available in each outlet in which the original drug is priced. This process allows the newer generics an opportunity to build sales in the individual pharmacy over a 6-month period, and then, through disaggregation, a probability-proportional-to-size statistical technique, the generic versions of the drug have a one-time chance for selection in proportion to sales volume at the particular outlet. Should a generic drug be selected, any price change that occurred from brand to generic is reflected in the index.

Prescription vs. over the counter. When a drug in the CPI's prescription sample loses its prescription status and is sold as an OTC drug, the CPI retains the item as part of the prescription drug sample while using its OTC price. Thus, the prescription drug index series shows any price change that occurs as a result of drugs changing status from prescription to OTC. The OTC version of the drug remains in the prescription drug sample until it rotates out during the next rotation scheduled for that item. Generally, each sample rotates every 4 years. At future sample rotations, the OTC item is eligible for initiation in the nonprescription drug stratum and ineligible in the prescription drug stratum. Similarly, should a drug in the nonprescription sample change its status (that is, from OTC to prescription), the CPI would show the resulting price change, if any, in the nonprescription drugs and supplies index.

Physicians' services. This item stratum covers services that are performed and billed by private-practice medical doctors. This includes all medical professionals with a Doctor of Medicine (M.D.) degree except for ophthalmologists, whose services are priced in the eye care stratum. It also includes osteopaths (they are not MDs, but often have hospital privileges). House, office, clinic, and hospital visits are included as long as the bill comes from the physician.[32] At initiation of a quote for physicians' services, the CPI data collector first establishes the practitioner's specialty and then disaggregates to an appropriate service. The data collector describes the characteristics of the selected visit and any related procedures using a CPI checklist specific to the medical specialty. Current Procedural Terminology (CPT) codes are used to help describe the item precisely; this description remains fixed for the 4 years during which the CPI program follows its price, unless either the selected combination of services changes or a CPT code definition is modified. Transaction prices in the physicians' services index may include Medicare Part B payments, as well as those fees that the doctor expects to receive directly from the patient or from private insurance.

Services by other medical professionals. This stratum covers services performed and billed by medical practitioners who are not Medical Doctors (lack an M.D. degree) and are not covered in the dental stratum or the eye care stratum. Included here are chiropractic and physical therapy, podiatry,

[31] A National Academy of Sciences panel that reviewed CPI practices suggested that BLS should experiment with using selected medical conditions as the CPI items. Under that approach, the CPI would follow the movement to new treatments (such as drug therapy replacing surgery) and, to the extent possible, show any price changes. (See Charles L. Schultze and Christopher Mackie, eds., *At what price? Conceptualizing and measuring cost-of-living and price indexes* (Washington, DC: National Academy Press, 2002), pp. 178–190.

[32] Ina Kay Ford and Daniel B. Ginsburg, "Medical care in the CPI," in E. Berndt and D. Cutler, eds., *Medical care output and productivity*, NBER Research Studies in Income and Wealth. (Chicago: University of Chicago Press, 2001), p. 215.

audiology (including hearing aids), acupuncture, nursing, nutritional counseling, occupational therapy, and psychology and psychotherapy.

Hospital services. Items in the hospital services stratum cover the hospital portion of a medical treatment, including inpatient and outpatient services. The pricing unit is the hospital visit, defined by a date of admission and a date of discharge as documented on a hospital bill and usually associated with a specific diagnosis or medical condition.[33] At initiation, the CPI data collector works with the respondent to select a hospital bill based on revenues generated by eligible payers. The data collector refers to the bill to describe the item in terms of the bundle of goods and services consumed during a time frame or visit for the purpose of bringing the patient to the physical (or mental) state required for discharge from the hospital. The form that the hospital visit takes as the pricing unit is that of its reimbursement method, the method used by the insurer to pay the hospital for the services. There are several possible types of reimbursement that insurers may write into their contracts with providers: Fee-for-service, diagnosis-related group, per diem, case rate, admission rate, package, ambulatory patient group, service units, and capitation. With the exceptions of fee-for-service and fee schedule, each type of reimbursement reflects either a lump-sum payment based on the diagnosis or type of procedure performed or a flat fee per unit of service.

Current procedures for selecting hospital services to price in the CPI involve the following basic steps:

- Disaggregation by setting to reflect the relative proportions of inpatient services versus outpatient services at the individual hospital outlet level
- Disaggregation by payer (for example, self-pay or insurance company)
- Selection of hospital bills based on selected payers, when the hospital administration will provide them
- Request for the type of reimbursement method and the actual or estimated payment for the described hospital visit, based on the terms of the contract between the provider and the insurer
- Description of the hospital visit, including a bundle of procedures, services, equipment use, supplies, and materials typically associated with the hospital event or episode, as defined by both the bill and the contract (the visit).

Monthly pricing and bimonthly pricing consist of updating the reimbursement method and amount based on the contract between provider and insurer, and maintaining current discounts and (for those fee-for-service reimbursements based on the hospital charge master with applied discounts) list prices.

Health insurance. As previously noted, the CPI employs an indirect method to measure price change for health insurance.[34] This indirect approach decomposes medical insurance into three parts:

1. Changes in the prices of medical care items covered by health insurance policies
2. Changes in the cost of administering the policies
3. Changes in the cost of maintaining reserves and, as appropriate, profits

Most of the expenditure for health insurance goes for the first item—the part that reflects the insurers' payments for medical treatment. The CPI program allocates this part of health insurance spending to the medical care indexes for those treatments in proportion to claims paid out for them.[35] The remaining weight for the other two parts of insurance is for the overhead of the insurers; this is all that remains in the CPI health insurance index. Note that it is only consumer-paid insurance that is in scope; out-of-scope or ineligible health insurance receipts include those from employers, Medicare Part A (funded through payroll taxes), Medicaid, and workers' compensation.

Price movement over time for the health insurance index in the CPI is determined by the movements of the other medical care strata, adjusted by changes in the retained earnings ratio. (See subsection titled "Retained earnings ratio.") This process yields a measure of price change for insurance of constant coverage and utilization. That is, changes in benefit coverage and utilization levels generally are offset by compensating premium charges and thus do not significantly affect retention rates. Implicit in the process is the assumption that the level of service from the individual carriers is strictly a function of the benefits paid. Other changes in the amount of service provided for policyholders, such as more convenient claims handling, affect the movement of the index even though, strictly speaking, they should be removed; still, the effects are probably small.

Retained earnings ratio. BLS obtains calendar year data for premium income, benefit payments, and retained earnings. For each year, the ratio of retained earnings to benefit payments is calculated, yielding a retained earnings ratio. The latest year's ratio is divided by the previous year's ratio to obtain the annual relative of change in the ratios. This annual relative of change is converted to a monthly relative (by

[33] At this time, neither the pricing of total treatment paths nor the measurement of patient outcomes is available for the CPI, given the structure of the medical care component and the difficulty of evaluating the results of treatments.

[34] See "Measuring price change for medical care in the CPI," *Consumer Price Index* (U.S. Bureau of Labor Statistics, April 12, 2010), **http://www.bls.gov/cpi/cpifact4.htm**.

[35] Ford and Ginsburg, "Medical care in the CPI," p. 216.

taking its 12th root) so the CPI can reflect the change month by month over the calendar year. Because it is not feasible to obtain the monthly change in price caused by changing retention margins, spreading the annual change evenly over the year is preferable to reflecting the entire annual change in one month.

Special pricing for other items

New vehicles. Prices for new cars and trucks, selected for inclusion in the CPI, pose a special problem because the manufacturer's suggested retail (sticker) price is not the transaction price for most new vehicles. Most automotive dealers offer customers concessions on the sticker price or, for models that are in high demand, the dealers charge an additional markup beyond the sticker price. When collecting the price of new vehicles, BLS economic assistants record all of the components of the sticker price separately. This includes the base price and the prices for options, dealer preparation, transportation, and so forth. In addition, they obtain from the dealer the average rebate, concession, and/or markup during the preceding 30 days. This enables BLS to estimate the true transaction price.

Quality adjustment is also common in calculation of the new vehicles index. The most frequently cited example of direct quality adjustment in the CPI deals with the annual model changeover for new cars and trucks. Each year, price adjustments are made to account for the quality differences between the old and the new models. In some cases, the adjustments are based on the previous model's retail price for optional equipment. In other cases, the quality adjustments must be derived from production cost data supplied by the manufacturers. These data are adjusted by estimated manufacturer and retailer markup rates to derive retail values for the quality changes.

Adjustments for quality change in the CPI new car index include structural and engineering changes that affect safety, reliability, performance, durability, fuel economy, carrying capacity, maneuverability, comfort , and convenience. Since 1999, quality adjustments have not been made for changes associated with pollution control mandates.[36]

The derivation of production cost-based quality adjustments for new cars is carried out in association with the BLS Producer Price Index and International Price programs. The adjustments exclude changes in style or appearance, such as chrome trim, unless these features have been offered as options and purchased by customers. Also, new technology sometimes results in better quality at the same or reduced cost. Usually, no satisfactory value can be developed for such a change. In such cases, the quality change is ignored, and prices are compared directly.

[36] "The treatment of mandated pollution control measures in the CPI," *Consumer Price Index* (U.S. Bureau of Labor statistics, October 16, 2001), **http://www.bls.gov/cpi/cpitreat.htm**.

In addition to quality adjustments for physical changes to cars and trucks, adjustments are made for changes in the warranty coverage provided by auto manufacturers when sufficient data are available to derive estimates of their values.

Vehicle leasing. The vehicle leasing index was first published by BLS in January 2002. The prices used in the index are monthly lease payments. As with new vehicles, the agreed-upon purchase price of the vehicle must be estimated. BLS economic assistants collect the base price and the prices for options, dealer preparation, transportation, and so forth. Also, any rebates available are included, along with the largest estimated concession or discount the dealer would allow for the leased vehicle on the day of pricing. Then, the lease terms are applied to obtain the residual value, depreciation amount, rent charge, and the total monthly lease payment. During the annual model changeover, the quality adjustments developed for the CPI new car index are also used in the CPI vehicle leasing index.

Used cars and trucks. Models that are from 2- to 7- years-old are priced in the used car and truck index. Data on used vehicle prices are obtained from a secondary source. Once a year, each sample vehicle is updated by one model year to maintain the same age vehicle. The sample prices are adjusted for quality change by applying the same information used for quality adjustment in the new vehicle index. This is done by figuring the percentage that the quality adjustments represent of the price of the vehicle when it was new. The quality adjustments are then assumed to depreciate at the same rate as the car as a whole.

Apparel. The special characteristics of apparel marketing have historically caused a number of problems in the maintenance of a constant-quality market basket of apparel in the CPI. Many apparel items are seasonal and inventory is constantly fluctuating in reaction to changing fashions. In addition, large price changes are common as marketing practices for apparel generally entail introducing such goods at high regular prices and discounting to lower sale prices throughout their product lifecycle.

When an outlet discontinues an apparel item, the BLS economic assistant follows the CPI substitution procedures to find the closest substitute that the outlet offers for sale. These procedures are developed by applying the results of hedonic regression models and ensure that the economic assistant matches many of the price-determining quality characteristics between the substitute and discontinued items.

Hedonic regression modeling is the technique used to determine the importance of the price-determining quality characteristics that add or subtract value to a particular good. In this approach, an item can be viewed as a collection of characteristics that, taken together, provide satisfaction or value to the consumer. For example, a woman's suit can be considered an aggregation of its components, such as a jacket and skirt or pants, each of which contributes value to the suit in the eyes of the consumer. In addition, characteristics of

the suit, such as its fiber content and its construction, add or subtract value from the consumer's standpoint.

Hedonic regression modeling is a tool that allows commodity analysts to estimate which characteristics are price-determining, and how these estimates influence the direction and magnitude of a good's price. This research has resulted in improved data collection documents and procedures for pricing apparel commodities. By noting the most important quality characteristics on data collection documents, economic assistants who collect data for the CPI can hold price-determining characteristics constant when pricing seasonal and fluctuating inventories. This improvement in data collection documents has enhanced the reliability of apparel price estimation, since it increases the number of direct price comparisons or sample observations that can be used for index calculations.

When the economic assistant must substitute to a new good or item because the previously priced item is no longer available in the retail outlet, the commodity analyst determines whether the items are comparable, noncomparable, or can be quality-adjusted by means of applying characteristic estimates developed in a hedonic regression model. For comparable items the price of the new item is directly compared to the price of the old item and the price change or relative is used for index estimation. For noncomparable items the price change for the item is imputed via the class-mean imputation method. For quality adjustments the price of the discontinued item is adjusted based on the difference in characteristics between the discontinued and substitute items using the characteristics value estimates developed in the hedonic regression model for the apparel item. For example, if a two-piece men's suit was priced in the apparel price sample and is now no longer available in the outlet, because the retailer will only stock three-piece suits instead of two-piece suits, the value of a vest included with a three-piece suit can be added to the price of the old two-piece suit using the hedonic price estimate for the vest and the quality-adjusted price of the old two-piece suit can be reliably compared directly with the price of the new three-piece suit for a constant quality measure of price change. Alternatively, if fiber percentages vary between two items, quality adjustment can account for the characteristic difference to permit constant quality comparison of the prices of the two goods.

Other characteristic differences that have been found to be statistically significant also have been factored out to permit constant-quality price comparisons for apparel items. Hedonic quality adjustments have played a significant role in increasing the number of constant quality price changes that can be used for index calculations by accounting for differences in quality characteristics when substitutions occur.

Natural gas. To measure a constant consumption amount for the CPI's utility (piped) gas service index, the data collector initiates a fixed level of energy or heat consumption for each observation. The fixed consumption amount is selected in Washington, based on household bill expenditure data as reported in the CE. Subsequently, when the observation is priced each month, field staff collects the cost of that fixed amount. This amount is defined as a fixed number of therms (a therm is 100,000 British Thermal Units, or BTUs). When the surveyed outlet delivers and bills its residential customers by the number of therms consumed, the CPI uses the current price per therm to determine the prices of that outlet's observations. But, when piped gas is delivered and billed by volume (for example, cubic feet), the CPI program must adjust each quote to account for the fact that the volume of gas needed to produce a constant amount of energy or BTUs varies, depending on the quality of gas (BTUs/CF). In this case, the amount of gas priced each month is adjusted based on the heat value of gas delivered by the outlet as follows:

Current adjusted consumption = original consumption × (original heat value/current heat value).

This adjustment ensures that a constant amount of energy is being priced from month to month for the utility (piped) gas service index.

Special pricing for seasonal items. Seasonal items are those commodities and services that are available only at certain times of the year rather than year round. Down parkas, snow skis, and fresh tangelos are examples of seasonal items. Special procedures are employed when selecting and pricing items generally available only part of the year to ensure that they are appropriately represented in the sample and that price changes are correctly included in the calculation of the CPI. In particular, the procedures prevent substituting away from a seasonal item when it is out of season.

Although seasonal items can exist in any ELI, some ELIs include an especially large percentage of such items and, consequently, receive special treatment. These seasonal ELIs include most apparel items, fresh fruit, indoor plants and cut flowers, fans and air-conditioners, some sports and recreational equipment, and admission to sporting events. The designation of an ELI as seasonal or nonseasonal is made at the regional level, using the four geographic census regions in the CPI design. Some items that exhibit a seasonal selling pattern in the Northeast region, for example, may be sold year round in the South. In practice, though, nearly all ELIs designated seasonal are seasonal in all four regions.

After the samples for these seasonal ELIs are selected following the normal sample selection procedures, the number of quotes is doubled to ensure that, despite the seasonal disappearance of a substantial number of quotes, a large enough number of in-season quotes remains to calculate the index.

The quotes in these ELIs are paired; that is, for each original quote that is selected, a second quote in the same ELI and outlet is initiated and priced 6 months later. In the fresh fruit ELIs, one quote of each pair is designated January–June, and the other quote is designated July-December. In all other seasonal ELIs, one quote of each pair is designated fall/winter, and one quote is designated spring/summer. The fall/winter and spring/summer designations are used for the nonfood quotes because these are the distinctions that are most com-

monly used by the retailing industry to categorize seasonal merchandise. These seasonal designations are used to help establish the specific items eligible for each quote so that year-round items and items from each season are initiated in their proper proportions.

Economic assistants attempt to price every item in each period during which it is designated for collection, even during those months when the item may be out of its indicated season. If the item is available, the price is collected and used in the calculation of the CPI. A common practice in marketing seasonal items, particularly seasonal clothing, is to mark down prices to clear the merchandise from the stores as the end of each season approaches. During the period when a seasonal item is unavailable, its price is imputed following standard imputation procedures. When an item returns at the beginning of its season several months later, the price is directly compared with the item's last price, as it has been imputed forward. This completes the circle in a sense: having followed the price of the item down to clearance price levels, BLS then follows the price back up to regular (or at least higher) prices the following season. Keep in mind that, in this context, the "following" season means the same season the next year; that is, the following fall/winter season for the fall/winter sample, and the following spring/summer season for the spring/summer sample.

When an item becomes permanently unavailable, the standard procedure is to substitute the most similar item sold in the outlet. In the case of a year-round item not in a seasonal ELI, this process takes place as soon as the item is permanently unavailable. For items in seasonal ELIs and seasonal items in ELIs that are not designated seasonal, however, the period during which a substitution can take place is restricted to those months when a full selection of appropriate seasonal merchandise is available.

These special initiation, pricing, and substitution procedures are intended to ensure that an adequate sample of items is available every month, and that the correct balance of seasonal and year-round items is maintained. As a result, the estimates of price movement for the ELIs that include seasonal items correctly reflect price changes not just for items available year round but for the entire universe of items included in those ELIs.

Other price adjustments and procedures

Bonus merchandise adjustments. Sometimes, products are offered with free merchandise included with the purchase of the original item. Such "bonus" items may provide additional satisfaction to consumers, and BLS will, therefore, make adjustments to the purchase price to take into consideration the value of the bonus merchandise. The adjustment made depends on the type of merchandise offered and the perceived value of the bonus to the consumer. If the bonus merchandise consists of more of the same item, the adjustment is reflected in the price of the item. For example, if a manufacturer offers two ounces of toothpaste "free with the purchase of the regular 6-ounce tube," the item's price is adjusted to reflect a decrease in the per ounce price. When the bonus is removed, the price per ounce returns to its previous level, and a price increase is recorded. In this instance, the value to the consumer is assumed to be one-third greater during the bonus period. If the bonus merchandise consists of an item that has some significant value to the consumer, and the item is of a different genre, an adjustment is made to account for the value of the free item when it is feasible to do so. Bonuses that are contingent on an additional unrelated purchase, such as a free can of soup when purchasing a whole chicken from the poultry case, are ignored.

Cents-off coupons. For a coupon to be used to reduce the reported price of an item, the coupon must be either attached to the item, attached to the product's display shelf, dispensed by machines attached to the product's display shelf, located at promotional displays, or distributed to all shoppers by product representatives standing in the immediate vicinity of the display shelf. All other coupons presented by customers as purchase reductions at the time of payment are ineligible.

Concessions. A concession is a deduction of a specific amount from the proposed selling price for the item. The usual CPI practice is to subtract from the proposed selling price the average concession for the priced item over the past 30 days.

Different day pricing. For a subset of items, if the selected priced item is not available for sale at the time of collection, prices from up to seven days prior to the actual day of collection are eligible. The item must have been offered for sale during the previous 7 days and the most recently available price is reported. The list of items eligible generally consists of specific items that may not be available every day, such as a specific type of fresh fish.

Discounts. A discount price is a reduced price that is available to only certain customers in a specific outlet. If the discount is available only during the period of price collection, such as that for a grocery-card discounted item, the discount is included only if 50 percent or more of sales for the affected item are discounted. If the discount is in effect for more than one collection period and the discount applies to 5 percent or more of the dollar sales of the item in the outlet, a probability selection is made to determine if the discount should be collected. For example, if the regular cash price accounts for 84 percent of sales, senior citizens' discounts account for 10 percent and employee discounts account for 6 percent of sales, a one-time probability-based selection is made among the three options to determine which price to report.

Manufacturers' rebates. When product manufacturers offer customers cash rebates at the time of purchase for purchases of items priced in the CPI, these rebates are reflected in the index as price reductions. When a rebate is

offered for a priced new vehicle, it is the estimated average rebate over the past 30 days that is subtracted from the vehicle's reported price. For vehicle leasing, it is the rebate in effect as of the day the collected price is obtained. For mail-in rebate offers, the price of the affected item is reported without subtracting the amount of the rebate. An attempt is made to determine the proportion of customers who take advantage of the rebate, and prior to use in the index, the reported price is then adjusted accordingly.

Membership retail outlets. Outlets that require a membership fee to be paid in order to be able to shop at the outlet are eligible for pricing in the CPI. If the actual price paid for products varies with the level of membership, a specific membership is selected and the reported prices reflect that membership level.

Quantity discounts. Many items in the CPI are sold both individually and in quantity. When consumers are able to purchase an amount greater than a single unit at a discounted price, the first multiple-unit price is reported for use in the CPI. For example, if the 12-ounce can of corn being priced can be purchased at 25 cents for a single can, three cans for 69 cents, or five cans for $1, the price used in the CPI will be the per ounce price of the three cans.

Shoppers' cards. If a priced outlet issues a card offering a "card discount" on selected products purchased by cardholders, such discounts are treated as "temporary discounts" and processed as follows. The discount is included only if 50 percent or more of sales for the affected item during the collection period are subject to the card discount.

Special-day prices. If a selected outlet has different prices for priced items based on the day of the week when a purchase is made, a selection is made between special-day and regular-day purchases, based on revenue. If the "special day" is selected, the price collected is for the most recent special-day price.

Utility refunds. Sometimes, public utility commissions require that utilities such as telephone, natural (piped) gas, or electricity companies make rebates to their customers. These rebates may arise from a number of different causes. For example, a utility may be permitted to use a new rate schedule temporarily until a final determination is made. If the final rates set by the commission are lower than the temporary ones, the difference must be refunded for consumption during the period. The CPI does not always view such refunds as reflecting current period prices for utility services. If all customers, both new and existing, are subject to having the refund applied to their bill, then the refund is included in the total price calculation. However, if the refund is only applied to those customers who were originally subject to the overcharge (i.e., existing customers only) then the refund is excluded. This procedure reduces the month-to-month volatility of utility indexes and ensures that they reflect current prices and price trends more accurately. Also excluded are refunds that are paid directly to consumers in a separate check and are not part of the bill. The utility indexes do include current-period credits that are based on current consumption, such as purchased gas adjustments and fuel adjustments.

Unit-priced food items. When food items that are sold on a unit basis but lack a labeled weight are being priced, two items are weighed to permit calculation of an average weight for the item. This helps reduce the variability in size that occurs among individual, loose items and is not overly burdensome for the data collection process. For example, if the item being priced is Red Delicious apples, and the price is 50 cents each, the BLS field staff reports the price of one apple and the combined weight of two apples taken from the produce rack. In computing the price per ounce, the combined weight is divided by 2, and the 50-cent price of the Red Delicious apple is divided by this average weight.

Container deposits. BLS collects information on container deposits for a variety of nonalcoholic and alcoholic beverages to reflect the influence of changes in deposit legislation on price change. Consumers who purchase throw-away containers are considered to be purchasing both the product itself and the convenience of throwing the container away. When a local jurisdiction enacts deposit legislation and no longer allows stores to sell throwaway containers, those consumers who were previously purchasing throwaway containers may experience a change in the price of this convenience. The price of the same-sized container of product plus its deposit establishes an upper bound for the price change, because the consumer could retain the former convenience by now purchasing returnables and simply throwing them away. In similar fashion, information about deposits and the status of legislation can be used to estimate price change when a container bill is repealed. Changes due to the enactment or repeal of container bills are shown in data for the month in which the legislation becomes effective.

Sales taxes. The CPI includes all applicable taxes paid by consumers for services and products purchased. Many prices for services and products used to calculate the CPI are collected with taxes included because this is the manner in which they are sold. Examples are tires and cigarettes. Other prices are collected excluding applicable taxes, with those taxes subsequently added in the Washington office. The tax rates for these items are determined from secondary sources based on the State, county, and local tax structure governing the sale of the service or product at the point of purchase.

Index calculation

As stated earlier, the CPI is actually calculated in two stages. Earlier sections described the first stage of that calculation—how the CPI calculates the *basic or elementary indexes*, which show the average price change of the items in each of the 8,018 CPI item–area combinations.

The next section describes the second stage of calculation: how the aggregate indexes are produced by averaging across the 8,018 CPI item–area combinations.

Estimation of upper level price change

Aggregation of elementary CPI data into published indexes requires three ingredients: elementary indexes, elementary expenditures to use as aggregation weights, and a price index aggregation formula that uses the expenditures to aggregate the sample of elementary indexes into a published index.

Input elementary price indexes

The CPI-U, CPI-W, and all versions of the C-CPI-U are constructed by using the same combination of Laspeyres and geometric mean elementary indexes. In other words, the prices for each series are combined in the same way to form the elementary price indexes.

Input elementary expenditure weights

To aggregate elementary indexes into published indexes, an aggregation weight for each elementary item–area combination is required. The function of the aggregation weight is to assign each elementary index a relative importance or contribution in the resulting aggregate index. The aggregation weight corresponds to consumer tastes and preferences and resulting expenditure choices among the 211 elementary items in the 38 elementary areas comprising the CPI sample, for a specified period.

CPI-U and CPI-W. In the CPI-U and CPI-W, aggregation weights (AW) are defined as

$$ {}_{i,a,p}\mathrm{AW}_{\beta} = \frac{{}_{i,a,p}(\hat{P}_{\alpha}\hat{Q}_{\beta})}{100}, $$

where ${}_{i,a,p}\hat{P}_{\alpha}$ is the estimated price of item (i) purchased in area (a) by population (p) in period (α), and ${}_{i,a,p}\hat{Q}_{\beta}$ is the estimated quantity of item (i) purchased in area (a) by population (p) in period (β). Period (α) is the base period of the corresponding elementary item–area index. For example, the "Sports equipment" (ITEM = RC02) in Seattle (AREA = A423) index has a base period of α = June 1985. CPI elementary indexes have varying base periods. Most published indexes have an index base period of α = 1982–1984.

The quantity (β) corresponds to the reference period of the expenditures used to derive the implicit quantity weights needed for Laspeyres aggregation. As of 2014, the CPI-U and CPI-W had an expenditure reference period of β = 2011–2012. Historically, the CPI expenditure reference period was updated approximately every 10 years. (See table 2.) In 2002, BLS instituted a biennial rotation schedule for updating the expenditure reference period. Effective with the January 2004 index, the expenditure reference period changed from β = 1999–2000 to β = 2001–2002; effective with the January 2006 index, it was updated again to 2003–2004; and so forth. It is worth noting that a change in the expenditure reference period results in a change in the implicit quantity (Q) assigned to each elementary index, but not the implicit price component (P) of the aggregation weight (AW) of each elementary index.

Table 2. Expenditure reference periods for the Consumer Price Index, All Urban Consumers (CPI-U) and the Urban Wage Earners and Clerical Workers (CPI-W), 1917–2015

Expenditure reference period	Month introduced	Terminal month
1917–1919	1919	Dec. 1924
Avg. 1917–1919 and 1934–1936	Jan. 1925	Dec. 1929
1934–1936	Jan. 1930	Dec. 1949
1947–1949	Jan. 1950	Dec. 1952
1950	Jan. 1953	Dec. 1963
1960–1961	Jan. 1964	Dec. 1977
1972–1973	Jan. 1978	Dec. 1986
1982–1984	Jan. 1987	Dec. 1997
1993–1995	Jan. 1998	Dec. 2001
1999–2000	Jan. 2002	Dec. 2003
2001–2002	Jan. 2004	Dec. 2005
2003–2004	Jan. 2006	Dec. 2007
2005–2006	Jan. 2008	Dec. 2009
2007–2008	Jan. 2010	Dec. 2011
2009–2010	Jan. 2012	Dec. 2013
2011–2012	Jan. 2014	Dec. 2015

Note: Prior to January 1953, previously published indexes often were revised retroactively, on the basis of more recent consumer expenditure data.

Source: U.S. Bureau of Labor Statistics.

Aggregation weights for the CPI-U and CPI-W are derived from estimates of household expenditures collected in the CE. Despite an increase in the CE sample size in 1999, expenditure estimates at the elementary item–area level would be unreliable due to sampling error without the use of statistical smoothing procedures. BLS uses two basic techniques to minimize the variance associated with each elementary item–area base-period expenditure esti-

mate. First, data are pooled over an extended period in order to build the expenditure estimates on an adequate sample size. The current reference period (β) uses 24 months of data.[37] Second, elementary item–area expenditures are averaged, or composite-estimated, with item-regional expenditures.[38] This has the effect of lowering the variance of each elementary item–area expenditure at the cost of biasing it toward the expenditure patterns observed in the larger geographical area. This process is summarized in the equations. in exhibit 3.

Exhibit 3. Estimation of CPI-U elementary aggregation weights

Expenditure on item (i) in area (a) by population (p) in year (β_n)

$$_{i,a,p}(PQ)_{\beta_n}$$

Total expenditures in area (a) by population (p) in year (β_n)

$$\sum_{i,a\in a,p}^{i} {}_{i,a,p}(PQ)_{\beta_n}$$

Share of total expenditures for item (i) in area (a) for population (p) in year (β_n)

$$_{i,a,p}s_{\beta_n} = \frac{_{i,a,p}(PQ)_{\beta_n}}{\sum_{i,a\in m,p}^{i} {}_{i,a,p}(PQ)_{\beta_n}}$$

Expenditure on item (i) in major area (m) by population (p) in year (β_n)

$$_{i,m,p}(PQ)_{\beta_n} = \sum_{i,a\in m.p}^{i,a} {}_{i,a,p}(PQ)_{\beta_n}$$

Total expenditures in major area (m) by population (p) in year (β_n)

$$\sum_{i,m\in m.p}^{i} {}_{i,m,p}(PQ)_{\beta_n}$$

Share of total expenditures for item (i) in area (m) for population (p) in year (β_n)

$$_{i,m,p}s_{\beta_n} = \frac{_{i,m,p}(PQ)_{\beta_n}}{\sum_{i,m\in m,p}^{i} {}_{i,m,p}(PQ)_{\beta_n}}$$

Composite-estimated share of total expenditures for item (i) in area (a) for population (p) in year (β_n)

$$_{i,a,p}\widehat{s}_{\beta_n} = \delta\left({}_{i,m,p}s_{\beta_n}\right) + (1-\delta)\left({}_{i,a,p}s_{\beta_n}\right)$$

Estimated expenditure on item (i) in area (a) by population (p) in year (β_n)

$$_{i,a,p}(\widetilde{P}\widetilde{Q})_{\beta_n} = \left(\sum_{i,a\in a,p}^{i} {}_{i,a,p}(PQ)_{\beta_n}\right) \times {}_{i,a,p}\widehat{s}_{\beta_n}$$

Raked expenditure on item (i) in area (a) by population (p) in year (β_n)

$$_{i,a,p}(\hat{P}\hat{Q})_{\beta_n} = {}_{i,a,p}(\widetilde{P}\widetilde{Q})_{\beta_n} \times \frac{\sum_{i,a\in e,m}^{i,a} {}_{i,a,p}(PQ)_{\beta_n}}{\sum_{i,a\in e,m}^{i,a} {}_{i,a,p}(\widetilde{P}\widetilde{Q})_{\beta_n}}$$

Estimated expenditure in expenditure reference period (β)

$$_{i,a,p}(\hat{P}\hat{Q})_{\beta} = \frac{1}{N}\left(\sum_{n=1}^{N} {}_{i,a,p}(\hat{P}\hat{Q})_{\beta_n}\right)$$

[37] Prior to 2002, the expenditure reference period was based on 36 months of data (for example, β = 1993–1995 from 1998 to 2001 and β = 1982–1984 from 1987 to 1997).

[38] Elementary areas are grouped into city-size classifications by region for the purpose of composite estimation. There are four regions (Northeast, Midwest, South, and West) and two city-size classifications (A-sized cities and non-A-sized cities) for a total of eight regional city-size classifications.

Exhibit 3. Estimation of CPI-U elementary aggregation weights—continued

Cost weight in pivot month (v)

$$_{i,a,p}(\hat{P}_v\hat{Q}_\beta) = {}_{i,a,p}(\hat{P}\hat{Q})_\beta \times \left(\frac{_{i,a,p}\mathrm{IX}_{a,v}}{_{i,a,p}\mathrm{IX}_{a,\beta}} \right)$$

Aggregation weight

$$_{i,a,p}(\hat{P}_\alpha\hat{Q}_\beta) = \frac{_{i,a,p}(\hat{P}_v\hat{Q}_\beta)}{_{i,a,p}IX_{\alpha,v}}.$$

where

p = population (urban or urban wage-earner)

a = CPI elementary area

i = CPI elementary item

e = expenditure class

m = One of eight CPI major areas, defined by region and city-size classification. Regions are Northeast, Midwest, South, and West; city-size types are self-representing and non-self-representing

P = price

Q = quantity

N = number of years in the CPI-U expenditure reference period (NOTE: Currently, $N = 2$.)

β_n = year belonging to expenditure reference period β (NOTE: $n = 1$ is 1999 and $n = 2$ is 2000 in the current CPI-U expenditure reference period.)

δ = weight assigned to major area (m), where $0 \leq \delta \leq 1$

α = lower-level index base period

v = year and month, usually December, prior to the month when expenditure weights from reference period β are first used in the CPI

$_{i,a,p}S_{\beta_n}$ = estimated expenditures (PQ) for item (i) in area (a) for population (p) as a percent of total CPI expenditures in area (a) in period β_n,

$_{i,a}\mathrm{IX}_{\alpha,\beta}$ = lower-level index of price change from index base period (α) to expenditure reference period (β) for item (i) in area (a)

$_{i,a}\mathrm{IX}_{\alpha,v}$ = lower-level index of price change from index base period (α) to pivot-month (v) for item (i) in area (a)

The estimated expenditure ${}_{i,a,p}(\widetilde{P}\widetilde{Q})_{\beta n}$ for item (i) in area (a) for population (p) in reference period (β) is derived from a weighted average of the item's relative importance in the elementary area (a) and its relative importance in its corresponding region-size classification (m), for each year encompassing reference period (β). The weight (δ) assigned to the region-size class (m) and the weight ($1 - \delta$) assigned to the elementary area (a) are a function of the variance in each area and the covariance of each measure.[39] The resulting average share ($\hat{s}$) is then multiplied by the sum of all expenditures in the elementary area in the corresponding year to obtain a revised item expenditure. In a process called "raking," the revised item expenditures are adjusted by a factor such that, once summed, they equal the unadjusted expenditures at the region-size class (m) expenditure class (e) level. Annual item–area expenditures (βn) have a lower bound of 1 cent ($0.01). The raked item expenditures in each year of reference period (β) are then averaged to obtain the estimated expenditure in (β). Finally, the estimated expenditure is adjusted by the corresponding item–area index to obtain the aggregation weight: an expenditure value with an implicit price of period (α) and implicit quantity of period (β).

Because the initial version of the C-CPI-U is published simultaneously with the CPI-U, it uses expenditure data from the same expenditure reference period (β) as the CPI-U as aggregation weights. Unlike those in the CPI-U, however, the expenditures are not adjusted forward to a December pivot month and rebased so that the implicit price corresponds to the item–area index base period. Rather, the estimated expenditure weights with implicit prices of period (β) and implicit quantities of period (β) are used as aggregation weights.

Before 2015, the interim version of each monthly C-CPI-U index was published in February of the ensuing year. Hence, if the ensuing year was one in which the weight was updated, then the interim version of each monthly C-CPI-U was based on more contemporaneous expenditures than its initial version. For example, 2012 initial indexes produced in 2012 used β = 2009–2010. Interim indexes for 2012 were produced in 2013 and likewise used β = 2009–2010. Initial indexes for 2013 also used β = 2009–2010. However, 2013 interim indexes produced in 2014 (a weight update year) were constructed using β = 2011–2012.[40]

Final C-CPI-U. For the final C-CPI-U, which uses the Törnqvist index for upper-level aggregation in a monthly chained construct, monthly expenditure estimates for each elementary item–area combination are required as aggregation weights. These are derived from the same CE data as the CPI-U aggregation weights. Like the biennial data used for CPI-U aggregation, adequacy of the underlying sample size from which the expenditure weights are estimated is an issue for C-CPI-U aggregation. To minimize the variance of the elementary item–area monthly expenditures, a ratio-allocation procedure is adopted to estimate each item–area monthly expenditure from U.S. monthly item expenditures:

Estimation of monthly expenditures at the elementary level

Estimated monthly expenditures

$$ {}_{i,a,p}(\hat{P}\hat{Q})_t = \sum_{i,a \in i,A}^{a} {}_{i,a,p}(PQ)_t \; \frac{\sum_{t \in T}^{T} {}_{i,a,p}(PQ)_t}{\sum_{i,a \in A}^{a} \sum_{t \in T}^{T} {}_{i,a,p}(PQ)_t}, $$

where

p	=	population (NOTE: C-CPI-U is produced for the urban population only.)
a	=	CPI elementary area
i	=	CPI elementary item
A	=	all CPI elementary areas ("U.S. city average")
P	=	price
Q	=	quantity
t	=	month
T	=	period covering month (t) and 11 months prior to month (t)

The monthly expenditure for an item in an elementary area is derived in two steps: First, the monthly expenditure for the item is summed across all 38 areas to obtain a U.S. monthly item expenditure. Second, the U.S. monthly item expenditure is allocated among all 38 elementary areas, according to each area's relative expenditure share for the item during the current and preceding 11 months. Note that

$$ {}_{i,A}(PQ)_t = {}_{i,A}(\hat{P}\hat{Q})_t . $$

The estimated monthly item–area expenditures have a lower bound of 1/12th of a penny ($0.000833), and when summed over the calendar year, they have a lower bound ($.01) equivalent to that of the annual data in the CPI-U expenditure reference period.

Aggregation formula

A Laspeyres price index is used to aggregate elementary indexes into published CPI-U and CPI-W indexes. The Laspeyres index uses estimated quantities from the predetermined expenditure reference period (β) to weight each elementary item–area index. These quantity weights remain fixed for a 2-year period, and then are replaced in January of each even year when the aggregation weights are updated. In a Laspey-

[39] For more information on composite estimation, see Michael P. Cohen and John P. Sommers, "Evaluation of the methods of composite estimation of cost weights for the CPI," *Proceedings of the American Statistical Association,* Business and Economic Statistics Section (Alexandria, VA: American Statistical Association, 1984.) pp. 466–471.

[40] Starting in 2015, BLS will begin issuing four preliminary estimates of the C-CPI-U, by quarter, with final data issued approximately 1 year after the reference month.

res aggregation, consumer substitution between items is assumed to be zero. The aggregate index for any given month is computed as a quantity-weighted average of the current month index divided by the index value in the index base period. Month-to-month price change is then calculated as a ratio of the long-term monthly indexes. The relevant equations are as follows:

CPI-U and CPI-W upper-level aggregation formula

Long-term price change

$$ {}_{I,A,p}\mathrm{IX}^{L}_{[z;t]} = {}_{I,A,p}\mathrm{IX}^{L}_{[z;v]} \times \frac{\sum_{i,a\in I,A} {}_{i,a,p}\mathrm{AW}_{\beta} \times {}_{i,a,p}\mathrm{IX}^{L\omega G}_{[\alpha;t]}}{\sum_{i,a\in I,A} {}_{i,a,p}\mathrm{AW}_{\beta} \times {}_{i,a,p}\mathrm{IX}^{L\omega G}_{[\alpha;v]}} , $$

Month-to-month price change

$$ {}_{I,A,p}\mathrm{IX}^{L}_{[t\text{-}1;t]} = \frac{{}_{I,A,p}\mathrm{IX}^{L}_{[z;t]}}{{}_{I,A,p}\mathrm{IX}^{L}_{[z;t\text{-}1]}} , $$

where

A = all elementary areas ("U.S. city average")

a = CPI elementary area

p = population (the C-CPI-U is calculated for the U-population only.)

i = CPI elementary item

I = all elementary items ("all-items")

t = month

z = base period of the aggregate index (Note: the U.S. city average, all-items CPI-U index has a base period of z = 1982–1984.)

α = base period of the elementary index (i) in area (a)

v = year and month, usually December, prior to the month when expenditure weights from reference period (β) are first used in the CPI

${}_{i,a}\mathrm{IX}_{[\alpha;t]}$ = lower-level index of price change from period (α) to month (t) for item (i) in area (a)

${}_{A,p}\mathrm{IX}^{L}_{[\alpha,v]}$ = lower-level index of price change from period (α) to pivot-month (v) for item (i) in area (a)

${}_{i,a,p}\mathrm{AW}_{\beta}$ = aggregation weight from reference period (β) for item (i) in area (a)

${}_{I,A,p}\mathrm{IX}^{L}_{[z,v]}$ = aggregate-level CPI-U index of price change from period (z) to pivot month (v) for aggregate item (I) in aggregate area (A) for population (p)

In contrast, the C-CPI-U is built by chaining together indexes of 1-month price change. For the final CCPI-U index, each monthly index is computed using the Törnqvist formula with monthly weights from both the current and the previous month. Consumer substitution behavior is not assumed by the Törnqvist formula; rather, it is implicitly accounted for by use of current- and base-month expenditures. An index of 1-month price change is calculated and then multiplied by the index value for the previous month to obtain the current-month index value. Following are the relevant equations:

Final C-CPI-U upper-level aggregation formula

Long-term price change

$$ {}_{I,A,p}\,p\mathrm{IX}^{T}_{[z;t]} = {}_{I,A,p}\mathrm{IX}^{T}_{[z;t\text{-}1]} \times {}_{I,A,p}\mathrm{IX}^{T}_{[t\text{-}1;t]} , $$

Month-to-month price change

$$ {}_{I,A,p}\mathrm{IX}^{T}_{[t\text{-}1;t]} = \prod_{i,a\in I,A} \left(\frac{{}_{i,a,p}\mathrm{IX}^{L\omega G}_{[\alpha;t]}}{{}_{i,a,p}\mathrm{IX}^{L\omega G}_{[\alpha;t\text{-}1]}} \right)^{\frac{{}_{i,a,p}S_{t\text{-}1} + {}_{i,a,p}S_{t}}{2}} , $$

where

p = population (Note: the C-CPI-U is calculated for the urban consumer population only.)

a = CPI elementary area

A = aggregate area

i = CPI elementary item

I = aggregate item

z = base period of the aggregate index (NOTE: the U.S. city average, all-items C-CPI-U in dex has a base-period of z = December 1999.)

a = base period of the elementary index (i) in area (a)

t = month

${}_{i,a}\mathrm{IX}_{[\alpha;t]}$ = lower-level index of price change from period (α) to month (t) for item (i) in area (a)

${}_{i,a}\mathrm{IX}_{[\alpha;t\text{-}1]}$ = lower-level index of price change from period (α) to month (t – 1) for item (i) in area (a)

${}_{i,a}S_{t}$ = expenditure in month (t) for item (i) in area (a) as percentage of total expenditures in month (t) for aggregate item (I) in aggre gate area (A)

${}_{i,a}S_{t\text{-}1}$ = expenditure in month (t-1) for item (i) in area (a) as percent of total expenditures in month (t – 1) for aggregate item (I) in aggregate area (A)

${}_{IA}\mathrm{IX}^{T}_{[z;t]}$ = aggregate-level C-CPI-U Törnqvist index of price change from period (z) to month (t) for aggregate item (I) in aggregate area (A)

Starting in 2015, BLS began revising the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) quarterly, and the Constant Elasticity of Substitution (CES) formula will replace the adjusted geometric mean formula for the calculation of the preliminary versions of that index.

The initial version of the C-CPI-U will continue to be released concurrently with the CPI-U for each calendar month. The C.E.S. formula will be used to calculate the C-CPI-U. The final version of the index will be released approximately 10–12 months later, according to the publication schedule outlined in the following table:

C-CPI-U quarterly release schedule

Index month	Quarterly release				
	1 (Feb)	2 (May)	3 (Aug)	4 (Nov)	5 (Feb)
***y* – 1, 1**	**Final**	*Final*	*Final*	*Final*	*Final*
***y* – 1, 2**	**Final**	*Final*	*Final*	*Final*	*Final*
***y* – 1, 3**	**Final**	*Final*	*Final*	*Final*	*Final*
***y* – 1, 4**	Interim$_3$	**Final**	*Final*	*Final*	*Final*
***y* – 1, 5**	Interim$_3$	**Final**	*Final*	*Final*	*Final*
***y* – 1, 6**	Interim$_3$	**Final**	*Final*	*Final*	*Final*
***y* – 1, 7**	Interim$_2$	Interim$_3$	**Final**	*Final*	*Final*
***y* – 1, 8**	Interim$_2$	Interim$_3$	**Final**	*Final*	*Final*
***y* – 1, 9**	Interim$_2$	Interim$_3$	**Final**	*Final*	*Final*
***y* – 1, 10**	Interim$_1$	Interim$_2$	Interim$_3$	**Final**	*Final*
***y* – 1, 11**	Interim$_1$	Interim$_2$	Interim$_3$	**Final**	*Final*
***y* – 1, 12**	Interim$_1$	Interim$_2$	Interim$_3$	**Final**	*Final*
***y*, 1**	Initial	Interim$_1$	Interim$_2$	Interim$_3$	**Final**
***y*, 2**		Interim$_1$	Interim$_2$	Interim$_3$	**Final**
***y*, 3**		Interim$_1$	Interim$_2$	Interim$_3$	**Final**
***y*, 4**		Initial	Interim$_1$	Interim$_2$	Interim$_3$
***y*, 5**			Interim$_1$	Interim$_2$	Interim$_3$
***y*, 6**			Interim$_1$	Interim$_2$	Interim$_3$
***y*, 7**			Initial	Interim$_1$	Interim$_2$
***y*, 8**				Interim$_1$	Interim$_2$
***y*, 9**				Interim$_1$	Interim$_2$
***y*, 10**				Initial	Interim$_1$
***y*, 11**					Interim$_1$
***y*, 12**					Interim$_1$
***y* + 1,1**					Initial

In the table, the lightface italic gray text indicates that the final index has been released earlier. Thus, reading down the first column shows that, in February of the current year (*y*, 2), the final version will be released for the first 3 months (January, February, and March) of the previous year (*y* – 1, 1; *y* – 1, 2; and *y* – 1, 3) and the initial version will be released for January of the current year (*y*, 1). Column 5 of the current year corresponds to column 1 of the previous year. The other columns are read similarly. A blank cell indicates that it is too early to have an index for that month at that time.

The final index will continue to be calculated with the Törnqvist formula. In between the initial release and the final release, there will be three quarterly updates, noted as Interim (1), Interim (2), and Interim (3) in the table. The 1-month price change for each interim release will be the same as the initial version. The interim versions reflect only updates to index levels—that is, the value of the index in a given month relative to the value in its base period. These updates result from the conversion of 1-month price changes from initial to final value in preceding months in the monthly chained series.

The CES uses an estimate of consumer substitution that lies between the estimates assumed in the geometric mean and Laspeyres formulas, and represents a model that is closer to actual consumer behavior. This estimate of consumer substitution, sigma (σ), is called the elasticity of substitution.

$$_{I,A}\mathrm{IX}^{C}_{[t-1;t]} = \left(\frac{\left(\sum_{i,a\in I,A} \left(\left(\frac{E^{C}_{i,a,V,bx,\sigma}}{\sum_{i,a\in I,A} E^{C}_{i,a,V,bx,\sigma}} \right) \left(\frac{\mathrm{IX}_{i,a,t}}{\mathrm{IX}_{i,a,[V]}} \right)^{(1-\sigma)} \right) \right)^{\left(\frac{1}{1-\sigma}\right)}}{\left(\sum_{i,a\in I,A} \left(\left(\frac{E^{C}_{i,a,V,bx,\sigma}}{\sum_{i,a\in I,A} E^{C}_{i,a,V,bx,\sigma}} \right) \left(\frac{\mathrm{IX}_{i,a,t-1}}{\mathrm{IX}_{i,a,[V]}} \right)^{(1-\sigma)} \right) \right)^{\left(\frac{1}{1-\sigma}\right)}} \right)$$

New formulas and quarterly release schedule

The CES month-to-month index relative for a biennial period is

$$E^{C}_{i,a,V,bx,\sigma} = P^{i,a}_{b} Q^{i,a}_{b} \left(\frac{\mathrm{IX}_{i,a,[V]}}{\mathrm{IX}_{i,a,[bx]}} \right)^{(1-\sigma)},$$

where

C = C.E.S index/weight,
i = elementary item stratum,
I = aggregate item,
a = elementary index area,
A = aggregate index area,
IX = component index,
T = current calendar month in calendar year y (e.g., if $\mathrm{IX}_{yymm} = \mathrm{IX}_{0308}$, then t = August and y = 2003),
$t-1$ = calendar month previous to calendar month t,
x = reference period of index (initially, x = December 1999),
$P^{i,a}_{b}$ = biennial expenditure reference period,
$Q^{i,a}_{b}$ = during biennial expenditure reference period
σ = sigma for component and aggregate index periods and for weight period, and
V = pivot month index period.

Calculation of seasonally adjusted indexes

Seasonal adjustment. Seasonal adjustment removes the estimated effect of changes that normally occur at the same time every year (such as price movements resulting from changing climatic conditions, production cycles, model changeovers, holidays, and sales). CPI series are selected for seasonal adjustment, if they pass certain statistical criteria and if there is an economic rationale for the observed seasonality. Seasonal factors used in computing the seasonally adjusted indexes are derived, using X-13ARIMA-SEATS seasonal adjustment software. X-13ARIMA-SEATS is an extension of the

X-12 variant of the Census Method II Seasonal Adjustment methodology. In some cases, intervention analysis seasonal adjustment is carried out using X-13ARIMA-SEATS, to derive more accurate seasonal factors. Consumer price indexes may be adjusted directly or aggregatively, depending on the level of aggregation of the index and the behavior of the component series.[41]

Intervention analysis seasonal adjustment. Some index series show erratic behavior due to non-seasonal economic events (called interventions) or methodology changes. These events, which can be one-time occurrences or recurring events that happen at infrequent and irregular intervals, adversely affect the estimate of the seasonal component of the series.

Intervention analysis seasonal adjustment allows non-seasonal economic phenomena, such as outliers and level shifts, to be factored out of indexes before calculation of seasonal adjustment factors. (An *outlier* is an extreme value for a particular month. A *level shift* is a change or shift in the price level of a CPI series caused by an event, such as an excise tax increase or oil embargo, occurring over one or more months.) An index series whose underlying trend has experienced a sharp and permanent shift will generate distorted results when adjusted using the standard X-13ARIMA-SEATS procedure. X-13ARIMA-SEATS regression techniques are used to model the distortions and account for them as part of the seasonal adjustment process. The result is an adjustment based on a representation of the series with the seasonal pattern emphasized. Intervention analysis seasonal adjustment also makes it possible to account for seasonal shifts, resulting in a better seasonal adjustment in the periods before and after the shift occurred. Not all CPI series are adjusted using intervention analysis seasonal adjustment techniques. However, for affected series, the resulting seasonal factors better represent the true seasonal pattern than factors calculated without these techniques. These seasonal factors are applied to the original unadjusted series. Level shifts and outliers, removed in calculating the seasonal factors, remain in the resulting seasonally adjusted series.

In recent years, BLS has used intervention analysis seasonal adjustment for various indexes—gasoline, fuel oil, new vehicles, women's and girls' apparel, educational books and supplies, electricity, utility (piped) gas service, water and sewerage maintenance, nonalcoholic beverages and beverage materials, and whiskey at home are examples. Series are adjusted using intervention analysis techniques when interventions are clearly identified. After a number of years, series may revert to adjustment using standard methods. In addition, for some series, intervention analysis is used, and the resulting series does not show a clear and stable seasonal pattern. In these cases, the series is not seasonally adjusted.

Direct and aggregative adjustment. Each year, BLS seasonally adjusts eligible lower level CPI index series directly with the X-13ARIMA-SEATS software using unadjusted indexes for the latest 5 to 8 calendar years. CPI index series are adjusted using the multiplicative model.

Most high-level index series are adjusted by the aggregative method, which is more appropriate for broad categories whose component indexes show strongly different seasonal patterns. Under the aggregative method, direct adjustment is first applied to indexes at lower levels of detail, and thereafter the adjusted detail is aggregated to yield the higher level seasonally adjusted indexes. If intervention analysis is indicated, it will be used in adjusting selected lower level indexes prior to aggregation. For those series that have not been selected for seasonal adjustment, the original, unadjusted data are used in the aggregation process.

Revision. The seasonal factors are updated annually. Each year in February, BLS recalculates and publishes revised seasonally adjusted indexes for the previous 5 years. Seasonally adjusted indexes become final in the last and 5th year of revision. Seasonal factors for the past year are used to generate seasonally adjusted indexes for the current year starting with the release of the January CPI.

Calculation of annual and semiannual average indexes

CPI annual average indexes use 12 successive months of CPI values as

$$I_{12\text{av}} = \sum_{t=1}^{12} I_{t,0} / 12 .$$

Semiannual average indexes are computed for the first half of the year (January to June) and for the second half of the year (July to December) using six successive months of CPI values as

$$I_{6\text{av}} = \sum_{t=1}^{6} I_{t,0} / 6 ,$$

where the value of each monthly index is real or interpolated, depending on availability.[42]

For bimonthly indexes, the intermediate indexes are calculated using a geometric mean of the values in the months adjacent to the one being estimated.

Average prices

Average prices are estimated from CPI data for selected food and beverage items, utility (piped) gas, electricity, gasoline, automotive diesel fuel, and fuel oil #2 to support the research and analytic needs of CPI data users. (See appendix 2.) Average food prices are published without tax, while the other average prices are published with tax included.

[41] J.A. Buszuwski and S. Scott, "On the use of intervention analysis in seasonal adjustment," *Proceedings of the American Statistical Association, Business and Economics Section.* (Alexandria, VA: American Statistical Association, 1988).

[42] To be published, a semiannual average must have at least two noninterpolated index values with sufficient samples. An annual average must have at least four noninterpolated index values with sufficient samples.

For each food and beverage item, the average price for a specified unit of size (for instance, pound or gallon) is published monthly for the U.S. city average and for the four regions: Northeast, Midwest, South, and West. Metric-equivalent sizes are shown, as well.

Average prices for utility (piped) gas, electricity, and gasoline are published monthly for the U.S. city average, the four regions, the three population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For utility (piped) gas, average prices per therm are published. For electricity, average prices per kilowatt-hour (kWh) are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published, as well as the average price across all grades.

Average prices per gallon for automotive diesel fuel and fuel oil #2 are published monthly for the U.S. city average, the four regions, the three population size classes, and 10 of 12 region/size-class cross-classifications.

All eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity. For example, prices for a variety of package sizes for flour are converted to prices per ounce. An average price per ounce of flour is then estimated and multiplied by 16 to yield a price per pound, the published quantity.

The average price for collection period t is estimated as

$$\overline{P}_t = \frac{\sum_i W_{it} P_{it} / P_{ib}}{\sum_i W_{it} / P_{ib}},$$

where W_{it} is the quote-level expenditure weight of items used in the average price estimation for the *ELI*/*PSU*/replicate.

Dividing the expenditure weight by the base price, P_{ib}, for a given quote yields an implicit estimate of quantity. Thus, the average price is, conceptually, a weighted average of prices, P_{it}, where the weights are quantity amounts. Imputed prices are used in estimating average prices.

Part III. Precision of CPI estimates

An important advantage of probability sampling methods is that a measure of the sampling error of survey estimates can be computed directly from the sample data. The CPI sample design accommodates error estimation by making two or more selections (replications) of items and outlets within an index area. Therefore, two or more samples of quotes in each self-representing PSU and one in each non-self-representing PSU are available. With this structure, which reflects all stages of the sample design, variance estimation techniques using replicated samples can be used.

Sources of error

We divide the total error into two sources: *sampling error* and *nonsampling error*. Sampling error is the uncertainty in the CPI caused by the fact that a sample of retail prices is used to compute the CPI, instead of using the complete universe of retail prices. The sampling variance attributable to the estimation of expenditure weights (see chapter 16 for more detail on consumer expenditure weights) is directly incorporated in the variance estimates computed for the CPI, due to the fact that these expenditures are independently estimated for each replicate. Nonsampling error is the rest of the error, and will be discussed at the end of this section. Incorrect information given by survey respondents and data processing errors are examples of nonsampling error.

BLS constantly tries to reduce error in the CPI. Variance and sampling error are reduced by using samples of retail prices and samples of consumer expenditures that are as large as possible, given resource constraints. The Bureau has developed a model that optimizes, on a 2-year basis, the allocation of resources. The model indicates the number of prices that should be observed in each geographic area and each item category to minimize the variance of the U.S. city average all-items index. The Bureau reduces nonsampling error through a series of computerized and professional data reviews, as well as through continuous survey process improvements and theoretical research.

Sample design

Starting in 1978 the CPI's sample design has accommodated variance estimation by using two or more independent samples of items and outlets in each geographic area. This allows two or more statistically independent estimates of the index to be made. The independent samples are called *replicates*, and the set of all observed prices is called the *full sample*.

As discussed earlier, BLS calculates CPI indexes for 38 geographic areas across the United States. The 38 areas consist of 31 *self-representing* areas and 7 *non-self-representing* areas. Self-representing areas are large metropolitan areas, such as the Boston metropolitan area, the St. Louis metropolitan area, and the San Francisco metropolitan area. Non-self-representing areas are collections of smaller metropolitan areas. For example, one non-self-representing area is a collection of 32 small metropolitan areas in the Northeast region (Buffalo, Hartford, Syracuse, Burlington, and others) of which 8 have been randomly selected to represent the entire set. Within each of the 38 areas, price data are collected for 211 item categories called item strata. Together, the 211 item strata cover all consumer purchases.

Multiplying the number of areas by the number of item strata gives 8,018 (= 38 × 211) different area-item combinations for which price indexes need to be calculated. Separate price indexes are calculated for each one of these 8,018 area-item combinations. After calculating all 8,018 of these *basic-level* indexes, the indexes are then aggregated to form *higher level* indexes, using expenditure estimates from the CE as their weights.

CPI variances are primarily computed with a stratified random groups method, for 1-, 2-, 6- and 12-month percent changes. From 1978 to 1998, the BLS computed CPI variances by using a first-order Taylor approximation of the ratio of cost weights. This methodology was replaced, beginning in January 1998, by the stratified random groups method, in which variances are computed separately for certain subsets of areas and items, and then those individual variances are combined to produce the variance of the entire item–area combination. Subsets of items are formed by the intersection of the item category with each 1 of the 8 major groups.

Variance estimation using replicates

Let IX(A,I,f,t) denote the index value for area = A, item category = I, in month = t, where f indicates that it is the full-sample value, and let IX$(A,I,f,t-k)$ denote the value of the same index in month = $t-k$. The uppercase letter A denotes a set of areas, such as the Northeast or Midwest region of the country, and the uppercase letter I denotes a set of item strata, such as all items or all items less food and energy, or even a single item stratum. Also, let IX(A,I,r,t) and IX$(A,I,r,t-k)$ be the corresponding index values for replicate = r. Most areas have two replicates, but some have more. Then the full-sample k-month percent change between months $t-k$ and t is computed by dividing IX(A,I,f,t) by IX$(A,I,f,t-k)$, subtracting 1, and multiplying by 100:

$$PC(A,I,f,t,t-k) = \left(\frac{\mathrm{IX}(A,I,f,t)}{\mathrm{IX}(A,I,f,t-k)} - 1 \right) \times 100 .$$

Every index has an aggregation weight AGGWT*(A I, f)* or AGGWT*(A, I, r)* associated with it, which is used to combine the index with other indexes to produce indexes for larger geographic areas and larger item categories. For example, the aggregation weights are used to combine all 8,018 basic-level indexes into higher level indexes such as the U.S. city average-all-items index. The product of an index and its weight is called a *cost weight:*

$$\mathrm{CW}(A, I, f, t) = \mathrm{IX}(A, I, f, t) \times \mathrm{AGGWT}(A, I, f, t).$$

A cost weight is an estimate of the total cost in area = *A* for consumption of item category *I* in month t. *A* replicate cost weight would be indexed with r instead of *f*. Because the aggregation weights are not indexed by time (except across pivot months; see section titled "Bridging across pivot months"), the preceding percent change formula is equivalent to

$$\mathrm{PC}(A,I,f,t,t-k) = \left(\frac{\mathrm{CW}(A,I,f,t)}{\mathrm{CW}(A,I,f,t-k)} - 1\right) \times 100,$$

which is equivalent to

$$\mathrm{PC}(A,I,f,t,t-k) = \left(\frac{\sum_{a \in A} \sum_{i \in I} \mathrm{CW}(a,i,f,t)}{\sum_{a \in A} \sum_{i \in I} \mathrm{CW}(a,i,f,t-k)} - 1\right) \times 100,$$

because cost weights are additive from the lowest area-item level up to the highest U.S. city average-all-items level. The lowercase letter a denotes one of the 38 basic-level areas included in area = *A*, and the lowercase letter *i* denotes one of the 211 item categories. (Note: Item aggregation *I* can be as small as one item stratum or may comprise one or more major groups.)

For the stratified random groups method, a replicate percent change is defined as follows: At each item–area replicate level, the individual full sample cost weight, CW(*a, i, f,* •) is subtracted from the full sample cost weight CW(*A, I, f,* •), and a replicate cost weight, CW(*a, i, r,* •), is added back in. The replicate percent change for area = *a*, item subset = *i*, replicate = *r* between months *t – k* and *t* is then computed as follows:

$$\mathrm{PC}_S(a,i,r,t,t-k) = \left(\frac{\mathrm{CW}(A,I,f,t) - \mathrm{CW}(a,i,f,t) + \mathrm{CW}(a,i,r,t)}{\mathrm{CW}(A,I,f,t-k) - \mathrm{CW}(a,i,f,t-k) + \mathrm{CW}(a,i,r,t-k)} - 1\right) \times 100$$

for self-representing areas. For non-self-representing areas, another replicate percent change for area = *a*, item category = *I*, replicate = *r* between months *t – k* and *t* is computed as

$$\mathrm{PC}_N(a,I,r,t,t-k) = \left(\frac{\mathrm{CW}(A,I,f,t) - \mathrm{CW}(a,I,f,t) + \mathrm{CW}(a,I,r,t)}{\mathrm{CW}(A,I,f,t-k) - \mathrm{CW}(a,I,f,t-k) + \mathrm{CW}(a,I,r,t-k)} - 1\right) \times 100,$$

where

$$\mathrm{CW}(A,I,\bullet,\bullet) = \sum_{a \in A} \sum_{i \in I} \mathrm{CW}(a,i,\bullet,\bullet).$$

The symbol $\alpha \in A$ means that the sum is over all basic-level areas within area *A*, and the symbol $i \in I$ means that the sum is over major groups within item category *I*.

The variance is computed with the following stratified random groups variance estimation formula:

Table 3. Response rates for commodities and services for the Consumer Price Index, All Urban Consumers (CPI-U), U.S. city average, by major group, 2014

Commodities and services	Eligible	Collected	Percent collected	Used in estimation	Percent in estimation
Outlets	305,184	284,730	93.3	271,931	89.1
Total quotes	1,180,932	970,546	82.2	944,414	80.0
Food and beverages	465,398	418,060	89.8	410,615	88.2
Housing (less shelter)	146,466	125,300	85.5	121,502	83.0
Apparel	135,950	75,102	55.2	70,700	52.0
Transportation	149,721	134,956	90.1	131,796	88.0
Medical care	76,631	40,847	53.3	39,534	51.6
Recreation	84,227	68,427	81.2	65,064	77.2
Education and communication	78,164	68,872	88.1	67,039	85.8
Other goods and services	44,375	38,982	87.8	38,164	86.0

Source: U.S. Bureau of Labor Statistics.

$$V[\mathrm{PC}(A,I,f,t,t-k)] =$$

$$\sum_{i \subset I} \sum_{a \subset A \cap S} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(\mathrm{PC}_S(a,i,r,t,t-k) - \mathrm{PC}(A,I,f,t,t-k)\right)^2$$

$$+ \sum_{a \subset A \cap N} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(\mathrm{PC}_N(a,I,r,t,t-k) - \mathrm{PC}(A,I,f,t,t-k)\right)^2 ,$$

where S and N are the sets of all self-representing and nonself-representing areas in the CPI's geographic sample, respectively; and $A \cap S$ and $A \cap N$ are the sets of all self-representing and nonself-representing areas within area = A. The number R_a is the number of replicates in area = a.

When the item category I no longer spans more than one major group, the preceding formula reduces to

$$V[\mathrm{PC}(A,I,f,t,t-k)] =$$

$$\sum_{a \in A} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(\mathrm{PC}(a,I,r,t,t-k) - \mathrm{PC}(A,I,f,t,t-k)\right)^2 .$$

Variance estimation without replicates

BLS computes index series for 85 special (SRC) item categories, which are below the item stratum level and thus do not have accompanying replicate index values. (CE weights are produced only down to the item-stratum level in each index area.) The stratified random groups methodology requires a replicate structure. So, for these SRC items (such as *butter* or *pork* or *new cars*), an alternative variance estimation method is needed. Given the availability (at the regional and higher area levels) of *independent* estimates for these SRC items, the jackknife variance estimation methodology can be employed. Each area full sample cost weight can be subtracted from the all-area full sample cost weight to provide a jackknife replicate estimate. By taking the ratio of these replicate cost weight estimates at times t and $t-k$, subtracting 1, and multiplying by 100, one obtains the required jackknife replicate percent change value. (For the U.S. city average special item estimates, there are 38 independent index areas, and so 38 jackknife replicate estimates to work with.)

The full-sample percent change is computed as before (except that item category = I here is smaller even than an item stratum):

$$\mathrm{PC}(A,I,f,t,t-k) = \left(\frac{\mathrm{CW}(A,I,f,t)}{\mathrm{CW}(A,I,f,t-k)} - 1\right) \times 100 .$$

The jackknife replicate percent change is computed as follows:

$$\mathrm{PC}(A-a,I,r,t,t-k) = \left(\frac{\mathrm{CW}(A,I,f,t) - \mathrm{CW}(a,I,f,t)}{\mathrm{CW}(A,I,f,t-k) - \mathrm{CW}(a,I,f,t-k)} - 1\right) \times 100 .$$

Then the variance for the k-month percent change is computed in the usual jackknife form:

$$V[\mathrm{PC}(A,I,f,t,t-k)] = \frac{N_A - 1}{N_A} \sum_{a \in A} \left(\mathrm{PC}(A-a,I,r,t,t-k) - \mathrm{PC}(A,I,f,t,t-k)\right)^2 .$$

Bridging across pivot months

Every 2 years, BLS updates its set of aggregation index weights based on CE data collected from the $t-2$ and $t-3$ years. In January 2012, BLS replaced its old set of aggregation weights with a new 2-year set of weights from expenditure data collected in 2009–2010. In January 2014, this set of weights was replaced by an updated set of weights from expenditure data collected in 2011–2012, and so on.

Whenever the variance estimates cross the pivot month (as they did in December 2011 and December 2013), a bridging factor has to be introduced into any variance calculation that crosses the pivot month anywhere between t and $t-k$ months (including month $t-k$, but not including month t). The bridg-

ing factor is then applied directly to the individual ratio of cost weights, for both full-sample and replicate values, inside each percent change calculation. Thus, in its most general form,

$$\mathrm{PC}\,(\bullet,\bullet,\bullet,t,t-k) = \left(\frac{\mathrm{CW}(\bullet,\bullet,\bullet,t)}{\mathrm{CW}(\bullet,\bullet,\bullet,t-k)} \times \frac{\mathrm{CW}(\bullet,\bullet,\bullet,\mathrm{old})}{\mathrm{CW}(\bullet,\bullet,\bullet,\mathrm{new})} - 1 \right) \times 100$$

for every combination of *area* and *item*, and for full-sample and replicate values, with the bridging factor defaulting to 1 whenever not applicable.

The bridging factor, CW(•,•,•, old)/CW((•,•,•, new), essentially allows the old aggregation weight in the bridge's numerator to cancel out the old aggregation weight in the $t - k$ cost weight, while the new aggregation weight in the bridge's denominator cancels out the new aggregation weight in the t cost weight, leaving IX(•,•,•,t)/X(•,•,•,$t - k$) free to move this level's percent change without disruption. Note that IX(•,•,•,old)/IX(•,•,•,new) = 1 at all times.

Nonsampling error

CPI estimates are subject to nonsampling error as well as sampling error. Surveys involve many operations, all of which are potential sources of nonsampling error. The errors arise from the survey process, regardless of whether the data are collected from the entire universe or from a sample of the population. The most general categories of nonsampling error are coverage error, nonresponse error, response error, processing error, and estimation error.

Coverage error in an estimate results from the omission of part of the target population (undercoverage) or the inclusion of units from outside of the target population (overcoverage). Coverage errors result from the omission of cities, households, outlets, and items that are part of the target populations from the relevant sampling frames or from their double-counting or improper inclusion in the frames. A potential source of coverage error is the time lag between the TPOPS and the initiation of price collection for commodities and services at sampled outlets. Because of the time lag, the products offered by the outlet at the time pricing is initiated may not coincide with the set from which the TPOPS respondents were purchasing.

Nonresponse error results when data are not collected for some sampled units because of the failure to interview households or outlets. This can occur when selected households and outlets cannot be contacted or refuse to participate in the survey. Nonresponse rates during monthly pricing for the CPI C&S and housing surveys are shown in tables 3 (page 38) and 4 (page 40).

Table 4. Response rates for shelter for the Consumer Price Index, All Urban Consumers (CPI-U), U.S. city average, 2014

Shelter	Eligible	Collected, data reported	No data at collection or other
Number of total units	99,383	72,966	26,417
Percentage of eligible units	100	73.4	26.6

Source: U.S. Bureau of Labor Statistics.

Response error results from the collection and use in estimation of incorrect, inconsistent, or incomplete data. Response error may arise because of the collection of data from inappropriate respondents, respondent memory or recall errors, deliberate distortion of responses, interviewer effects, misrecording of responses, pricing of wrong items, misunderstanding or misapplication of data collection procedures, or misunderstanding of the survey needs and/or lack of cooperation from respondents. The pricing methodology in the commodities and services component of the CPI allows the previous period's price to be available at the time of collection. This dependent pricing methodology is believed to reduce response variance for measuring change, but may cause response bias and lag. The housing component of the CPI employs an independent pricing methodology specifically to avoid potential response bias.

Processing error arises from incorrect editing, coding, and data transfer. Price data are collected by CADC. Automated data checking ensures that only correct data types are collected; other automated logic checks remove all redundant question patterns, and the instrument informs the field staff when not all required data have been collected. In both systems, errors also can result from software problems in the computer processing that cause correctly entered data to be lost. Computer screening and professional review of the data provide checks on processing accuracy. Occasional studies of these processing errors in the CPI have shown them to be extremely small.

Estimation error results when the survey process does not accurately measure what is intended. Such errors may be conceptual or procedural in nature, arising from a misunderstanding of the underlying survey measurement concepts or a misapplication of rules and procedures.

Substitutions and adjustments for quality change in the items priced for the CPI are possible sources of estimation error due to procedural difficulties. Ideally, CPI data collection forms

and procedures would yield all information necessary to determine or explain price and quality differences for all items defined within an ELI. Because such perfect information is not available, BLS economists supplement directly collected data with secondary data. Estimation error will result, if the BLS adjustment process—which may require significant judgment or lack key data—is misapplied, or if it consistently overestimates or underestimates quality change for particular kinds of items.

The effect of the aging of housing units is an example of potential estimation error, which is similar to the issue of quality change in commodities and services. Until 1988, BLS did not adjust for the slow depreciation of houses and apartments over time. BLS research indicates that annual changes for the residential rent and owners' equivalent rent indexes would have been 0.1 to 0.2 percent larger if some type of aging adjustment had been included.

The total nonsampling error of the CPI results from errors in the type of data collected, the methods of collection, the data processing routines, and the estimation processes. The cumulative nonsampling error can be much greater than the sampling error.

Response rates

Response rates are calculated for the CPI at the data collection phase and at the index estimation phase for ongoing pricing. The response rate at the data collection phase is the number of responding sample units divided by the sum of (1) the number of eligible sample units and (2) the number of sample units with eligibility not determined. A sample unit is eligible if it belongs to the defined target population and responses should be collected from the unit for one or more items. The response rate at estimation is defined as the number of sample units used in estimation divided by the sum of (1) the number of eligible sample units and (2) the number of sample units with eligibility not determined.

Commodities and services items (any except rent and owner's equivalent rent) are further broken down into outlets and quotes. An "outlet" is a generic term used to describe places where prices are collected. A "quote" is a specific item to be priced in a specific outlet. There may be from 1 to more than 50 quotes priced in an outlet. Table 3 shows the relatively low percentages of quotes reported collected and used in estimation for apparel. Low rates for these items largely can be attributed to the design of the apparel sample. Because apparel items are commonly in stores only at certain times of the year, most of the apparel sample is doubled, with each half of the sample designated for pricing during part of the year. Thus, at any particular time of the year many apparel quotes, although eligible, are designated "out of season," and prices are not collected. For additional information, see the earlier section on seasonal items.

The response rates for housing (shelter) shown in table 4 include categories for renters only. Owners are out of scope for the CPI housing sample. A unit qualifies as renter if its tenure status is known either by previous knowledge or is collected in the current interview period. The response rates at the data collection phase for housing (shelter) are separated into three categories. If usable information is obtained, the unit is designated eligible and data reported. If the assigned unit is located but is unoccupied, the unit is designated "eligible, found vacant." In instances where the unit is eligible but no data are available (for example refusals), the unit is designated "eligible, other." The response rates at the estimation phase are units that are used in either rent or REQ.

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Appendix 1. List of published indexes

CPI-U and CPI-W Indexes Published at the U.S. City Average (National) Level

- All items
  - Food and beverages
    - Food
      - Food at home
        - Cereals and bakery products
          - Cereals and cereal products
            - Flour and prepared flour mixes
            - Breakfast cereal
            - Rice, pasta, cornmeal
              - Rice*
          - Bakery products
            - Bread
              - White bread*
              - Bread other than white*
            - Fresh biscuits, rolls, muffins
            - Cakes, cupcakes, and cookies
              - Fresh cakes and cupcakes*
              - Cookies*
            - Other bakery products
              - Fresh sweetrolls, coffeecakes, doughnuts*
              - Crackers, bread, and cracker products*
              - Frozen and refrigerated bakery products, pies, tarts, turnovers*
        - Meats, poultry, fish, and eggs
          - Meats, poultry, and fish
            - Meats
              - Beef and veal
                - Uncooked ground beef
                - Uncooked beef roasts
                - Uncooked beef steaks
                - Uncooked other beef and veal
              - Pork
                - Bacon, breakfast sausage, and related products
                - Bacon and related products*
                - Breakfast sausage and related products*
                - Ham
                - Ham, excluding canned*
                - Pork chops
                - Other pork, including roasts and picnics
              - Other meats
                - Frankfurters*
                - Lunchmeats*
                - Lamb and organ meats*
                - Lamb and mutton*
            - Poultry
              - Chicken
                - Fresh whole chicken*
                - Fresh and frozen chicken parts*
              - Other poultry, including turkey
            - Fish and seafood
              - Fresh fish and seafood
              - Processed fish and seafood
                - Shelf stable fish and seafood*
                - Frozen fish and seafood*

Appendix 1. List of published indexes—continued

- Eggs
- Dairy and related products
  - Milk
    - Fresh whole milk*
    - Fresh milk other than whole*
  - Cheese and related products
  - Ice cream and related products
  - Other dairy and related products
- Fruits and vegetables
  - Fresh fruits and vegetables
    - Fresh fruits
      - Apples
      - Bananas
      - Citrus fruits
        - Oranges, including tangerines*
      - Other fresh fruits
    - Fresh vegetables
      - Potatoes
      - Lettuce
      - Tomatoes
      - Other fresh vegetables
  - Processed fruits and vegetables
    - Canned fruits and vegetables
      - Canned fruits*
      - Canned vegetables*
    - Frozen fruits and vegetables
      - Frozen vegetables*
    - Other processed fruits and vegetables, including dried
      - Dried beans, peas, and lentils*
- Nonalcoholic beverages and beverage materials
  - Juices and nonalcoholic drinks
    - Carbonated drinks
    - Frozen noncarbonated juices and drinks
    - Nonfrozen noncarbonated juices and drinks
  - Beverage materials, including coffee and tea
    - Coffee
      - Roasted coffee*
      - Instant and freeze-dried coffee*
    - Other beverage materials, including tea
- Other food at home
  - Sugar and sweets
    - Sugar and artificial sweeteners
    - Candy and chewing gum
    - Other sweets
  - Fats and oils
    - Butter and margarine
      - Butter*
      - Margarine*
    - Salad dressing
    - Other fats and oils, including peanut butter
      - Peanut butter*
  - Other foods
    - Soups
    - Frozen and freeze dried prepared foods
    - Snacks

Appendix 1. List of published indexes—continued

- Spices, seasonings, condiments, sauces
- Salt and other seasonings and spices*
- Olives, pickles, relishes*
- Other condiments
- Baby food
- Other miscellaneous foods
- Prepared salads
  - Food away from home
    - Full service meals and snacks
    - Limited service meals and snacks
    - Food at employee sites and schools
      - Food at elementary and secondary schools
    - Food from vending machines and mobile vendors
    - Other food away from home
  - Alcoholic beverages
    - Alcoholic beverages at home
      - Beer, ale, and other malt beverages at home
      - Distilled spirits at home
        - Whiskey at home*
        - Distilled spirits, excluding whiskey, at home*
      - Wine at home
    - Alcoholic beverages away from home
      - Beer, ale, and other malt beverages away from home*
      - Wine away from home*
      - Distilled spirits away from home*

- Housing
  - Shelter
    - Rent of primary residence
    - Lodging away from home
      - Housing at school, excluding board
      - Other lodging away from home, including hotels and motels
    - Owners' equivalent rent of residences
      - Owner's equivalent rent of primary residence
    - Tenants' and household insurance
  - Fuels and utilities
    - Household energy
      - Fuel oil and other household fuels
        - Fuel oil
        - Propane, kerosene, firewood
      - Energy services
        - Electricity
        - Utility (piped) gas service
    - Water and sewer and trash collection services
      - Water and sewerage maintenance
      - Garbage and trash collection
  - Household furnishings and operations
    - Window and floor coverings and other linens
      - Floor coverings
      - Window coverings
      - Other linens
    - Furniture and bedding
      - Bedroom furniture
      - Living room, kitchen, and dining room furniture
      - Other furniture
        - Infants' furniture

Appendix 1. List of published indexes—continued

- Appliances
  - Major appliances
    - Laundry equipment*
  - Other appliances
- Other household equipment and furnishings
  - Clocks, lamps, and decorator items
  - Indoor plants and flowers
  - Dishes and flatware
  - Nonelectric cookware and tableware
- Tools, hardware, outdoor equipment and supplies
  - Tools, hardware and supplies
  - Outdoor equipment and supplies
- Housekeeping supplies
  - Household cleaning products
  - Household paper products
  - Miscellaneous household products
- Household operations
  - Domestic services
  - Gardening and lawn care services
  - Moving, storage, freight expense
  - Repair of household items

Apparel
- Men's and boys' apparel
  - Men's apparel
    - Men's suits, sport coats, and outerwear
    - Men's furnishings
    - Men's shirts and sweaters
    - Men's pants and shorts
  - Boys' apparel
- Women's and girls' apparel
  - Women's apparel
    - Women's outerwear
    - Women's dresses
    - Women's suits and separates
    - Women's underwear, nightwear, sportswear and accessories
  - Girls' apparel
- Footwear
  - Men's footwear
  - Boys' and girls' footwear
  - Women's footwear
- Infants' and toddlers' apparel
- Jewelry and watches
  - Watches
  - Jewelry

Transportation
- Private transportation
  - New and used motor vehicles
    - New vehicles
      - New cars and trucks*
      - New cars*
      - New trucks*
    - Used cars and trucks
    - Leased cars and trucks
    - Car and truck rental

Appendix 1. List of published indexes—continued

- Motor fuel
  - Gasoline (all types)
    - Gasoline, unleaded regular*
    - Gasoline, unleaded midgrade*
    - Gasoline, unleaded premium*
  - Other motor fuels
- Motor vehicle parts and equipment
  - Tires
  - Vehicle accessories other than tires
    - Vehicle parts and equipment other than tires*
    - Motor oil, coolant, and fluids*
- Motor vehicle maintenance and repair
  - Motor vehicle body work
  - Motor vehicle maintenance and servicing
  - Motor vehicle repair
- Motor vehicle insurance
- Motor vehicle fees
  - State and local registration and license fees
  - Parking and other fees
    - Parking fees and tolls*
    - Automobile service clubs*

- Public transportation
  - Airline fare
  - Other intercity transportation
    - Intercity bus fare*
    - Intercity train fare*
    - Ship fare*
  - Intracity transportation
    - Intracity mass transit*

- Medical care
  - Medical care commodities
    - Medicinal drugs
      - Prescription drugs
      - Nonprescription drugs
    - Medical equipment and supplies
  - Medical care services
    - Professional services
      - Physicians' services
      - Dental services
      - Eyeglasses and eye care
      - Services by other medical professionals
    - Hospital and related services
      - Hospital services
        - Inpatient hospital services*
        - Outpatient hospital services*
      - Nursing homes and adult day services
      - Care of invalids and elderly at home
    - Health insurance

- Recreation
  - Video and audio
    - Televisions
    - Cable and satellite television and radio service
    - Other video equipment

Appendix 1. List of published indexes—continued

- Video discs and other media, including rental of video and audio
  - Video discs and other media
- Rental of video or audio discs and other media
  - Audio equipment
  - Audio discs, tapes, and other media
- Pets, pet products and services
  - Pets and pet products
    - Pet food*
    - Purchase of pets, pet supplies, accessories*
  - Pet services, including veterinary
    - Pet services*
    - Veterinarian services*
- Sporting goods
  - Sports vehicles, including bicycles
  - Sports equipment
- Photography
  - Photographic equipment and supplies
    - Film and photographic supplies*
    - Photographic equipment*
  - Photographers and film processing
    - Photographer fees*
    - Film processing*
- Other recreational goods
  - Toys
    - Toys, games, hobbies and playground equipment*
  - Sewing machines, fabric and supplies
  - Music instruments and accessories
- Other recreation services
  - Club dues and fees for participant sports and group exercises
  - Admissions
    - Admission to movies, theaters, and concerts*
    - Admission to sporting events*
  - Fees for lessons or instructions
- Recreational reading materials
  - Newspapers and magazines
  - Recreational books

- Education and communication
  - Education
    - Educational books and supplies
      - College textbooks*
    - Tuition, other school fees, and childcare
      - College tuition and fees
      - Elementary and high school tuition and fees
      - Child care and nursery school
      - Technical and business school tuition and fees
  - Communication
    - Postage and delivery services
      - Postage
      - Delivery services
    - Information and information processing
      - Telephone services
        - Wireless telephone services
        - Land-line telephone services

Appendix 1. List of published indexes—continued

- Information technology, hardware, and services
  - Personal computers and peripheral equipment
  - Computer software and accessories
  - Internet services and electronic information providers
  - Telephone hardware, calculators, and other consumer information items
- Other goods and services
  - Tobacco and smoking products
    - Cigarettes
    - Tobacco products other than cigarettes
  - Personal care
    - Personal care products
      - Hair, dental, shaving, and miscellaneous personal care products
      - Cosmetics, perfume, bath, nail preparations and implements
    - Personal care services
      - Haircuts and other personal care services
    - Miscellaneous personal services
      - Legal services
      - Funeral expenses
      - Laundry and dry cleaning services
      - Apparel services other than laundry and dry cleaning
      - Financial services
        - Checking account and other bank services*
        - Tax return preparation and other accounting fees*
    - Miscellaneous personal goods
      - Stationery, stationery supplies, gift wrap*
      - Infants' equipment*

Special aggregate indexes

All items—old base
All items less energy
All items less food
All items less food and energy
All items less medical care
All items less shelter
All items less food and shelter
All items less food, shelter, and energy
All items less food, shelter, energy, and used cars and trucks
Apparel less footwear
Commodities
Commodities less food
Commodities less food and beverages
Commodities less food and energy commodities
Commodities less food, energy, and used cars and trucks
Domestically produced farm food
Durables
Education and communication commodities
Education and communication services
Energy
Energy commodities
Household furnishings and supplies
Information technology commodities
Nondurables
Nondurables less food
Nondurables less food and apparel
Nondurables less food and beverages

Appendix 1. List of published indexes—continued

Nondurables less food, beverages, and apparel
Other goods
Other personal services
Other services
Recreation commodities
Recreation services
Rent of shelter
Services
Services less energy services
Services less medical care services
Services less rent of shelter
Transportation commodities less motor fuel
Transportation services
Utilities and public transportation
Video and audio products
Video and audio services
Purchasing power of the consumer dollar
Purchasing power of the consumer dollar–old base

* Special index based on a substantially smaller sample.

Appendix 1. List of published indexes—continued

CPI-U and CPI-W Indexes Published at the Regional City-Size Class and Local Area Levels

- All items
  - Food and beverages
    - Food
      - Food at home
        - Cereal and bakery products
        - Meats, poultry, fish, and eggs
        - Dairy and related products
        - Fruits and vegetables
        - Nonalcoholic beverages and beverage materials
        - Other food at home
      - Food away from home
    - Alcoholic beverages
  - Housing
    - Shelter
      - Rent of primary residence
      - Owners' equivalent rent of residences
        - Owner's equivalent rent of primary residence
    - Fuels and utilities
      - Household energy
        - Energy services
          - Electricity
          - Utility (piped) gas service
    - Household furnishings and operations
  - Apparel
  - Transportation
    - Private transportation
      - New and used motor vehicles
        - New vehicles
        - Used cars and trucks
      - Motor fuel
        - Gasoline (all types)
          - Gasoline, unleaded regular*
          - Gasoline, unleaded midgrade*
          - Gasoline, unleaded premium*
      - Motor vehicle insurance
  - Medical care
  - Recreation
  - Education and communication
    - Tuition, other school fees, and childcare
  - Other goods and services

- Special Aggregate indexes
- All items—old base
- All items less energy
- All items less food and energy
- All items less medical care
- All items less shelter
- Commodities
- Commodities less food
- Commodities less food and beverages
- Durables
- Education and communication commodities
- Education and communication services
- Energy
- Household furnishings and supplies

Appendix 1. List of published indexes—continued

Nondurables
Nondurables less food
Nondurables less food and beverages
Other goods
Other personal services
Services
Services less medical care services
Services less rent of shelter
Transportation commodities less motor fuel
* Special index based on a substantially smaller sample.

C-CPI-U Indexes Published at the U.S. City Average (National) Level

(The C-CPI-U is issued for national averages only, and employs a December 1999 = 100 reference base.)

All items
- Food and beverages
  - Food
    - Food at home
    - Food away from home
  - Alcoholic beverages

- Housing
  - Shelter
  - Fuels and utilities
  - Household furnishings and operations

- Apparel

- Transportation
  - Private transportation
  - Public transportation

- Medical care
  - Medical care commodities
  - Medical care services

- Recreation

- Education and communication
  - Education
  - Communication

- Other goods and services

Special aggregate indexes

All items less food and energy
Commodities
Durables
Energy
Nondurables
Services

Appendix 1. List of published indexes—continued

CPI-U and CPI-W Indexes Published at the National City-Size Class

- All items
  - Food and beverages
    - Food
      - Food at home
      - Food away from home
    - Alcoholic beverages

  - Housing
    - Shelter
      - Rent of primary residence
      - Owners' equivalent rent of residences
        - Owner's equivalent rent of primary residence
    - Fuels and utilities
      - Household energy
        - Energy services
          - Electricity
          - Utility (piped) gas service
    - Household furnishings and operations

  - Apparel

  - Transportation
    - Private transportation
      - New and used motor vehicles
        - New vehicles
          - New cars and trucks*
          - New cars*
        - Used cars and trucks
      - Motor fuel
        - Gasoline (all types)

          - Gasoline, unleaded regular*
          - Gasoline, unleaded midgrade*
          - Gasoline, unleaded premium*

  - Medical care
    - Medical care commodities
    - Medical care services
      - Professional services

  - Recreation
  - Education and communication
  - Other goods and services

- Special aggregate indexes
- All items—old base
- All items less energy
- All items less food
- All items less food and energy

Appendix 1. List of published indexes—continued

All items less medical care
All items less shelter
Commodities
Commodities less food
Commodities less food and beverages
Commodities less food and energy commodities
Durables
Education and communication commodities
Education and communication services
Energy
Energy commodities
Household furnishings and supplies
Nondurables
Nondurables less food
Nondurables less food and apparel
Nondurables less food and beverages
Nondurables less food, beverages, and apparel
Other goods
Other personal services
Other services
Recreation commodities
Recreation services
Rent of shelter
Services
Services less energy services
Services less medical care services
Services less rent of shelter
Transportation commodities less motor fuel
Transportation services

* Special index based on a substantially smaller sample.

Appendix 2. List of average retail price series published by the Bureau of Labor Statistics ("X" indicates published)

Title	United States	Region	Population size class	Area
Energy				
Utility natural gas per therm	X	X	X	X
Fuel oil #2 per gallon (3.785 liters)	X	X	X	
Electricity per kWh	X	X	X	X
Gasoline, all types, per gallon/3.785 liters	X	X	X	X
Gasoline, unleaded regular, per gallon/3.785 liters	X	X	X	X
Gasoline, unleaded midgrade, per gallon/3.785 liters	X	X	X	X
Gasoline, unleaded premium, per gallon/3.785 liters	X	X	X	X
Automotive diesel fuel, per gallon/3.785 liters	X	X	X	
Cereals and bakery products				
Flour, white, all purpose, per lb (453.6 gm)	X	X		
Rice, white, long grain, uncooked, per lb (453.6 gm)	X	X		
Spaghetti and macaroni, per lb (453.6 gm)	X	X		
Bread, white, pan, per lb (453.6 gm)	X	X		
Bread, French, per lb (453.6 gm)	X	X		
Bread, whole wheat, pan, per lb (453.6 gm)	X	X		
Cookies, chocolate chip, per lb (453.6 gm)	X	X		
Crackers, soda, salted, per lb (453.6 gm)	X	X		
Beef and veal				
Ground chuck, 100% beef, per lb (453.6 gm)	X	X		
Ground beef, 100% beef, per lb (453.6 gm)	X	X		
Ground beef, lean and extra lean, per lb (453.6 gm)	X	X		
All uncooked ground beef, per lb (453.6 gm)	X	X		
Chuck roast, USDA Choice, bone-in, per lb (453.6 gm)	X	X		
Chuck roast, graded and ungraded, excluding USDA Prime and Choice, per lb (453.6 gm)	X	X		
Chuck roast, USDA Choice, boneless, per lb (453.6 gm)	X	X		
Round roast, USDA Choice, boneless, per lb (453.6 gm)	X	X		
Round roast, graded and ungraded, excluding USDA Prime and Choice, per lb (453.6 gm)	X	X		
Rib roast, USDA Choice, bone-in, per lb (453.6 gm)[1]	X	X		
All uncooked beef roasts, per lb (453.6 gm)	X	X		
Steak, T-bone, USDA Choice, bone-in, per lb (453.6 gm)[2]	X	X		
Steak, rib eye, USDA Choice, boneless, per lb (453.6 gm)[3]	X	X		
Steak, round, USDA Choice, boneless, per lb (453.6 gm)	X	X		
Steak, round, graded and ungraded, excluding USDA Prime and Choice, per lb (453.6 gm)	X	X		
Steak, sirloin, USDA Choice, bone-in, per lb (453.6 gm)[4]	X	X		

Appendix 2. List of average retail price series published by the Bureau of Labor Statistics ("X" indicates published)—continued

Title	United States	Region	Population size class	Area
Steak, sirloin, graded and ungraded, excluding USDA Prime and Choice, per lb (453.6 gm)	X	X		
Steak, sirloin, USDA Choice, boneless, per lb (453.6 gm)	X	X		
Short ribs, any primal source, bone-in, per lb (453.6 gm)	X	X		
Beef for stew, boneless, per lb (453.6 gm)	X	X		
All uncooked beefsteaks, per lb (453.6 gm)	X	X		
All uncooked other beef (excluding veal), per lb (453.6 gm)	X	X		
Pork and other meats				
Bacon, sliced, per lb (453.6 gm)	X	X		
Chops, center cut, bone-in, per lb (453.6 gm)	X	X		
Chops, boneless, per lb (453.6 gm)	X	X		
All pork chops, per lb (453.6 gm)	X	X		
Ham, rump, or shank half, bone-in, smoked, per lb (453.6 gm)	X	X		
Ham, boneless, excluding canned, per lb (453.6 gm)	X	X		
All ham (excluding canned ham and luncheon slices), per lb (453.6 gm)	X	X		
Ham, canned, 3 or 5 lbs, per lb (453.6 gm)	X	X		
Shoulder picnic, bone-in, smoked, per lb (453.6 gm)	X	X		
All other pork (excluding canned ham and luncheon slices), per lb (453.6 gm)	X	X		
Sausage, fresh, loose, per lb (453.6 gm)	X	X		
Frankfurters, all meat or all beef, per lb (453.6 gm)	X	X		
Bologna, all beef or mixed, per lb (453.6 gm)	X	X		
Lamb and mutton, bone-in, per lb (453.6 gm)	X	X		
Poultry, fish, and eggs				
Chicken, fresh, whole, per lb (453.6 gm)	X	X		
Chicken breast, bone-in, per lb (453.6 gm)	X	X		
Chicken breast, boneless, per lb (453.6 gm)	X	X		
Chicken legs, bone-in, per lb (453.6 gm)	X	X		
Turkey, frozen, whole, per lb (453.6 gm)	X	X		
Tuna, light, chunk, per lb (453.6 gm)	X	X		
Eggs, grade A, large, per doz	X	X		
Eggs, grade AA, large, per doz	X	X		
Dairy products				
Milk, fresh, whole, fortified, per ½ gal (1.9 lit)	X	X		
Milk, fresh, whole, fortified, per gal (3.8 lit)	X	X		
Milk, fresh, low fat, per ½ gal (1.9 lit)	X	X		

Appendix 2. List of average retail price series published by the Bureau of Labor Statistics ("X" indicates published)—continued

Title	United States	Region	Population size class	Area
Milk, fresh, low fat, per gal (3.8 lit)	X	X		
Butter, salted, grade AA, stick, per lb (453.6 gm)	X	X		
American processed cheese, per lb (453.6 gm)	X	X		
Cheddar cheese, natural, per lb (453.6 gm)	X	X		
Ice cream, prepackaged, bulk, regular, per ½ gal (1.9 lit)	X	X		
Yogurt, natural, fruit flavored, per 8 oz (226.8 gm)	X	X		
Fresh fruits and vegetables				
Apples, Red Delicious, per lb (453.6 gm)	X	X		
Bananas, per lb (453.6 gm)	X	X		
Oranges, Navel, per lb (453.6 gm)	X	X		
Oranges, Valencia, per lb (453.6 gm)	X	X		
Cherries, per lb (453.6 gm)	X	X		
Grapefruit, per lb (453.6 gm)	X	X		
Grapes, Thompson, Seedless, per lb (453.6 gm)	X	X		
Lemons, per lb (453.6 gm)	X	X		
Peaches, per lb (453.6 gm)	X	X		
Pears, Anjou, per lb (453.6 gm)	X	X		
Strawberries, dry pint, per 12 oz (340.2 gm)	X	X		
Potatoes, white, per lb (453.6 gm)	X	X		
Lettuce, iceberg, per lb (453.6 gm)	X	X		
Lettuce, romaine, per lb (453.6 gm)	X	X		
Tomatoes, field grown, per lb (453.6 gm)	X	X		
Broccoli, per lb (453.6 gm)	X	X		
Cabbage, per lb (453.6 gm)	X	X		
Carrots, short trimmed and topped, per lb (453.6 gm)	X	X		
Celery, per lb (453.6 gm)	X	X		
Corn on the cob, per lb (453.6 gm)	X	X		
Cucumbers, per lb (453.6 gm)	X	X		
Onions, dry yellow, per lb (453.6 gm)	X	X		
Peppers, sweet, per lb (453.6 gm)	X	X		
Processed fruits and vegetables				
Applesauce, any variety, all sizes, per lb (453.6 gm)	X	X		
Orange juice, frozen concentrate, 12 oz can, per 16 oz (473.2 mL)	X	X		
Beans, dried, any type, all sizes, per lb (453.6 gm)	X	X		
Corn, canned, any style, all sizes, per lb (453.6 gm)	X	X		
Potatoes, frozen, French fried, per lb (453.6 gm)	X	X		
Peaches, any variety, all sizes, per lb	X	X		

Appendix 2. List of average retail price series published by the Bureau of Labor Statistics ("X" indicates published)—continued

Title	United States	Region	Population size class	Area
Other food items				
Sugar, white, all sizes, per lb (453.6 gm)	X	X		
Sugar, white, 33–80 oz pkg, per lb (453.6 gm)	X	X		
Margarine, stick, per lb (453.6 gm)	X	X		
Margarine, soft, tubs, per lb (453.6 gm)	X	X		
Shortening, vegetable oil blends, per lb (453.6 gm)	X	X		
Peanut butter, creamy, all sizes, per lb (453.6 gm)	X	X		
Cola, nondiet, cans, 72-oz 6 pk., per 16 oz (473.2 mL) {deposit may be included in price.}	X	X		
Cola, nondiet, per 2 liters (67.6 oz) {deposit may be included in price.}	X	X		
Coffee, 100 percent, ground roast, all sizes, per lb (453.6 gm)	X	X		
Coffee, 100 percent, ground roast, 13.1–20 oz can, per lb (453.6 gm)	X	X		
Coffee, instant, plain, regular, all sizes, per lb (453.6 gm)	X	X		
Potato chips, per 16 oz (453.6 gm)	X	X		
Alcoholic Beverages				
Malt beverages, all types, all sizes, any origin, per 16 oz (473.2 mL)	X	X		
Vodka, all types, all sizes, any origin, per 1 liter (33.8 oz)	X	X		
Wine, red and white table, all sizes, any origin, per 1 liter (33.8 oz)	X	X		

1 Last in published 1997.

2 Last published in April 2002.

3 Last published in October 2001.

4 Last published April 1994.

CPI Appendix 3. Characteristics of the Consumer Price Index, 1890 to date

Date	Survey providing expenditure weight		Base period	Census providing population weights	Number of areas included	Family composition	Earnings of chief earner	Source and amount of family income	Length of employment	Economic level, length of residence, nativity, and race	Title(s)
	Group weights	Item weights									
1890[1]	None	1901	Varied	None	Varied	Two or more persons.	Salaried worker earning $1,200 or less during year. No limitation on wage earners.	No limitation.	No limitation.	No limitation.	
1919	1917–1919	1917–1919	1913								
Feb. 1921					[2]32	Minimum of husband, wife, and one child who was not a boarder or lodger. No boarders nor more than three lodgers present.	Salaried worker earning $2,000 or less. No limitation on wage earners.	At least 75 percent from principal earner or others who contributed all earnings to family fund.		No slum or charity families; White only; in area entire year and in United States 5 years or more; no non-English-speaking families.	Cost of living.
Sept. 1935				[3]Average 1920–1930							
Dec. 1935[4]			1923–1925								
Aug. 1940[5]	1934–1936	[6]1934–1936	1935–1939	1930	[7]33	Two or more persons. Not more than two boarders or lodgers, or guests for more than 26 guest-weeks.	At least $300. Salaried worker earning less than $2,000 during year or less than $200 during any month. No upper limitation on wage earners.	At least $500. Less than one-fourth from interest, dividends, royalties, speculative gains, rents, gifts, or income in kind. No rent in payment of services. Less than 3 months' free rent. No subsidiary clerical worker earning $2,000 or more.	At least 1,008 hours spread over 36 weeks.	No relief families, either on direct or work relief; White only, except where Black population was significant part of total; in area 9 months or more.	Indexes of the cost of living of wage earners and lower salaried workers in large cities.
May 1941[8]					34						
July 1943				[9]1940							
Sept. 1945											Consumer Price Index for Moderate-Income Families in Large Cities.

CPI Appendix 3. Characteristics of the Consumer Price Index, 1890 to date—Continued

Date	Survey providing expenditure weight		Base period	Census providing population weights	Number of areas included	Family composition	Earnings of chief earner	Source and amount of family income	Length of employment	Economic level, length of residence, nativity, and race	Title(s)
	Group weights	Item weights									
Jan. 1951[10]	1947–1949	[11]1934–1936		1950		Two or more persons.	No limitation. (Family income not in excess of $10,000.)	Family income under $10,000 after taxes in the survey year. No minimum income limit, except that families with no income from wages or salaries were excluded.	Family head must have been employed at least 26 weeks.	No exclusion for receipt of relief as such, but only families with wage or salary earnings included. No length of residence, nativity, or racial limitations.	
Jan.1953[12]	[13]1950	[13]1950	[14]1947–1949		46				No specific requirement, but major portion of income of family head must be from employment as wage earner or salaried clerical worker.		**Short title:** Consumer Price Index. **Complete name:** Index of Change in Prices of Goods and Services Purchased by City Wage-Earner and Clerical-Worker Families to Maintain Their Level of Living.
Jan. 1962			[15]1957–1959								
Jan. 1964[16]	[17]1960–1961	[17]1960–1961		1960	50	Families of two or more persons and single workers; at least one full-time wage earner.	No limitation.	More than half of combined family income from wage-earner or clerical-worker occupation.	A minimum of 37 weeks for at least 1 family member.	No restrictions other than the wage-earner and clerical-worker definition.	Consumer Price Index for Urban Wage Earners and Clerical Workers.
Jan. 1966[18]					56						
Jan. 1971[19]			1967								

CPI Appendix 3. Characteristics of the Consumer Price Index, 1890 to date—Continued

Date	Survey providing expenditure weight		Base period	Census providing population weights	Number of areas included	Family composition	Earnings of chief earner	Source and amount of family income	Length of employment	Economic level, length of residence, nativity, and race	Title(s)
	Group weights	Item weights									
Jan. 1978[20]	[21]1972–1973	[22]1974		1970	85	For earner and clerical-worker indexes, families of two or more persons and single workers; at least one full-time wage earner.. No limitation for urban consumer index.		For wage-earner and clerical-worker indexes, more than half of combined family income from wage-earner or clerical-worker occupation. No limitation for urban consumer index.	For wage-earner and clerical-worker indexes, a minimum of 37 weeks for at least one family member. No employment required for urban consumer index.	For wage-earner and clerical-worker indexes, no restrictions other than the wage-earner and clerical-worker definition. No limitation for urban consumer index.[23]	**1.** Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). **2.** Consumer Price Index for All Urban Consumers (CPI-U).
Jan.1983[24]						CPI-U					
Jan. 1985[25]						CPI-W					
Jan. 1987[26]	[27]1982–1984	[28]1985–1989		1980	91	Families of two or more persons and single workers; at least one full-time wage earner. Students residing in college-regulated housing are treated as separate family units.					
Jan. 1988			[29]1982–1984								
Jan. 1998[30]	[31]1993–1995	[32]1992–1996		1990							
Jan. 2002[33]	[34]1999–2000	[35]1997–2001		1990							
July 2002[36]	1999–2000		Dec.1999			Same as CPI-U population.					Chained Consumer Price Index for All Urban Consumers (C-CPI-U).
Jan. 2004[37]	[38]2001–2002	[39]2000–2003									
Jan. 2006[40]	[41]2003–2004	[42]2002–2005									
Jan. 2008[43]	[44]2005–2006	[45]2004–2007									
Jan. 2010[46]	[47]2007–2008	[48]2006–2009									
Jan. 2012[49]	[50]2009–2010	[51]2008–2011									
Jan. 2014[52]	[53]2011–2012	[54]2010–2013									

[1] Food price indexes only.

[2] For 19 cities, data were available back to December 1914, and for 13 cities, back to 1917. For the United States, data were available back to the 1913 annual average.

[3] Indexes between 1918 and 1929 were recomputed retroactively with population weights based on the average of the 1920 and 1930 censuses.

[4] Index published in December 1935 for July 15, 1935; Indexes were also calculated on the 1913 = 100 base.

[5] Indexes between 1925 and 1929 were recomputed retroactively, with group weights based on the average of 1917–1919 and 1934–1936. Indexes between March 15, 1930, and March 15, 1940, were recomputed retroactively with 1934–1936 group weights.

[6] During World War II, weights were adjusted to account for rationing and shortages.

[7] There were 51 to 56 cities included in the food index.

[8] Index published in May 1941 for March 14, 1941. Food indexes were based on 51 cities.

[9] Census data for 1940 were supplemented by ration book registration data.

[10] Index published in March 1951 for January 1951.

[11] All-item and group indexes bteween January 1950 and January 1951 were revised retroactively. Rent and all-item indexes were corrected for new-unit bias from 1940. Old series also published through 1952.

[12] Item weights were revised for only the seven cities for which 1947–1949 expenditure data were available. Index was published in February and January 1953. Linked to old series as of December 1952. Old series also published during a 6-month overlap period.

[13] Data were adjusted to 1952 for weight derivation.

[14] Indexes also were calculated on the base of 1935–1939 = 100 through December 1957.

[15] Index published in February for January 1962. Indexes also were calculated on bases of 1947–1949 = 100 and 1939 = 100.

[16] Index published March 3 for January 1964. Linked to old series as of December 1963. Old series also published during a 6-month overlap period.

[17] Data were adjusted to December 1963 for weight derivation.

[18] Index published in February for January 1966. Linked to old series as of December 1965.

[19] Index published in February for January 1971. Indexes were also calculated on the 1957–1959 = 100 base.

[20] Index published in February for January 1978. Linked to old series as of December 1977. Old series also published during a 6-month overlap period.

[21] Data were adjusted to December 1977 for weight derivation.

[22] Item weights based on Points of Purchase Survey in 1974.

[23] Coverage was expanded to include wage earners and clerical workers in the entire nonfarm parts of metropolitan areas, in addition to those living within the urbanized areas of metropolitan areas and urban places of 2,500 or more inhabitants.

[24] Changed homeowners' costs from asset approach to flow-of-service approach (rental equivalence).

[25] Changed homeowners' costs from asset approach to flow-of-service approach (rental equivalence).

[26] Index published in February for January 1987. Linked to old series as of December 1986. Old series also published during a 6-month overlap period.

[27] Data were adjusted to December 1986 for weight derivation.

[28] Item weights based on Continuing Point of Purchase Survey (CPOPS) from 1985–1989; first "rolling revision."

[29] Index published in February for January 1988. Indexes also calculated on the 1967 = 100 base.

[30] Index published in February for January 1989. Linked to old series as of December 1997. Old series also published during a 6-month overlap period.

[31] Data adjusted to December 1997 for weight derivation.

[32] At time of revision, the CPOPS covered 1992–1996. The revised TPOPS was introduced in 1998.

[33] Index published in February for January 2002. Linked to old series as of December 2001. Old series also published during a 6-month overlap period.

[34] Data were adjusted to December 2001 for weight deviation.

[35] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 1997 forward.

[36] New index. Elementary indexes aggregated by using an adjusted geometric mean for the preliminary versions and a Törnqvist formula for the final version. Until 2014, first issued in preliminary form (initial); subject to revision in February (interim) and again the following February (final). Starting in

[37] Index published in February for January 2004. Linked to old series as of December 2003.

[38] Data were adjusted to December 2003 for weight deviation.

[39] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 1999 forward.

[40] Index published in February for January 2006. Linked to old series as of December 2005.

[41] Data were adjusted to December 2005 for weight deviation.

[42] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 2001 forward.

[43] Index published in February for January 2008. Linked to old series as of December 2007.

[44] Data were adjusted to December 2007 for weight deviation.

[45] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 2003 forward.

[46] Index published in February for January 2010. Linked to old series as of December 2009.

[47] Data were adjusted to December 2009 for weight deviation.

[48] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 2005 forward.

[49] Index published in February for January 2012. Linked to old series as of December 2011.

[50] Data were adjusted to December 2011 for weight deviation.

[51] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 2007 forward.

[52] Index published in February for January 2014. Linked to old series as of December 2013.

[53] Data were adjusted to December 2013 for weight deviation.

[54] TPOPS on 4-year rotation; at the time of expenditure weight update, largely reflected data from 2009 forward.

Appendix 4. 2018 CPI geographic sample

PSU code(1)	PSU name	Pricing cycle (2)	PSU definition (state, and county or parish (Louisiana))	Stratum population	Percentage of index population
Region 1—Northeast, Division 1—New England					
S11A	Boston–Cambridge–Newton, MA–NH	O	MA: Essex, Middlesex, Norfolk, Plymouth, Suffolk NH: Rockingham, Strafford	4,552,402	1.57
N11B	Hartford–West Hartford–East Hartford, CT	E	CT: Hartford, Middlesex, Tolland	5,005,793	1.73
N11C	Springfield, MA	O	MA: Hampden, Hampshire	4,233,926	1.46
Region 1—Northeast, Division 2—Middle Atlantic					
S12A	New York–Newark–Jersey City, NY–NJ–PA	M	NJ: Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union NY: Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester PA: Pike	19,567,410	6.76
S12B	Philadelphia–Camden–Wilmington, PA–NJ–DE–MD	E	DE: New Castle MD: Cecil NJ: Burlington, Camden, Gloucester, Salem PA: Bucks, Chester, Delaware, Montgomery, Philadelphia	5,965,343	2.06
N12C	Pittsburgh, PA	E	PA: Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, Westmoreland	4,065,877	1.4
N12D	Buffalo–Cheektowaga–Niagara Falls, NY	E	NY: Erie, Niagara	3,483,174	1.2
N12E	[W1]Rochester, NY	O	NY: Livingston, Monroe, Ontario, Orleans, Wayne, Yates	3,925,318	1.36
N12F	Reading, PA	O	PA: Berks	3,562,332	1.23
Region 2—Midwest, Division 3—East North Central					
S23A	Chicago–Naperville–Elgin, IL–IN–WI	M	IL: Cook, De Kalb, Du Page, Grundy, Kane, Kendall, Lake, McHenry, Will IN: Jasper, Lake, Newton, Porter WI: Kenosha	9,461,105	3.27
S23B	Detroit–Warren–Dearborn, MI	E	MI: Lapeer, Livingston, Macomb, Oakland, St. Clair, Wayne	4,296,250	1.48
N23C	Cincinnati, OH–KY–IN	E	IN: Dearborn, Ohio, Union KY: Boone, Bracken, Campbell, Gallatin, Grant, Kenton, Pendleton OH: Brown, Butler, Clermont, Hamilton, Warren	3,395,853	1.17
N23D	Cleveland–Elyria, OH	O	OH: Cuyahoga, Geauga, Lake, Lorain, Medina	3,257,953	1.12
N23E	Columbus, OH	O	OH: Delaware, Fairfield, Franklin, Hocking, Licking, Madison, Morrow, Perry, Pickaway, Union	3,758,510	1.3
N23F	Milwaukee–Waukesha–West Allis, WI	O	WI: Milwaukee, Ozaukee, Washington, Waukesha	3,256,494	1.12
N23G	Dayton, OH	O	OH: Greene, Miami, Montgomery	3,924,320	1.36

Appendix 4. 2018 CPI geographic sample—continued

PSU code(1)	PSU name	Pricing cycle (2)	PSU definition (state, and county or parish (Louisiana))	Stratum population	Percentage of index population
N23H	[W1]Flint, MI	O	MI: Genesee	3,911,189	1.35
N23I	[W2]Janesville–Beloit, WI	E	WI: Rock	3,745,126	1.29
N23J	[W3]Frankfort, IN	E	IN: Clinton	3,427,365	1.18
Region 2—Midwest, Division 4—West North Central					
S24A	Minneapolis–St. Paul–Bloomington, MN–WI	O	MN: Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Le Sueur, Mille Lacs, Ramsey, Scott, Sherburne, Sibley, Washington, Wright	3,348,859	1.16
			WI: Pierce, St. Croix		
S24B	St. Louis, MO–IL	E	IL: Bond, Calhoun, Clinton, Jersey, Macoupin, Madison, Monroe, St. Clair	2,787,701	0.96
			MO: Franklin, Jefferson, Lincoln, St. Charles, St. Louis, St. Louis City, Warren		
N24C	[W2]Omaha–Council Bluffs, NE–IA	E	IA: Harrison, Mills, Pottawattamie	2,974,017	1.03
			NE: Cass, Douglas, Sarpy, Saunders, Washington		
N24D	[W2]Wichita, KS	O	KS: Butler, Harvey, Kingman, Sedgwick, Sumner	2,842,770	0.98
N24E	Lincoln, NE	O	NE: Lancaster, Seward	3,288,318	1.14
N24F	[W3]Wahpeton, ND–MN	E	MN: Wilkin	2,947,903	1.02
			ND: Richland		
Region 3—South, Division 5—South Atlantic					
S35A	Washington–Arlington–Alexandria, DC–VA–MD–WV	O	DC: District of Columbia	5,636,232	1.95
			MD: Calvert, Charles, Frederick, Montgomery, Prince George's		
			VA: Alexandria City, Arlington, Clarke, Culpeper, Fairfax, Fairfax City, Falls Church City, Fauquier, Fredericksburg City, Loudoun, Manassas City, Manassas Park City, Prince William, Rappahannock, Spotsylvania, Stafford, Warren		
			WV: Jefferson		
S35B	Miami–Fort Lauderdale–West Palm Beach, FL	E	FL: Broward, Miami–Dade, Palm Beach	5,564,635	1.92
S35C	Atlanta–Sandy Springs–Roswell, GA	E	GA: Barrow, Bartow, Butts, Carroll, Cherokee, Clayton, Cobb, Coweta, Dawson, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Haralson, Heard, Henry, Jasper, Lamar, Meriwether, Morgan, Newton, Paulding, Pickens, Pike, Rockdale, Spalding, Walton	5,286,728	1.83
S35D	Tampa–St. Petersburg–Clearwater, FL	O	FL: Hernando, Hillsborough, Pasco, Pinellas	2,783,243	0.96
S35E	Baltimore–Columbia–Towson, MD	E	MD: Anne Arundel, Baltimore, Baltimore City, Carroll, Harford, Howard, Queen Anne's	2,710,489	0.94
N35F	[W3]Charlotte–Concord–Gastonia, NC–SC	O	NC: Cabarrus, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Union	3,035,149	1.05
			SC: Chester, Lancaster, York		

Appendix 4. 2018 CPI geographic sample—continued

PSU code(1)	PSU name	Pricing cycle (2)	PSU definition (state, and county or parish (Louisiana))	Stratum population	Percentage of index population
N35G	[W1]Orlando–Kissimmee–Sanford, FL	E	FL: Lake, Orange, Osceola, Seminole	2,642,941	0.91
N35H	Richmond, VA	E	VA: Amelia, Caroline, Charles City, Chesterfield, Colonial Heights City, Dinwiddie, Goochland, Hanover, Henrico, Hopewell City, King William, New Kent, Petersburg City, Powhatan, Prince George, Richmond City, Sussex	3,027,856	1.05
N35I	Raleigh, NC	E	NC: Franklin, Johnston, Wake	2,549,176	0.88
N35J	Greenville–Anderson–Mauldin, SC	O	SC: Anderson, Greenville, Laurens, Pickens	3,094,518	1.07
N35K	[W3]Winston–Salem, NC	E	NC: Davidson, Davie, Forsyth, Stokes, Yadkin	2,637,083	0.91
N35L	Cape Coral–Fort Myers, FL	O	FL: Lee	3,091,153	1.07
N35M	Ocala, FL	O	FL: Marion	2,568,744	0.89
N35N	Gainesville, FL	E	FL: Alachua, Gilchrist	2,913,140	1.01
N35O	[W2]Wilmington, NC	O	NC: New Hanover, Pender	2,736,321	0.94
N35P	[W2]Jacksonville, NC	E	NC: Onslow	3,100,604	1.07
N35Q	[W1]Clarksburg, WV	O	WV: Doddridge, Harrison, Taylor	2,563,098	0.89
Region 3—South, Division 6—East South Central					
N36A	[W4]Louisville/Jefferson County, KY–IN	O	IN: Clark, Floyd, Harrison, Scott, Washington KY: Bullitt, Henry, Jefferson, Oldham, Shelby, Spencer, Trimble	2,529,624	0.87
N36B	Birmingham–Hoover, AL	O	AL: Bibb, Blount, Chilton, Jefferson, Shelby, St. Clair, Walker	2,483,606	0.86
N36C	Chattanooga, TN–GA	E	GA: Catoosa, Dade, Walker TN: Hamilton, Marion, Sequatchie	2,620,595	0.9
N36D	[W4]Huntsville, AL	E	AL: Limestone, Madison	2,801,399	0.97
N36E	Florence–Muscle Shoals, AL	O	AL: Colbert, Lauderdale	2,550,408	0.88
N36F	[W1]Meridian, MS	E	MS: Clarke, Kemper, Lauderdale	2,397,313	0.83
Region 3—South, Division 7—West South Central					
S37A	Dallas–Fort Worth–Arlington, TX	O	TX: Collin, Dallas, Denton, Ellis, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, Somervell, Tarrant, Wise	6,426,214	2.22
S37B	Houston–The Woodlands–Sugar Land, TX	E	TX: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller	5,920,416	2.04
N37C	San Antonio–New Braunfels, TX	O	TX: Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, Wilson	2,436,095	0.84
N37D	Oklahoma City, OK	E	OK: Canadian, Cleveland, Grady, Lincoln, Logan, McClain, Oklahoma	2,812,948	0.97
N37E	Baton Rouge, LA	E	LA: Ascension, East Baton Rouge, East Feliciana, Iberville, Livingston, Pointe Coupee, St. Helena, West Baton Rouge, West Feliciana	2,543,610	0.88
N37F	Lafayette, LA	O	LA: Acadia, Iberia, Lafayette, St. Martin, Vermilion	2,444,837	0.84
N37G	Brownsville–Harlingen, TX	O	TX: Cameron	2,581,037	0.89
N37H	Amarillo, TX	E	TX: Armstrong, Carson, Oldham, Potter, Randall	2,756,117	0.95

Appendix 4. 2018 CPI geographic sample—continued

PSU code(1)	PSU name	Pricing cycle (2)	PSU definition (state, and county or parish (Louisiana))	Stratum population	Percentage of index population
N37I	[W2]Russellville, AR	O	AR: Pope, Yell	2,620,998	0.91
N37J	[W3]Paris, TX	E	TX: Lamar	2,851,943	0.98
Region 4—West, Division 8—Mountain					
S48A	Phoenix–Mesa–Scottsdale, AZ	E	AZ: Maricopa, Pinal	4,192,887	1.45
S48B	Denver–Aurora–Lakewood, CO	O	CO: Adams, Arapahoe, Broomfield, Clear Creek, Denver, Douglas, Elbert, Gilpin, Jefferson, Park	2,543,482	0.88
N48C	Las Vegas–Henderson–Paradise, NV	E	NV: Clark	3,227,960	1.11
N48D	Provo–Orem, UT	E	UT: Juab, Utah	3,724,271	1.29
N48E	Yuma, AZ	O	AZ: Yuma	3,840,701	1.33
N48F	[W3]St. George, UT	O	UT: Washington	3,206,759	1.11
Region 4—West, Division 9—Pacific					
S49A	Los Angeles–Long Beach–Anaheim, CA	M	CA: Los Angeles, Orange	12,828,837	4.43
S49B	San Francisco–Oakland–Hayward, CA	E	CA: Alameda, Contra Costa, Marin, San Francisco, San Mateo	4,335,391	1.5
S49C	Riverside–San Bernardino–Ontario, CA	O	CA: Riverside, San Bernardino	4,224,851	1.46
S49D	Seattle–Tacoma–Bellevue, WA	E	WA: King, Pierce, Snohomish	3,439,809	1.19
S49E	San Diego–Carlsbad, CA	O	CA: San Diego	3,095,313	1.07
S49F	Honolulu, HI	O	HI: Honolulu	1,360,301	0.47
S49G	Anchorage, AK	E	AK: Anchorage, Matanuska–Susitna	523,154	0.18
N49H	Portland–Vancouver–Hillsboro, OR–WA	O	OR: Clackamas, Columbia, Multnomah, Washington, Yamhill WA: Clark, Skamania	5,208,366	1.8
N49I	[W1]Santa Rosa, CA	E	CA: Sonoma	5,163,670	1.78
N49J	Chico, CA	E	CA: Butte	4,623,339	1.6
N49K	[W4]Moses Lake, WA	O	WA: Grant	4,363,676	1.51

(1) PSU code (1st character: S—self-representing or N—non-self-representing; 2nd character: region number; 3rd character: division number; 4th character: A–Q, depending on number of PSUs within a Census division).

(2) E = Even months, O = Odd months, M = Monthly.

Note: The superscripts W1–W4 designate the respective wave during which each new PSU will enter the index; no designation indicates a continuing PSU.

Source: U.S. Bureau of Labor Statistics.

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items

MAJOR GROUP: FOOD AND BEVERAGES

CEREALS AND BAKERY PRODUCTS

FA Cereals and cereal products

FA01	*Flour and prepared flour mixes*	
FA011		FLOUR AND PREPARED FLOUR MIXES
FA02	*Breakfast cereal*	
FA021		BREAKFAST CEREAL
FA03	*Rice, pasta, cornmeal*	
FA031		RICE, PASTA, CORNMEAL

FB Bakery products

FB01	*Bread*	
FB011		BREAD
FB02	*Fresh biscuits, rolls, muffins*	
FB021		FRESH BISCUITS, ROLLS, AND MUFFINS
FB03	*Cakes, cupcakes, and cookies*	
FB031		CAKES AND CUPCAKES (EXCLUDING FROZEN)
FB032		COOKIES
FB04	*Other bakery products*	
FB041		CRACKERS AND BREAD, AND CRACKER PRODUCTS
FB042		SWEETROLLS, COFFEE CAKE, AND DOUGHNUTS (EXCLUDING FROZEN)
FB043		FROZEN BAKERY PRODUCTS, AND FROZEN/REFRIGERATED DOUGHS AND BATTERS
FB044		PIES, TARTS, TURNOVERS (EXCLUDING FROZEN)

MEATS, POULTRY, FISH, AND EGGS

FC Beef and veal

FC01	*Uncooked ground beef*	
FC011		UNCOOKED GROUND BEEF
FC02	*Uncooked beef roasts*	
FC021		UNCOOKED BEEF ROASTS
FC03	*Uncooked beef steaks*	
FC031		UNCOOKED BEEF STEAKS
FC04	*Uncooked other beef and veal*	
FC041		UNCOOKED OTHER BEEF AND VEAL

FD Pork

FD01	*Bacon, breakfast sausage, and related products*	
FD011		BACON, BREAKFAST SAUSAGE, AND RELATED PRODUCTS
FD02	*Ham*	
FD021		HAM
FD03	*Pork chops*	
FD031		PORK CHOPS
FD04	*Other pork, including roasts and picnics*	
FD041		OTHER PORK INCLUDING ROASTS AND PICNICS

FE Other meats

FE01	*Other meats*	
FE011		FRANKFURTERS
FE012		LUNCHMEATS
FE013		LAMB, ORGAN MEATS, AND GAME

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

FF	**Poultry**	
FF01	*Chicken*	
FF011		CHICKEN
FF02	*Other poultry including turkey*	
FF021		OTHER POULTRY INCLUDING TURKEY
FG	**Fish and seafood**	
FG01	*Fresh fish and seafood*	
FG011		FRESH FISH AND SEAFOOD
FG02	*Processed fish and seafood*	
FG021		PROCESSED FISH AND SEAFOOD
FH	**Eggs**	
FH01	*Eggs*	
FH011		EGGS
	DAIRY AND RELATED PRODUCTS	
FJ	**Dairy and related products**	
FJ01	*Milk*	
FJ011		MILK
FJ02	*Cheese and related products*	
FJ021		CHEESE AND RELATED PRODUCTS
FJ03	*Ice cream and related products*	
FJ031		ICE CREAM AND RELATED PRODUCTS
FJ04	*Other dairy and related products*	
FJ041		OTHER DAIRY AND RELATED PRODUCTS
	FRUITS AND VEGETABLES	
FK	**Fresh fruits**	
FK01	*Apples*	
FK011		APPLES
FK02	*Bananas*	
FK021		BANANAS
FK03	*Citrus fruits*	
FK031		CITRUS FRUITS
FK04	*Other fresh fruits*	
FK041		OTHER FRESH FRUITS
FL	**Fresh vegetables**	
FL01	*Potatoes*	
FL011		POTATOES
FL02	*Lettuce*	
FL021		LETTUCE
FL03	*Tomatoes*	
FL031		TOMATOES
FL04	*Other fresh vegetables*	
FL041		OTHER FRESH VEGETABLES, INCLUDING FRESH HERBS
FM	**Processed fruits and vegetables**	
FM01	*Canned fruits and vegetables and other shelf-stable fruits and vegetables*	
FM011		CANNED FRUITS AND VEGETABLES AND OTHER SHELF-STABLE FRUITS AND VEGETABLES
FM02	*Frozen fruits and vegetables*	

FM021		FROZEN FRUITS AND VEGETABLES
FM03	*Other processed fruits and vegetables, including dried*	
FM031		OTHER PROCESSED FRUITS AND VEGETABLES, INCLUDING DRIED

NONALCOHOLIC BEVERAGES AND BEVERAGE MATERIALS

FN	**Juices and nonalcoholic drinks**	
FN01	*Carbonated drinks*	
FN011		CARBONATED DRINKS
FN02	*Frozen noncarbonated juices and drinks*	
FN021		FROZEN NONCARBONATED JUICES AND DRINKS
FN03	*Nonfrozen noncarbonated juices and drinks*	
FN031		NONFROZEN NONCARBONATED JUICES AND DRINKS

FP	**Beverage materials, including coffee and tea**	
FP01	*Coffee*	
FP011		COFFEE
FP02	*Other beverage materials, including tea*	
FP021		TEA
FP022		OTHER BEVERAGE MATERIALS

OTHER FOOD AT HOME

FR	**Sugar and sweets**	
FR01	*Sugar and artificial sweeteners*	
FR011		SUGAR AND ARTIFICIAL SWEETENERS
FR02	*Candy and chewing gum*	
FR021		CANDY AND CHEWING GUM
FR03	*Other sweets*	
FR031		OTHER SWEETS

FS	**Fats and oils**	
FS01	*Butter and margarine*	
FS011		BUTTER AND MARGARINE
FS02	*Salad dressing*	
FS021		MAYONNAISE, SALAD DRESSING, AND SANDWICH SPREADS
FS03	*Other fats and oils, including peanut butter*	
FS031		PEANUT BUTTER AND OTHER NUT BUTTERS
FS032		OTHER FATS AND OILS

FT	**Other foods**	
FT01	*Soups*	
FT011		SOUPS
FT02	*Frozen and freeze-dried prepared foods*	
FT021		FROZEN AND FREEZE-DRIED PREPARED FOODS
FT03	*Snacks*	
FT031		SNACKS
FT04	*Spices, seasonings, condiments, sauces*	
FT041		SALT AND OTHER SEASONINGS AND SPICES
FT042		OLIVES, PICKLES, RELISHES
FT043		SAUCES AND GRAVIES
FT044		OTHER CONDIMENTS (EXCLUDING OLIVES, PICKLES, AND RELISHES)
FT05	*Baby food*	

FT051		BABY FOOD
FT06	*Other miscellaneous foods*	
FT061		PREPARED SALADS
FT062		OTHER MISCELLANEOUS FOODS

FOOD AWAY FROM HOME

FV	**Food away from home**	
FV01	*Full-service meals and snacks*	
FV011		FULL-SERVICE MEALS AND SNACKS
FV02	*Limited-service meals and snacks*	
FV021		LIMITED-SERVICE MEALS AND SNACKS
FV03	*Food at employee sites and schools*	
FV031		FOOD AT EMPLOYEE SITES AND SCHOOLS
FV04	*Food from vending machines and mobile vendors*	
FV041		FOOD FROM VENDING MACHINES AND MOBILE VENDORS
FV05	*Other food away from home*	
FV051		BOARD, CATERED EVENTS, AND OTHER FOOD AWAY FROM HOME

ALCOHOLIC BEVERAGES

FW	**Alcoholic beverages at home**	
FW01	*Beer, ale, and other malt beverages at home*	
FW011		BEER, ALE, AND OTHER MALT BEVERAGES AT HOME
FW02	*Distilled spirits at home*	
FW021		DISTILLED SPIRITS AT HOME
FW03	*Wine at home*	
FW031		WINE AT HOME
FX	**Alcoholic beverages away from home**	
FX01	*Alcoholic beverages away from home*	
FX011		ALCOHOLIC BEVERAGES AWAY FROM HOME

H **MAJOR GROUP: HOUSING**

SHELTER

HA	**Rent of primary residence**	
HA01	*Rent of primary residence*	
HA011		RENT OF PRIMARY RESIDENCE
HB	**Lodging away from home**	
HB01	*Housing at school, excluding board*	
HB011		HOUSING AT SCHOOL, EXCLUDING BOARD
HB02	*Other lodging away from home, including hotels and motels*	
HB021		RENTAL OF LODGING AWAY FROM HOME
HC	**Owners' equivalent rent of primary residence**	
HC01	*Owners' equivalent rent of primary residence*	
HC011		OWNERS' EQUIVALENT RENT OF PRIMARY RESIDENCE
HC09	*Unsampled owners' equivalent rent of secondary residence*	

HD	**Tenants' and household insurance**	
HD01	*Tenants' and household insurance*	
HD011		TENANTS' AND HOUSEHOLD INSURANCE
	FUELS AND UTILITIES	
HE	**Fuel oil and other fuels**	
HE01	*Fuel oil*	
HE011		FUEL OIL
HE02	*Propane, kerosene, and firewood*	
HE021		OTHER HOUSEHOLD FUELS
HF	**Gas (piped) and electricity**	
HF01	*Electricity*	
HF011		ELECTRICITY
HF02	*Utility (piped) gas service*	
HF021		UTILITY (PIPED) GAS SERVICE
HG	**Water and sewer and trash collection services**	
HG01	*Water and sewerage maintenance*	
HG011		RESIDENTIAL WATER AND SEWERAGE SERVICE
HG02	*Garbage and trash collection*	
HG021		GARBAGE AND TRASH COLLECTION
	HOUSEHOLD FURNISHINGS AND OPERATIONS	
HH	**Window and floor coverings and other linens**	
HH01	*Floor coverings*	
HH011		FLOOR COVERINGS
HH02	*Window coverings*	
HH021		CURTAINS AND DRAPES
HH022		WINDOW COVERINGS
HH03	*Other linens*	
HH031		BATHROOM LINENS
HH032		BEDROOM LINENS
HH033		KITCHEN AND DINING ROOM LINENS
HJ	**Furniture and bedding**	
HJ01	*Bedroom furniture*	
HJ011		MATTRESS AND FOUNDATIONS
HJ012		BEDROOM FURNITURE OTHER THAN MATTRESS AND SPRINGS
HJ02	*Living room, kitchen, and dining room furniture*	
HJ021		SOFAS, FURNITURE COVERS, AND DECORATIVE PILLOWS
HJ022		LIVING ROOM CHAIRS
HJ023		LIVING ROOM TABLES
HJ024		KITCHEN AND DINING ROOM FURNITURE
HJ03	*Other furniture*	
HJ031		INFANTS' FURNITURE
HJ032		OUTDOOR FURNITURE
HJ033		OCCASIONAL FURNITURE
HJ09	*Unsampled furniture*	
HJ090		RENTAL OF FURNITURE

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

HK	**Appliances**	
HK01	*Major appliances*	
HK011		REFRIGERATORS AND HOME FREEZERS
HK012		LAUNDRY EQUIPMENT
HK013		RANGES AND COOKTOPS
HK014		MICROWAVE OVENS
HK02	*Other appliances*	
HK021		FLOOR CLEANING EQUIPMENT
HK022		SMALL ELECTRIC KITCHEN APPLIANCES
HK023		OTHER ELECTRIC APPLIANCES
HK09	*Unsampled appliances*	
HK090		PORTABLE DISHWASHERS
HL	**Other household equipment and furnishings**	
HL01	*Clocks, lamps, and decorator items*	
HL011		LAMPS AND LIGHTING FIXTURES
HL012		HOUSEHOLD DECORATIVE ITEMS AND CLOCKS
HL02	*Indoor plants and flowers*	
HL021		INDOOR PLANTS AND FRESH CUT FLOWERS
HL03	*Dishes and flatware*	
HL031		DISHES
HL032		FLATWARE
HL04	*Nonelectric cookware and tableware*	
HL041		NONELECTRIC COOKINGWARE
HL042		TABLEWARE AND NONELECTRIC KITCHENWARE
HM	**Tools, hardware, outdoor equipment, and supplies**	
HM01	*Tools, hardware, and supplies*	
HM011		PAINT, WALLPAPER TOOLS, AND SUPPLIES
HM012		POWER TOOLS
HM013		MISCELLANEOUS HARDWARE, SUPPLIES, AND EQUIPMENT
HM014		NONPOWERED HANDTOOLS
HM02	*Outdoor equipment and supplies*	
HM021		POWERED LAWN AND GARDEN EQUIPMENT, AND OTHER OUTDOOR ITEMS
HM022		LAWN AND GARDEN MATERIALS, OTHER DECORATIVE ITEMS, AND PESTICIDES
HM09	*Unsampled tools, hardware, outdoor equipment, and supplies*	
HM090		UNSAMPLED ITEMS
HN	**Housekeeping supplies**	
HN01	*Household cleaning products*	
HN011		LAUNDRY AND CLEANING PRODUCTS
HN012		LAUNDRY AND CLEANING EQUIPMENT
HN02	*Household paper products*	
HN021		HOUSEHOLD PAPER PRODUCTS
HN03	*Miscellaneous household products*	
HN031		MISCELLANEOUS HOUSEHOLD PRODUCTS
HP	**Household operations**	
HP01	*Domestic services*	
HP011		DOMESTIC SERVICES
HP02	*Gardening and lawn care services*	
HP021		GARDENING AND LAWN CARE SERVICES
HP03	*Moving, storage, freight expense*	
HP031		MOVING, STORAGE, FREIGHT EXPENSE

HP04	*Repair of household items*	
HP041		APPLIANCE REPAIR
HP042		REUPHOLSTERY OF FURNITURE
HP043		INSIDE HOME MAINTENANCE AND REPAIR SERVICES
HP09	*Unsampled household operations*	
HP090		UNSAMPLED ITEMS

A MAJOR GROUP: APPAREL

APPAREL COMMODITIES

MEN'S AND BOYS' APPAREL

AA	**Men's apparel**	
AA01	*Men's suits, sport coats, and outerwear*	
AA011		MEN'S SUITS
AA012		MEN'S SPORT COATS AND TAILORED JACKETS
AA013		MEN'S OUTERWEAR
AA02	*Men's furnishings*	
AA021		MEN'S UNDERWEAR, HOSIERY, AND NIGHTWEAR
AA022		MEN'S ACCESSORIES
AA023		MEN'S ACTIVE SPORTSWEAR
AA03	*Men's shirts and sweaters*	
AA033		MEN'S SHIRTS, SWEATERS, AND VESTS
AA04	*Men's pants and shorts*	
AA041		MEN'S PANTS AND SHORTS
AA09	*Unsampled men's apparel*	
AA090		UNSAMPLED ITEMS

AB	**Boy's apparel**	
AB01	*Boy's apparel*	
AB011		BOYS' OUTERWEAR
AB012		BOY'S SHIRTS AND SWEATERS
AB013		BOYS' UNDERWEAR, NIGHTWEAR, HOSIERY, AND ACCESSORIES
AB014		BOYS' SUITS, SPORT COATS, AND PANTS
AB015		BOYS' ACTIVE SPORTSWEAR
AB09	*Unsampled boy's apparel*	
AB090		UNSAMPLED ITEMS

WOMEN'S AND GIRLS' APPAREL

AC	**Women's apparel**	
AC01	*Women's outerwear*	
AC011		WOMEN'S OUTERWEAR
AC02	*Women's dresses*	
AC021		WOMEN'S DRESSES
AC03	*Women's suits and separates*	
AC031		WOMEN'S TOPS
AC032		WOMEN'S SKIRTS, PANTS, AND SHORTS
AC033		WOMEN'S SUITS AND COORDINATES
AC04	*Women's underwear, nightwear, sportswear, and accessories*	
AC041		WOMEN'S UNDERWEAR AND OTHER UNDERGARMENTS
AC042		WOMEN'S HOSIERY AND ACCESSORIES

AC043		WOMEN'S ACTIVE SPORTSWEAR
AC09	*Unsampled women's apparel*	
AC090		UNSAMPLED ITEMS
AD	**Girls' apparel**	
AD01	*Girls' apparel*	
AD011		GIRLS' OUTERWEAR
AD012		GIRLS' DRESSES
AD013		GIRLS' TOPS
AD014		GIRLS' SKIRTS, PANTS, AND SHORTS
AD015		GIRLS' ACTIVE SPORTSWEAR
AD016		GIRLS' UNDERWEAR, SLEEPWEAR, HOSIERY, AND ACCESSORIES
AD09	*Unsampled girls' apparel*	
AD090		UNSAMPLED ITEMS
AE	**Footwear**	
AE01	*Men's footwear*	
AE011		MEN'S FOOTWEAR
AE02	*Boys' and girls' footwear*	
AE021		BOYS' FOOTWEAR
AE022		GIRLS' FOOTWEAR
AE03	*Women's footwear*	
AE031		WOMEN'S FOOTWEAR
AF	**Infants' and toddlers' apparel**	
AF01	*Infants' and toddlers' apparel*	
AF011		INFANTS' AND TODDLERS' OUTER PLAY, DRESS, SLEEPWEAR, AND ACCESSORIES
AF012		INFANTS' AND TODDLERS' UNDERWEAR AND DIAPERS
AG	**Jewelry and watches**	
AG01	*Watches*	
AG011		WATCHES
AG02	*Jewelry*	
AG021		JEWELRY
T		**MAJOR GROUP: TRANSPORTATION**
	PRIVATE TRANSPORTATION	
TA	**New and used motor vehicles**	
TA01	*New vehicles*	
TA011		NEW CARS AND TRUCKS
TA012		NEW MOTORCYCLES
TA02	*Used cars and trucks*	
TA021		USED CARS AND TRUCKS
TA03	*Leased cars and trucks*	
TA031		VEHICLE LEASING
TA04	*Car and truck rental*	
TA041		AUTOMOBILE AND TRUCK RENTAL
TA09	*Unsampled new and used motor vehicles*	
TA090		UNSAMPLED ITEMS

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

TB	**Motor fuel**	
TB01	*Gasoline (all types)*	
TB011		REGULAR UNLEADED GASOLINE
TB012		MID-GRADE UNLEADED GASOLINE
TB013		PREMIUM UNLEADED GASOLINE
TB02	*Other motor fuels*	
TB021		AUTOMOTIVE DIESEL FUEL
TB022		ALTERNATIVE MOTOR FUELS
TC	**Motor vehicle parts and equipment**	
TC01	*Tires*	
TC011		TIRES
TC02	*Vehicle accessories other than tires*	
TC021		VEHICLE PARTS AND EQUIPMENT OTHER THAN TIRES
TC022		MOTOR OIL, COOLANT, AND FLUIDS
TD	**Motor vehicle maintenance and repair**	
TD01	*Motor vehicle body work*	
TD011		MOTOR VEHICLE BODY WORK
TD02	*Motor vehicle maintenance and servicing*	
TD021		MOTOR VEHICLE MAINTENANCE AND SERVICING
TD03	*Motor vehicle repair*	
TD031		MOTOR VEHICLE REPAIR
TD09	*Unsampled vehicle maintenance and repair*	
TD090		UNSAMPLED SERVICE POLICIES
TE	**Motor vehicle insurance**	
TE01	*Motor vehicle insurance*	
TE011		MOTOR VEHICLE INSURANCE
TF	**Motor vehicle fees**	
TF01	*State motor vehicle registration and license fees*	
TF011		STATE MOTOR VEHICLE REGISTRATION AND LICENSE FEES
TF03	*Parking and other fees*	
TF031		PARKING FEES AND TOLLS
TF032		AUTOMOBILE SERVICE CLUBS
TF09	*Unsampled motor vehicle fees*	
TF090		UNSAMPLED ITEMS
	PUBLIC TRANSPORTATION	
TG	**Public transportation**	
TG01	*Airline fare*	
TG011		AIRLINE FARES
TG02	*Other intercity transportation*	
TG021		INTERCITY BUS FARES
TG022		INTERCITY TRAIN FARES
TG023		SHIP FARES
TG03	*Intracity transportation*	
TG031		INTRACITY MASS TRANSIT
TG032		TAXI FARE
TG033		CAR AND VANPOOLS
TG09	*Unsampled public transportation*	
TG090		UNSAMPLED ITEMS

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

M **MAJOR GROUP: MEDICAL CARE**

MEDICAL CARE COMMODITIES

MF Medicinal drugs
MF01 Prescription drugs
MF011 PRESCRIPTION DRUGS
MF02 Nonprescription drugs
MF021 *NONPRESCRIPTION DRUGS*
MG Medical equipment and supplies
MG01 Medical equipment and supplies
MG011 DRESSINGS AND FIRST-AID KITS
MG012 MEDICAL EQUIPMENT FOR GENERAL USE
MG013 *SUPPORTIVE AND CONVALESCENT MEDICAL EQUIPMENT*
MG09 UNSAMPLED RENT OR REPAIR OF MEDICAL EQUIPMENT

MEDICAL CARE SERVICES

MC Professional services
MC01 Physicians' services
MC011 PHYSICIANS' SERVICES
MC02 Dental services
MC021 DENTAL SERVICES
MC03 Eyeglasses and eye care
MC031 EYEGLASSES AND EYE CARE
MC04 Services by other medical professionals
MC041 SERVICES BY OTHER MEDICAL PROFESSIONALS

MD Hospital and related services
MD01 Hospital services
MD011 HOSPITAL SERVICES
MD02 Nursing homes and adult daycare
MD021 NURSING AND CONVALESCENT HOME CARE
MD022 ADULT DAYCARE
MD03 Care of invalids and elderly at home
MD031 CARE OF INVALIDS, ELDERLY AND CONVALESCENTS IN THE HOME
ME01 Commercial health insurance
ME011 COMMERCIAL HEALTH INSURANCE, RETAINED EARNINGS
ME02 Blue Cross/Blue Shield
ME021 BLUE CROSS/BLUE SHIELD HEALTH INSURANCE, RETAINED EARNINGS
ME03 Health maintenance plans
ME031 HEALTH MAINTENANCE PLANS, RETAINED EARNINGS
ME04 Medicare and other health insurance
ME041 MEDICARE AND COMMERCIAL MEDICARE SUPPLEMENTS, RETAINED EARNINGS

R **MAJOR GROUP: RECREATION**

RA Video and audio
RA01 Televisions
RA011 TELEVISIONS
RA02 Cable and satellite television and radio service
RA021 CABLE AND SATELLITE TELEVISION AND RADIO SERVICE

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

RA03	*Other video equipment*
RA031	OTHER VIDEO EQUIPMENT
RA04	*Video discs, and other media, including rental of video and audio*
RA041	PRERECORDED VIDEO DISCS/DIGITAL FILES/DOWNLOADS AND OTHER MEDIA
RA042	RENTAL OF VIDEO OR AUDIO DICS AND OTHER MEDIA
RA05	*Audio equipment*
RA051	AUDIO COMPONENTS, RADIOS, TAPE RECORDERS/PLAYERS, AND OTHER EQUIPMENT
RA06	*Audio discs, tapes, and other media*
RA061	AUDIO DISC TAPES, DIGITAL FILES, AND DOWNLOADS
RA09	*Unsampled video and audio*
RA090	UNSAMPLED ITEMS
RB	**Pets, pet products, and services**
RB01	*Pets and pet products*
RB011	PET FOOD
RB012	PURCHASE OF PETS, PET SUPPLIES, ACCESSORIES
RB02	*Pet services, including veterinary*
RB021	PET SERVICES
RB022	VETERINARIAN SERVICES
RC	**Sporting goods**
RC01	*Sports vehicles, including bicycles*
RC011	OUTBOARD MOTORS AND POWERED SPORTS VEHICLES
RC012	UNPOWERED BOATS AND TRAILERS
RC013	BICYCLES AND ACCESSORIES
RC02	*Sports equipment*
RC021	GENERAL SPORTS EQUIPMENT, EXCLUDING WATER
RC022	WATER SPORTS EQUIPMENT
RC023	HUNTING, FISHING, AND CAMPING EQUIPMENT
RC09	*Unsampled sporting goods*
RC090	UNSAMPLED ITEMS
RD	**Photography**
RD01	*Photographic equipment and supplies*
RD011	FILM AND PHOTOGRAPHIC SUPPLIES
RD012	PHOTOGRAPHIC EQUIPMENT
RD02	*Photographers and film processing*
RD021	PHOTOGRAPHER'S FEES
RD022	FILM PROCESSING
RD09	*Unsampled photography*
RD090	UNSAMPLED RENT AND REPAIR OF PHOTOGRAPHIC EQUIPMENT
RE	**Other recreational goods**
RE01	*Toys and games*
RE011	TOYS, GAMES, HOBBIES, AND PLAYGROUND EQUIPMENT
RE012	VIDEO GAME HARDWARE, SOFTWARE, AND ACCESSORIES
RE02	*Sewing machines, fabric, and supplies*
RE021	SEWING ITEMS
RE03	*Music instruments and accessories*
RE031	MUSIC INSTRUMENTS AND ACCESSORIES
RE09	*Unsampled recreation services*
RE090	UNSAMPLED ITEMS

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

RF	**Recreation services**	
RF01	*Club membership dues and fees for participant sport and group exercises*	
RF011		CLUB DUES AND FEES FOR PARTICIPANT SPORTS AND GROUP EXERCISES
RF02	*Admissions*	
RF021		ADMISSION TO MOVIES, THEATERS, CONCERTS, AND OTHER REOCCURING EVENTS
RF022		ADMISSION TO SPORTING EVENTS
RF03	*Fees for lessons or instructions*	
RF031		FEES FOR LESSONS OR INSTRUCTIONS
RF09	*Unsampled recreation services*	
RF090		UNSAMPLED ITEMS
RG	**Recreational reading materials**	
RG01	*Newspapers and magazines*	
RG011		SINGLE-COPY NEWSPAPERS AND MAGAZINES
RG012		NEWSPAPER AND MAGAZINE SUBSCRIPTIONS
RG02	*Recreational books*	
RG021		BOOKS PURCHASED THROUGH BOOK CLUBS
RG022		BOOKS PURCHASED AT RETAIL OUTLETS OTHER THAN BOOK CLUBS
RG09	*Unsampled recreational reading materials*	
RG090		UNSAMPLED ITEMS
E		**MAJOR GROUP: EDUCATION AND COMMUNICATION**
	EDUCATION	
EA	**Educational books and supplies**	
EA01	*Educational books and supplies*	
EA011		COLLEGE TEXTBOOKS
EA012		ELEMENTARY AND HIGH SCHOOL BOOKS AND SUPPLIES
EA013		ENCYCLOPEDIAS AND OTHER SETS OF REFERENCE BOOKS
EA09	*Unsampled educational books and supplies*	
EA090		UNSAMPLED ITEMS
EB	**Tuition, other school fees, and childcare**	
EB01	*College tuition and fees*	
EB011		COLLEGE TUITION AND FIXED FEES
EB02	*Elementary and high school tuition and fees*	
EB021		ELEMENTARY AND HIGH SCHOOL TUITION AND FIXED FEES
EB03	*Childcare and preschool*	
EB031		DAYCARE AND PRESCHOOL
EB04	*Technical and business school tuition and fees*	
EB041		TECHNICAL AND BUSINESS SCHOOL TUITION AND FIXED FEES
EB09	*Unsampled tuition, other school fees, and childcare*	
EB090		UNSAMPLED ITEMS
	COMMUNICATION	
EC	**Postage and delivery services**	
EC01	*Postage*	
EC011		POSTAGE
EC02	*Delivery services*	
EC021		DELIVERY SERVICES

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

Information and information processing

ED Telephone services

ED03 *Wireless Telephone services*
ED031 WIRELESS TELEPHONE SERVICES
ED04 *Telephone services, land-line*
ED041 TELEPHONE SERVICES, LANDLINE

EE Information and information processing other than telephone services

EE01 *Personal computers and peripheral equipment*
EE011 PERSONAL COMPUTERS AND PERIPHERAL EQUIPMENT
EE02 *Computer software and accessories*
EE021 COMPUTER SOFTWARE AND ACCESSORIES
EE03 *Computer information processing services*
EE031 INTERNET ACCESS AND OTHER INFORMATION SERVICES
EE04 *Other information processing equipment*
EE041 TELEPHONE, PERIPHERAL EQUIPMENT, AND ACCESSORIES
EE042 CALCULATORS, TYPEWRITERS, AND OTHER INFORMATION PROCESSING EQUIPMENT
EE09 *Unsampled information and information processing*
EE090 UNSAMPLED ITEMS

G MAJOR GROUP: OTHER GOODS AND SERVICES

GA Tobacco and smoking products

GA01 *Cigarettes*
GA011 CIGARETTES
GA02 *Tobacco products other than cigarettes*
GA021 TOBACCO PRODUCTS OTHER THAN CIGARETTES
GA09 *Unsampled tobacco and smoking products*
GA090 UNSAMPLED ITEMS

GB Personal care products

GB01 *Hair, dental, shaving, and miscellaneous personal care products*
GB011 PRODUCTS AND NONELECTRIC ARTICLES FOR THE HAIR
GB012 DENTAL AND SHAVING PRODUCTS, INCLUDING NONELECTRIC ARTICLES
GB013 DEODORANT/SUNTAN PREPARATIONS, SANITARY/FOOTCARE PRODUCTS
GB014 ELECTRIC PERSONAL CARE APPLIANCES
GB02 *Cosmetics, perfume, bath, nail preparations, and implements*
GB021 COSMETICS, PERFUME, BATH, NAIL PREPARATIONS, and IMPLEMENTS
GB09 *Unsampled personal care products*
GB090 WOMEN'S HAIRPIECES/WIGS AND RENT/REPAIR PERS. CARE APPLS

GC Personal care services

GC01 *Haircuts and other personal care services*
GC011 HAIRCUTS AND OTHER PERSONAL CARE SERVICES

GD Miscellaneous personal services

GD01 *Legal services*
GD011 LEGAL SERVICES
GD02 *Funeral expenses*
GD021 FUNERAL EXPENSES
GD03 *Laundry and dry cleaning services*
GD031 LAUNDRY AND DRY CLEANING SERVICES
GD04 *Apparel services other than laundry and dry cleaning*

Appendix 5. Major groups, expenditure classes, item stratum, and entry-level items—continued

GD041		SHOE REPAIR AND OTHER SHOE SERVICES
GD042		CLOTHING ALTERATIONS, RENTALS, AND REPAIRS
GD043		WATCH AND JEWELRY REPAIR
GD05	*Financial services*	
GD051		CHECKING ACCOUNTS AND OTHER BANK SERVICES
GD052		TAX RETURN PREPARATION AND OTHER ACCOUNTING FEES
GD09	*Unsampled items*	
GD090		UNSAMPLED ITEMS
GE	**Miscellaneous personal goods**	
GE01	*Miscellaneous personal goods*	
GE011		STATIONERY, STATIONERY SUPPLIES, AND GIFT WRAP
GE012		LUGGAGE
GE013		INFANTS' EQUIPMENT

CPI Appendix 6: Sample Allocation Methodology for Commodities and Services

The primary objective of the commodities and services sample design is to determine values for all sample design variables that minimize the sampling variance of 6-month price change for the commodities and services portion of the CPI. The sample design variables are the number of entry-level items (ELIs) to select in each item stratum and the number of outlets to select per Telephone Point of Purchase Survey (TPOPS) category-replicate panel in each Primary Sampling Unit (PSU). To that end, the variance of price change for the commodities and services portion of the CPI and the total annual cost of data collection and processing are modeled as functions of the design variables. These models allow the sample design problem to be expressed as that of minimizing the total variance of price change, subject to various cost and sample allocation constraints. Within this framework, nonlinear programming methods are used to solve the problem for optimal values of the sample design variables.

Certain simplifying assumptions are made to render the problem tractable and operationally more manageable. The number of PSUs, the number of replicate panels per PSU, and the classification of ELIs into item strata have been determined in previous work (Williams et al., 1993; Lane, 1996). Item strata are divided into 13 item groups for the design: four food-at-home groups (nonmeat staples; meat, poultry, and fish; fruits and vegetables; and other food at home and alcoholic and nonalcoholic beverages); food away from home; household furnishings and operations; fuels and utilities; apparel; transportation less motor fuel; motor fuel; medical care; education and communications; and recreation and other commodities and services. The 87 PSUs are divided into 15 groups according to size and number of replicate panels. (See the table that follows.) It is assumed that the same item and outlet sample sizes will apply to all PSUs within the same PSU group. This assumption reduces the allocation problem to that of determining the number of ELI selections per replicate panel by PSU group and item group [$\{K_{ij}, i = 1, ..., 15, j = 1, ..., 13\}$, i = PSU group, j = item group], and the number of outlet selections per TPOPS category per replicate by PSU group and item group $\{M_{ij}, i = 1, ..., 15, j = 1, ..., 13\}$. These are the design variables.

PSU Groups for Commodities and Services Design

PSU group	Name	PSU group	Name
1.	New York City	8.	Smaller self-representing PSUs
2.	New York City suburbs	9.	Non-self-representing PSUs, Census Region 1
		10.	Non-self-representing PSUs, Census Region 2
3.	Los Angeles suburbs	11.	Non-self-representing PSUs, Census Region 3
4.	Chicago	12.	Non-self-representing PSUs, Census Region 4
5.	Philadelphia and San Francisco	13.	Smaller non-self-representing PSUs, Census Regions 2–4 (there isn't one for Region 1)
6.	Detroit and Boston	14.	Los Angeles City
		.	
7.	Other large self-representing PSUs	15	Anchorage, AK, and Honolulu, HI

Let σ^2_{Total} be the total price change variance for the commodities and services portion of the CPI, and let C_{Total} be the total annual cost of data collection. Then the sample design problem can be expressed as that of minimizing σ^2_{Total} subject to the following cost and sample allocation constraints:

$C_{\text{Total}} \leq$ Total data collection budget for commodities and services,

$M_{ij} \geq 2$, $i = 1,..., 15$, $j = 1 ,..., 13$,

$K_{ij} \geq$ Number of item strata in PSU group i, item group j, $i = 1,..., 15$, $j = 1,..., 13$,

$K_{ij} \leq$ Maximum number of item hits in PSU group i, item group j, $i = 1,..., 15$, $j = 1,..., 13$, and

Average number of item hits per stratum–index area in PSU group i, item group ≥ 9, $i = 1, ..., 15$, $j = 1, ..., 13$.

A detailed description of BLS sample allocation methods follows.

The sampling variance function

Variance component models attempt to allocate parts of the total sampling variance to different sources of variation. For the commodities and services item–outlet sample, the following four sources of variation are modeled: PSU selection, item selection, outlet selection, and a residual component that includes other sources, such as sampling within the outlet.

The variance function for the commodities and services sample design is modeled for index areas. Each self-representing PSU is a single index area. Non-self-representing PSUs represent seven index areas, with the sample for each area represented by 2 to 22 PSUs. In the equations that follow, both k, representing what we shall call a super-index area, and k', representing an index area, are used. The only difference between the two is that the three index areas for smaller non-self-representing PSUs by Census region are combined into one super-index area for all small non-self-representing PSUs. As mentioned earlier, the variance model assumes that the total variance of price change for item group j within super-index area k can be expressed as a sum of four components:

$$\sigma^2_{j,k} = \sigma^2_{\text{psu},j,k} + \sigma^2_{\text{item},j,k} + \sigma^2_{\text{outlet},j,k} + \sigma^2_{\text{error},j,k} .$$

In this equation,

$\sigma^2_{\text{psu},j,k}$ is the component of variance due to sampling of PSUs in non-self-representing areas,

$\sigma^2_{\text{item},j,k}$ is the component of variance due to sampling of ELIs within item strata,

$\sigma^2_{\text{outlet},j,k}$ is the component of variance due to sampling of outlets, and

$\sigma^2_{\text{error},j,k}$ is a residual component of variance that includes disaggregation, the final stage of within-outlet item selection .

Similarly, it is assumed that the variance of price change of an individual sampled unit or quote has the same structure:

$$\sigma^2_{\text{unit},j,k} = \sigma^2_{\text{unit,psu},j,k} + \sigma^2_{\text{unit,item},j,k} + \sigma^2_{\text{unit,outlet},j,k} + \sigma^2_{\text{unit,error},j,k} .$$

In this equation,

$\sigma^2_{\text{unit},j,k}$	is the total variance of price change of an individual sampled unit or quote for item j in super-index area k,
$\sigma^2_{\text{unit,psu},j,k}$	is the component of unit variance due to sampling of PSUs in non-self-representing areas,
$\sigma^2_{\text{unit,item},j,k}$	is the component of unit variance due to sampling of ELIs within item strata,
$\sigma^2_{\text{unit,outlet},j,k}$	is the component of unit variance due to sampling of outlets, and
$\sigma^2_{\text{unit,error,j},k}$	is the corresponding residual component of unit variance.

Thus, the projected sampling variance for a given index area k in PSU group i is

$$\sigma^2(\text{PC}_k) =$$

$$\sum_{j=1}^{13}\sum_{k'\in k}\text{RI}^2_{j,k}\left(\frac{\sigma^2_{\text{unit,item},j,k}}{f_1(K_{ij},N_k)}+\frac{\sigma^2_{\text{unit,outlet},j,k}}{f_2(M_{ij},K_{ij},N_k)}+\frac{\sigma^2_{\text{unit,error},j,k'}}{f_3(M_{ij},K_{ij},N_k)}+\frac{\sigma^2_{\text{unit,psu},j,k'}}{f_4(N_{k'})}\right),$$

where

$$f_1(K_{ij},N_k)=(N_k,H_k,K_{ij}),$$
$$f_2(M_{ij},K_{ij},N_k)=\left[\left(N_kH_kM'_{i,j}+N_kH_kM_{i,j}\text{NPV}_j\right)\text{NRO}_j\right],$$
$$f_3(M_{ij},K_{ij},N_k)=\left[\left(N_kH_kM_{ij}\ K_{ij}\right)\left(\text{NRQV}_j\right)\right], \text{ and}$$
$$f_4(N_{k'})= \text{the number of non-self-representing PSUs in index area } k',$$

in which

PC_k	is the price change in super-index area k,
H_k	is the number of replicate panels per PSU in the super-index area k,
NRO_j	is the outlet initiation response rate for major group j,
NRQV_j	is the quote quote-level response rate for major group j for variance projection,
NPV_j	is the weighted sum of non-POPS categories in major group ji, with each category weighted by its probability of selection, for variance projection,
M'_{ij}	is the number of unique in-scope outlets selected per PSU replicate, modeled as the quadratic function $M'_{ij}=(AV_{ij}M_{ij}+BV_{ij}M^2_{ij})$ of the outlet sample size, where AV_{ij} and BV_{ij} are coordinates that are determined by the unique outlet cost predictor function program, and
N_k	is the number of PSUs in super-index area k.

The sampling variance of price change for the All U.S. City Average commodities and services index is

$$\sigma^2_{\text{Total}} = \sum_j \sum_k \text{RI}^2_{j,k} w_k^2 \sigma^2_{j,k} ,$$

where

$\text{RI}_{j,k}$ is the relative importance of item group *j* in super-index area *k*, scaled to sum to 1.0 over all commodities and services item groups, and

w_k is the 1990 Census population weight of super-index area *k*.

Relative importances of item groups are obtained from the most recent 2 years of the Consumer Expenditure Survey and are the proportion of total expenditures in super-index area *k* that come from item group *j*.

The cost function

The modeled costs of the commodities and services portion of the CPI are the costs of initiation data collection and travel and of pricing data collection (personal visit and telephone) and travel. Each of these models is developed in terms of outlet- and quote-related costs and as a function of the design decision variables.

Initiation costs

Outlet related initiation costs. For PSU group *i* and major group *j*, outlet-related costs for initiation are given by

$\text{CI}_O\left(M_{ij}, K_{ij}\right) = 0.25 N_i \quad H_i \quad (\text{CO}_j + \text{COT}_j) \quad \left(AC_{ij} M_{ij} + BC_{ij} M_{ij}^2 + \text{NPC}_j M_{ij}\right)$, where

$\text{CI}_O\left(M_{ij}, K_{ij}\right)$	is the outlet-related initiation cost for major group *j* in PSU group *i,*
N_i	is the number of PSUs in group *i,*
H_i	is the number of replicates per PSU in PSU group *i,*
CO_j	is the compensation initiation cost per outlet for major group *j,*
NPC_j	is the weighted sum of non-POPS categories in major group *j*, with each category weighted by its probability of selection,
COT_j	is the per diem and mileage cost per outlet for major group *j,*

and $\left(AC_{ij} M_{ij} + BC_{ij} M_{ij}^2\right)$ is a quadratic overlap function used to predict the number of unique sample outlets and to account for the overlap of elements in the outlet sample within and between major groups for a replicate panel. Like AV_{ij} and BV_{ij}, AC_{ij} and BC_{ij} are coordinates determined by the unique outlet cost predictor function program. The number 0.25 accounts for the rotation or reinitiation of the outlet sample in one-fourth of the sample TPOPS categories' PSUs each year.

Quote related-initiation costs. Quote related initiation costs are given by
$\text{CI}_Q\left(M_{ij}, K_{ij}\right) = 0.25 N_i H_i \quad \text{WOD}_j \quad \text{CQ}_j \quad M_{ij} K_{ij} \quad \text{NRO}_j$, where

$\text{CI}_Q\ (M_{ij}, K_{ij})$	is the quote-related cost of initiation for major group *j* in PSU group *i*,
WOD_j	is a seasonal items initiation factor for major group *j,*
CQ_j	is the initiation cost per quote for major group *j,* and
NRO_j	is as before.

Repricing costs

The costs of ongoing price data collection and processing are also developed as both outlet- and quote-related costs.

Outlet-related repricing costs.For PSU group *i* and major group *j*, outlet-related costs for ongoing pricing are given by

$$\mathrm{CP}_O(M_{ij},K_{ij}) = \mathrm{MBO}_{ij} \quad N_i \quad H_i \quad \mathrm{NRO}_j \quad (AC_{ij}M_{ij} + BC_{ij}M_{ij}^2 + \mathrm{NPC}_j M_{ij}) \quad (\mathrm{CPVO}_j + \mathrm{CPO}_j) \quad (1 \quad \mathrm{RTO}_j) + \mathrm{CTO}_j \quad \mathrm{RTO}_j],$$ where

$\mathrm{CP}_O(M_{ij},K_{ij})$	is the total outlet-related cost for ongoing pricing for major group *j* in PSU group *I,*
CPVO_j	is the compensation cost (time spent in travel) for a personal visit for pricing per outlet for major group *j,*
CPO_j	is the travel cost (per diem and mileage) for a personal visit for pricing per outlet for major group *j* (equal to 3.33 for every *j*),
RTO_j	is the proportion of outlets priced by telephone for major group *j,*
CTO_j	is the per-outlet cost for telephone collection, (equal to 3.43 for every *j* initially),
NPO_j	is the weighted sum of non-POPS categories in major group *j*, with each category weighted by its probability of selection for cost projections,
MBO_{ij}	is a factor used to adjust for the monthly–bimonthly mix of outlets by PSU and major group, and NRO_j and NPC_j are as before.

Quote-related repricing costs. Quote-related costs for ongoing pricing are given by

$$\mathrm{CP}_Q(M_{ij},K_{ij}) = \mathrm{MBQ}_{ij} \quad N_i \quad H_i \quad M_{ij} \quad K_{ij} \quad \mathrm{NRQC}_j \quad [\mathrm{CPVQ}_j \quad (1 \quad \mathrm{RTQ}_j) + \mathrm{CTQ}_j \quad \mathrm{RTQ}_j],$$ where

$\mathrm{CP}_Q(M_{ij},K_{ij})$	is the total quote-related cost for ongoing pricing,
MBQ_{ij}	is a factor to adjust for the monthly–bimonthly mix of quotes by PSU and major product group.
CPVQ_j	is the per-quote cost (compensation not spent in travel) for a personal visit for pricing,
$\mathrm{RTQ}_{,j}$	is the proportion of telephone collected quotes for major group *j,*
$\mathrm{CTQ}_{,j}$	is the per quote cost for telephone collection for major group *j,* and
NRQC_j	is the quote-level response rate for projecting costs for major group *j*.

Total cost function

The total cost function associated with data collection for commodities and services, summed over all item groups and PSU groups, is then given by

$$C_{\mathrm{Total}} = \sum_{i,j} [\mathrm{CI}_O(M_{ij},K_{ij}) + \mathrm{CI}_Q(M_{ij},K_{ij}) + \mathrm{CP}_O(M_{ij},K_{ij}) + \mathrm{CP}_Q(M_{ij},K_{ij})],$$

and the sample design problem can be expressed as that of minimizing the total variance, $\sigma^2_{\mathrm{Total}}$, subject to the following constraints:

$C_{\mathrm{Total}} \leq$ Total expenditure limit,

$M_{ij} \geq 2$, $i = 1, ..., 15$, $j = 1, ...,13$,

$K_{ij} \geq$ Number of item strata in PSU group *i,* item group *j*, $i = 1, ..., 15$, $j = 1, ..., 13$,

K_{ij} ≤Maximum number of item hits in PSU group *i,* item group *j, i* = 1 ,..., 15, *j* = 1, ..., 13,

and

Average number of item hits per stratum-index area in PSU group *i,* item group ≥ 9,

i = 1, ..., 15, *j* = 1, ..., 13.

We note here that the last set of constraints is added to address concerns regarding small-sample bias at the elementary index level by ensuring a minimum average sample allocation of nine expected quotes in total per index area–item stratum combination.

Model coefficients

The parameters of the cost function are estimated from agency administrative records dating from fiscal year 1996 forward and a Time and Travel Study conducted by the BLS Office of Field Operations (OFO). Distinctions between personal visits and telephone collection of data are made on the basis of information from OFO and from an analysis of commodities and services microdata conducted within the BLS Prices Statistical Methods Division. Response rates for each item group are derived from field initiation records and ongoing pricing experience.

Because outlet samples are selected independently for each TPOPS category and outlets may be listed in the sample frames for more than one TPOPS category, an individual outlet may be selected more than once. For example, a grocery store could be selected for both bakery products and dairy products. Thus, the number of *unique* outlets realized by the sampling process is needed to project outlet-related costs. Quadratic regressions are used to predict the number of unique outlets realized in sample selection as a function of designated sample size. The regressions are developed and reevaluated with each rotation by using the most current sampling frames available for each item to model the number of unique outlets obtained in simulations of sampling procedures for each PSU and item group as a function of designated sample sizes.

Components of price change variance are computed with the use of restricted maximum-likelihood estimation methods with commodities and services price microdata, the most recent estimates being based on price data collected in 2009–2011. Component estimates are developed for 6-month price changes for the 13 item groups for each index area and month. Mean unit components of variance estimates are then computed by averaging the unit components of variance across months.

Solutions

Solutions are found with the SAS procedure PROC OPTMODEL. For each item group, the number of item selections is bounded below by the number of strata in the item group.

ELI selections are then distributed among item strata within each item group, with consideration given to differences in relative importance, estimates of variances for production stratum-level price change and response rates among the item strata within each item group, as well as special problems identified by commodity analysts and field staff. Similarly, designated outlet sample sizes are distributed among the various TPOPS categories in item groups in order to manage variations in expected response rates and respondent burden.

In general, recent sample designs have shifted resources in many item groups from sampling many outlets to sampling fewer outlets, with more item selections per outlet. This shift is due primarily to the large residual component of price change sampling variance estimated for most item groups, coupled with a trend of an increasing number of unique outlets realized in TPOPS sampling.

Appendix 7. Point-of-Purchase Survey (POPS) categories[1]

The following tabulation lists retail entry-level items (ELIs) and numbers, by category, in the BLS point-of-Purchase Survey (POPS):

POPS Category and title, ELI number and title

F14 **Fresh fish or fresh seafood**
FG011 Fresh fish and seafood

F15 **Processed fish or processed seafood, including frozen, canned, or cooked**
FG021 Processed fish and seafood

F20 **Miscellaneous dairy products, including yogurt, powdered milk, or coffee creamers**
FJ041 Other dairy and related products

F29 **Canned fruits or vegetables**
FM011 Canned and other shelf-stable fruits and vegetables

F30 **Frozen fruits or vegetables**
FM021 Frozen fruits and vegetables

F31 **Dried or other processed fruits and vegetables**
FM031 Other processed fruits and vegetables, including dried

F32 **Carbonated Drinks**
FN011 Carbonated Drinks

F33 **Noncarbonated juices or drinks, frozen and non frozen**
FN021 Frozen noncarbonated juices and drinks
FN031 Non frozen noncarbonated juices and drinks

F34 **Roasted, instant, or freeze-dried coffee**
FP011 Coffee

F35 **Powdered drinks, tea, cocktail mixes, or ice**
FP021 Tea
FP022 Other beverage materials

F36 **Sugar or artificial sweeteners**
FR011 Sugar and artificial sweeteners

F37 **Candy or chewing gum**
FR021 Candy and chewing gum

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

F38 **Jellies, syrups, honey, molasses, marshmallows, icings, or fudge mixes**
FR031 Other sweets

F39 **Butter or margarine**
FS011 Butter and margarine

F40 **Salad dressing or mayonnaise**
FS021 Mayonnaise, salad dressing, and sandwich spreads

F41 **Peanut butter, or cooking fats and oils**
FS031 Peanut butter and other nut butters
FS032 Other fats and oils

F47 **Baby food**
FT051 Baby food

F48 **Prepared salads or salad bars, excluding restaurants**
FT061 Prepared salads

F49 **Easy-to-prepare canned or packaged foods, excluding fruits, vegetables, and soups**
FT062 Other miscellaneous foods

F50 **Full-service meals or snacks, such as meals at sit-down restaurants**
FV011 Full-service meals and snacks

F51 **Limited-service meals or snacks, such as meals from fast food restaurants or delivered meals**
FV021 Limited-service meals and snacks

F52 **Meals or snacks at schools or employer-provided cafeterias, dining rooms, or snack bars**
FV031 Food at employee sites and schools

F53 **Food or beverages from vending machines or mobile vendors**
FV041 Food from vending machines and mobile vendors

F54 **Catered events or board**
FV051 Board, catered events, and other food away from home

F55 **Beer, ale, sake, or other malt beverages for home use**
FW011 Beer, ale, and other malt beverages at home

F56 **Hard liquor for home use**
FW021 Distilled spirits at home

F57 **Wine for home use**
FW031 Wine at home

F58 **Alcoholic beverages served in bars, restaurants, clubs, or similar places**
FX011 Alcoholic beverages away from home

F59 **Cereal, rice, pasta, cornmeal or flour**
FA011 Flour and prepared flour mixes
FA021 Breakfast cereal
FA031 Rice, pasta, and cornmeal

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

F60 **Bread, cookies, or other baked goods, including frozen**
FB011 Bread
FB021 Fresh biscuits, rolls, and muffins
FB031 Cakes and cupcakes (excluding frozen)
FB032 Cookies
FB041 Crackers, and bread and cracker products
FB042 Sweet rolls, coffeecakes, and doughnuts (excluding frozen)
FB043 Frozen bakery products and frozen/refrigerated doughs and batters
FB044 Pies, Tarts, and turnovers (excluding frozen)

F61 **Meat, including beef, poultry, pork, or lunch meats**
FC011 Uncooked ground beef
FC021 Uncooked beef roasts
FC031 Uncooked beef steaks
FC041 Other uncooked beef and veal
FD011 Bacon, breakfast sausage, and related products
FD021 Ham
FD031 Pork chops
FD041 Other pork, including roasts and picnics
FE011 Frankfurters
FE012 Lunch meats
FE013 Lamb, organ meats, and game
FF011 Chicken
FF021 Other poultry, including turkey

F62 **Milk, eggs, cheese, ice cream, or frozen yogurt**
FH011 Eggs
FJ011 Milk
FJ021 Cheese and cheese products
FJ031 Ice cream and related products

F63 **Fresh Fruits or Vegetables**
FK011 Apples
FK021 Bananas
FK031 Citrus fruits
FK041 Other fresh fruits
FL011 Potatoes
FL021 Lettuce
FL031 Tomatoes
FL041 Other fresh vegetables, including fresh herbs

F64 **Frozen prepared foods, chips, nuts, or other snacks or soups**
FT011 Soups and soup bases
FT021 Frozen and freeze-dried prepared foods
FT031 Snacks

F65 **Condiments, spices, sauces, or gravies**
FT041 Salt and other seasonings and spices
FT042 Olives, pickles, and relishes
FT043 Sauces and gravies
FT044 Other condiments (excluding olives, pickles, and relishes)

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

H02 **Lodging away from home, such as hotels, motels, or vacation rentals**
HB021 rental of lodging away from home

H03 **Fuel oil for household heating**
HE011 Fuel oil

H04 **Propane, firewood, coal, or charcoal used for household heating or cooking**
HE021 Other household fuels

H05 **Residential water or sewer service**
HG011 Residential water and sewerage service

H06 **Garbage or trash collection service**
HG021 Garbage and trash collection

H07 **Floor coverings, such as hard surface tiling, carpets, or scatter rugs**
HH011 Floor coverings

H08 **Window coverings, such as curtains, drapes, or blinds**
HH021 Curtains and drapes
HH022 Window coverings

H09 **Household linens, such as kitchen or bathroom towels, bedding, or tablecloths**
HH031 Bathroom linens
HH032 Bedroom linens
HH033 Kitchen and dining room linens

H10 **Bedroom furniture, including mattresses or springs**
HJ011 Mattresses and foundations
HJ012 Bedroom furniture other than mattresses and springs

H14 **Infants' furniture**
HJ031 infants' furniture

H15 **Outdoor furniture**
HJ032 outdoor furniture

H16 **Other furniture, including entertainment centers, bookcases, or desks**
HJ033 Occasional furniture

H17 **Refrigerators or home freezers**
HK011 Refrigerators and home freezers

H18 **Washers or dryers**
HK012 Washers and dryers

H19 **Stoves, Ovens, or microwave ovens**
HK013 Ranges and cooktops
HK014 Microwave ovens

H20 **Vacuums or other electric floor-cleaning equipment**
HK021 Floor-cleaning equipment

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

H21 **Small electric kitchen appliances or clothing irons**
HK022 Small electric kitchen appliances

H22 **Heating or cooling equipment or home safety devices**
HK023 Other electric appliances

H23 **Household decorative items, including clocks or lamps**
HL011 Lamps and lighting fixtures
HL012 Household decorative items and clocks

H24 **Dishes, glassware, or flatware**
HL031 Dishes
HL032 Flatware

H25 **Nonelectric kitchen utensils, cookware, or bake ware**
HL041 Non electric cooking ware
HL042 Table ware and nonelectric kitchenware

H26 **Indoor plants or fresh-cut flowers**
HL021 Indoor plants and fresh-cut flowers

H27 **Paint, Wallpaper tools, or related supplies**
HM011 Paint, wallpaper tools, and supplies

H28 **Power Tools**
HM012 Power tools

H29 **Non powered tools or miscellaneous hardware**
HM013 Miscellaneous hardware, supplies, and equipment
HM014 Non powered tools

H30 **Barbeque grills, powered lawn and garden equipment, or other outdoor items**
HM021 Lawn and garden equipment and outdoor equipment and grills

H31 **Lawn and garden supplies or insecticides**
HM022 Lawn and garden materials, other decorative items, and pesticides

H32 **Household laundry and cleaning products or supplie**
HN011 Laundry and cleaning products
HN012 Laundry and cleaning equipment

H33 **Paper napkins, paper towels, facial tissue, or toilet paper**
HN021 Household paper products

H34 **Other disposable products, such as plastic or foil wraps, garbage bags, paper plates, batteries, or light bulbs**
HN031Miscellaneous household products

H35 **Housekeeping services**
HP011 Domestic Services

H36 **Gardening or Lawn Care Services**
HP021 Gardening and lawn care services

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

H37 **Moving, storage, or freight services**
HP031 Moving, storage, and freight expense

H38 **Major appliance repair**
HP041 Appliance repair

H39 **Reupholstery of household furniture**
HP042 Reupholstery of furniture

H40 **Inside home maintenance or repair**
HP043 Inside home maintenance and repair services

H41 **Living room, dining room, or kitchen furniture**
HJ021 Sofas, furniture covers, and decorative pillows
HJ022 Living room chairs
HJ023 Living room tables
HJ024 Kitchen and dining room furniture

A01 **Men's suits or blazers**
AA011 Men's suits
AA012 Men's sport coats and tailored jackets

A02 **Men's coats or jackets**
AA013 Men's outerwear

A03 **Men's socks, underwear, sleepwear, or bathrobes**
AA021 Men's underwear, hosiery, nightwear, and loungewear

A04 **Men's accessories, such as ties, belts, or wallets**
AA022 Men's accessories

A05 **Men's active sportswear, such as exercise apparel or bathing suits**
AA023 Men's active sportswear

A06 **Men's shirts, sweaters, or vests**
AA033 Men's shirts, sweaters, and vests

A07 **Men's pants, jeans, or shorts**
AA041 Men's pants and shorts

A08 **Boys' clothing or accessories**
AB011 Boys' outerwear
AB012 Boys' shirts and sweaters
AB013 Boys' underwear, sleepwear, hosiery, and accessories
AB014 Boys' suits, sport coats, and pants
AB015 Boys' active sportswear

A09 **Women's Outerwear**
AC011 Women's outerwear

A10 **Women's dresses**
AC021 Women's dresses

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

A11 **Women's tops, skirts, pants, or shorts**
AC031 Women's tops
AC032 Women's skirts, pants, and shorts

A12 **Women's suits or suit components**
AC033 Women's suits and coordinates

A13 **Women's underwear or nightwear**
AC041 Women's underwear, nightwear, and other undergarments

A14 **Women's hosiery or accessories**
AC042 Women's hosiery and accessories

A15 **Women's active sportswear, such as exercise apparel or bathing suits**
AC043 Women's active sportswear

A16 **Girls' clothing or accessories**
AD011 Girls' outerwear
AD012 Girls' dresses
AD013 Girls' tops
AD014 Girls' skirts, pants, and shorts
AD015 Girls' active sportswear
AD016 Girls' underwear, sleepwear, hosiery, and accessories

A17 **Men's footwear**
AE011 Men's footwear

A18 **Boys' or girls' footwear**
AE021 Boys' footwear
AE022 Girls' footwear

A19 **Women's footwear**
AE031 Women's footwear

A20 **Infants' and toddlers' clothing or accessories, excluding underwear and diapers**
AF011 Infants' and toddlers' outer, play, dress, and sleepwear and accessories

A21 **Infants' and toddlers' underwear or diapers**
AF012 Infants' and toddlers' underwear and diapers

A22 **Watches**
AG011 Watches

A23 **Jewelry**
AG021 Jewelry

T01 **New cars, trucks, or vans**
TA011 New car and truck purchase

T02 **New motorcycles**
TA012 New motorcycles

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

T03 **Leased cars, trucks, or vans**
TA031 Vehicle leasing

T04 **Car, truck, or van rental**
TA041 Automobile and truck rental

T05 **Gasoline, diesel, or alternative fuels**
TB011 Regular unleaded gasoline
TB012 Midgrade unleaded gasoline
TB013 Premium unleaded gasoline
TB021 Automotive diesel fuel
TB022 Alternative motor fuels

T07 **Tires**
TC011 Tires

T08 **Vehicle parts or accessories**
TC021 Vehicle parts and equipment other than tires

T09 **Motor oil, coolants, or fluids**
TC022 Motor oil, coolants, and fluids

T10 **Motor vehicle bodywork**
TD011 Motor vehicle bodywork

T11 **Motor vehicle maintenance, inspections, or towing**
TD021 Motor vehicle maintenance and servicing

T12 **Motor vehicle repair**
TD031 Motor vehicle repair

T15 **Parking fees or tolls**
TF031 Parking fees and tolls

T16 **Automobile service clubs**
TF032 Automobile service clubs

T17 **Ship travel or passenger cruises**
TG023 Ship fares

T18 **Intracity mass transit**
TG031 Intracity mass transit

T19 **Taxi or cab fare**
TG032 Taxi fare

T20 **Car or van pools**
TG033 Car and van pools

M01 **Prescription drugs**
MF011 Prescription drugs

M02 **Nonprescription drugs**
MF021 Nonprescription drug

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

M03 **Medical equipment, supplies, or dressings**
MG011 Dressings and first-aid kits
MG012 Medical equipment for general use
MG013 Supportive and convalescent medical equipment

M04 **Physician's services**
MC011 Physician's services

M05 **Dental services**
MC021 Dental services

M06 **Eyeglasses or eye care**
MC031 Eyeglasses and eye care

M07 **Services by other medical professionals**
MC041 Services by other medical professionals

M08 **Hospital services**
MD011 Hospital services

M09 **Adult daycare**
MD022 Adult daycare

R01 **Televisions**
RA011 Televisions

R02 **Cable or satellite television or radio service**
RA021 Cable and satellite television and radio service

R03 **DVD players, camcorders, or other video equipment**
RA031 Other video equipment

R04 **Prerecorded video, such as dvds, digital files, downloads, and other media**
RA041 Prerecorded video discs, digital files, downloads, and other media

R05 **Rental of DVDs or video games**
RA042 Rental of video or audio discs, tapes, digital files, or downloads

R06 **Audio equipment for automobiles or home**
RA051 Audio components, radios, tape recorders/players, and other equipment

R07 **Prerecorded or blank audiotapes, CDs, or records**
RA061 Audio discs and tapes, prerecorded and blank

R08 **Pet food**
RB011 Pet food

R09 **Pets, pet supplies, or accessories**
RB012 Purchase of pets, pet supplies, and accessories

R10 **Pet services, such as grooming, boarding, or training**
RB021 Pet services

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

R11 **Veterinarian services**
RB022 Veterinarian services

R12 **Outboard motors or powered sports vehicles**
RC011 Outboard motors and powered sports vehicles

R13 **Unpowered boats or trailers**
RC012 Unpowered boats and trailers

R14 **Bicycles or bicycling accessories**
RC013 Bicycles and accessories

R15 **General sports equipment**
RC021 General sports equipment, excluding water
RC022 Water sports equipment

R16 **Hunting, fishing, or camping equipment**
RC023 Hunting, fishing, and camping equipment

R17 **Film or film development supplies or disposable cameras**
RD011 Film and photographic supplies

R18 **Cameras or other photographic equipment, excluding film**
RD012 Photographic equipment

R19 **Photographer's fees**
RD021 Photographer's fees

R20 **Digital photo prints or film development**
RD022 Film processing

R21 **Toys, games, hobby supplies, or playground equipment**
RE011 Toys, games, hobbies, and playground equipment

R22 **Video game hardware, games, or accessories**
RE012 Video game hardware, software, and accessories

R23 **Sewing machines, fabric, or sewing supplies**
RE021 Sewing items

R24 **Musical instruments or musical accessories**
RE031 Musical instruments and accessories

R25 **Club membership dues for fraternal or civic organizations or fees for participant sports**
RF011 Club dues and fees for participant sports and group exercises

R26 **Admissions, such as to movies, concerts, or theme parks**
RF021 Admission to movies, theaters, concerts, and other reoccurring events

R27 **Admissions to sporting events**
RF022 Admissions to sporting events

R28 **Recreational lessons or instruction**
RF031 Fees for lessons or instruction

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

R29 **Single-copy newspapers or magazines**
RG011 Single-copy newspapers and magazines

R30 **Newspaper or magazine subscriptions**
RG012 Newspaper and magazine subscriptions

R31 **Books purchased through book clubs**
RG021 Books purchased through book clubs

R32 **Other books, audiobooks, or e books**
RG022 Books purchased at other than book clubs

E01 **College or university-level textbooks**
EA011 College textbooks

E02 **Elementary or high school textbooks**
EA012 Elementary and high school books and supplies

E03 **Encyclopedias or other sets of reference books**
EA013 Encyclopedias and other sets of reference books

E04 **Tuition or fixed fees for a college or university**
EB011 College tuition and fixed fees

E05 **Tuition or fixed fees for private elementary or high schools**
EB021 Elementary and high school tuition and fixed fees

E06 **Daycare providers, including nursery schools**
EB031 Daycare and preschool

E07 **Tuition or fixed fees for technical or vocational schools**
EB041 Technical and business school tuition and fixed fees

E08 **Delivery services**
EC021 Delivery services

E11 **Personal computers or peripheral equipment**
EE011 Personal computers and peripheral equipment

E12 **Computer software, computer accessories, and blank media, including memory cards, recordable discs and other forms**
EE021 Computer software and accessories

E13 **Accessing the Internet at home and away, including separate or bundled charges**
EE031 Internet access and other information services

E14 **Home or cellular telephones, answering machines, or other phone accessories**
EE041Telephones, peripheral equipment, and accessories

E15 **Calculators, typewriters, or other information-processing equipment**
EE042 Calculators, typewriters, and other information-processing equipment

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

E16 **Cellular telephone service**
ED031 Wireless phone service

E17 **Local or long-distance landline telephone service, including Prepaid phone cards**
ED041 Telephone service landline

G01 **Cigarettes**
GA011 Cigarettes

G02 **Cigars, smoking tobacco, or chewing tobacco**
GA021 Tobacco products other than cigarettes

G03 **Hair Products, such as shampoo, sprays, pins, or combs**
GB011 Products and nonelectric articles for the hair

G04 **Dental or shaving products**
GB012 Dental and Shaving Products, Including Nonelectric Articles

G05 **Deodorant, feminine hygiene products, suntan lotions, or foot care products**
GB013 Deodorant/suntan preparations and sanitary/foot care products

G06 **Electric personal care appliances, such as shavers or hair dryers**
GB014 Electric personal care appliances

G07 **Cosmetics, perfumes, or bath and nail preparations**
GB021 Cosmetics/perfume/bath/nail preparations and implements

G08 **Personal care services, such as haircuts, nail services, or tanning**
GC011 Haircuts and other personal care services

G09 **Legal services**
GD011 Legal fees

G10 **Funeral services**
GD021 Funeral expenses

G11 **Laundry or dry cleaning services**
GD031 Laundry and dry cleaning services

G12 **Shoe repair or other shoe services**
GD041 Shoe repair and other shoe services

G13 **Clothing rental, alterations, or repairs**
GD042 Clothing alterations, rentals, and repairs

G14 **Watch or jewelry repair**
GD043 Watch and jewelry repair

G15 **Checking account fees, credit card fees, or other bank services**
GD051 Checking accounts and other bank services

Appendix 7. Point-of-Purchase Survey (POPS) categories—continued

G16 **Tax return preparation or other accounting services**
GD052 Tax return preparation and other accounting services

G18 **Stationary, school supplies, or gift wrap**
GE011 Stationery, stationery supplies, and gift wrap

G19 **Luggage, briefcases, or other carrying cases**
GE012 Luggage

G20 **Infants' equipment, such as strollers, car seats, bottles, or dishes**
GE013 Infants' equipment

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[1] Some POPS category numbers have been changed to reflect changes in item composition.

Appendix 8. Non-Point-of-Purchase Survey (Non-POPS) sample designs

For each non-POPS entry-level item (e.g., electricity), the following information is given:

1. Source of the universe data
2. Sampling unit for outlets
3. Measure of size
4. Desired final pricing unit

EC011 Postage

1. The distribution of household mail by type of postal service and postal zone, as determined by the postal service in the *Household Mailstream Study, Final Report*, prepared for the U.S. Postal Service.
2. U.S. Postal Service
3. Postal revenue for each type of postal service and postal zone
4. Specific postal service and zones traveled

MD031 Care of invalids, elderly, and convalescents in the home

1. Center for Medicare and Medicaid Services (CMS) Home Healthcare Care system
2. Facilities providing adult home care in each CPI sample area
3. Each facility within a given CPI sample area has an equal chance of being selected.
4. Specific services provided

HD011/TE011 Insurance—tenants/motor vehicle

1. National Association of Insurance Commissioners
2. Insurance companies serving the states in which CPI sample areas are located
3. Total revenue for noncommercial policies, by type of insurance
4. Specific policy serving within each CPI sample area

HF011 Electricity

1. a. Consumer Expenditure (CE) survey
   b. Direct information from the regional field offices
2. Electric utility companies reported in the CE survey or electric utility companies serving each of the CPI sample areas
3. Expenditures for electricity, as reported in the CE survey, or an estimate of the number of residential customers provided by the field
4. Specific type of service for a specific number of kilowatt hours

HF021 Utility natural gas

1. a. Consumer Expenditure (CE) survey
   b. Direct information supplied by the regional field offices
2. Gas utility companies reported in the CE survey or gas companies serving each of the CPI sample areas
3. Expenditures for natural gas, as reported in the CE survey or an estimate of the number of residential customers provided by the field
4. Specific type of service and specific number of cubic feet or therms of gas

Appendix 8. Non-Point-of-Purchase Survey(Non-POPS) sample designs—continued

MD021 Nursing and convalescent home care

1. Center for Medicare and Medicaid Services (CMS) Nursing Home Care system
2. Facilities providing nursing home care in each CPI sample area
3. Number of beds
4. Specific accommodations and services provided

TA021 Used vehicles

1. J. D. Power data
2. Selection of used vehicles, based on vehicle sales data from J. D. Powers
3. Expenditures reported for used vehicles in the CE survey
4. Specific used vehicles with specific options; prices collected from the National Automobile Dealers Association (NADA) *Official Used Car Guide*

TF011 State vehicle registration and driver's license

1. Each state's Department of Motor Vehicles
2. State motor vehicle department in each CPI sample area
3. Revenue generated by each type of fee
4. Specific class/vehicle registration, type of license, or vehicle property tax

TG011 Airline fares

1. Department of Transportation data file consisting of a 10-percent sample of all passenger itineraries originating in the United States
2. All airlines providing service from any CPI sample area
3. Total number of nonbusiness passengers per airline, per trip itinerary, per fare class
4. Specific trip itinerary and fare class for the selected airline

TG021 Intercity bus fares

1. Scheduled intercity bus trips from each CPI sample area
2. Bus companies serving each CPI sample area
3. Number of buses that leave for a given destination
4. Specific trip itinerary and fare class

TG022 Intercity train service

1. Data file of intercity train trips provided by Amtrak and the Alaskan Railroad
2. Amtrak and the Alaskan Railroad
3. Number of tickets sold
4. Specific trip and class

Appendix 9. Relative importance of components in the Consumer Price Indexes, 2011−2012 weights: U.S. city average, December 2014

Item and group	U.S. city average	
	CPI-U	CPI-W
Expenditure category		
All items	100.000	100.000
Food and beverages	15.272	16.011
Food	14.257	15.052
Food at home	8.427	9.259
Cereals and bakery products	1.138	1.255
Cereals and cereal products	.370	.420
Flour and prepared flour mixes	.048	.052
Breakfast cereal	.197	.221
Rice, pasta, cornmeal	.126	.147
Bakery products	.767	.835
Bread	.230	.247
Fresh biscuits, rolls, muffins	.116	.121
Cakes, cupcakes, and cookies	.189	.208
Other bakery products	.233	.259
Meats, poultry, fish, and eggs	2.014	2.376
Meats, poultry, and fish	1.880	2.221
Meats	1.229	1.478
Beef and veal	.582	.714
Uncooked ground beef	.238	.292
Uncooked beef roasts	.085	.098
Uncooked beef steaks	.207	.253
Uncooked other beef and veal	.053	.071
Pork	.372	.438
Bacon, breakfast sausage, and related products	.141	.161
Ham	.078	.091
Pork chops	.064	.083
Other pork including roasts and picnics	.089	.103
Other meats	.275	.326
Poultry	.360	.439
Chicken	.294	.369
Other poultry including turkey	.066	.069
Fish and seafood	.291	.305
Fresh fish and seafood	.148	.149
Processed fish and seafood	.142	.156
Eggs	.134	.155
Dairy and related products	.898	.950
Milk	.283	.320
Cheese and related products	.286	.287
Ice cream and related products	.126	.132
Other dairy and related products	.204	.211
Fruits and vegetables	1.379	1.419
Fresh fruits and vegetables	1.076	1.088
Fresh fruits	.575	.580
Apples	.083	.086
Bananas	.087	.102
Citrus fruits	.146	.159
Other fresh fruits	.259	.233
Fresh vegetables	.500	.509
Potatoes	.075	.080
Lettuce	.072	.077
Tomatoes	.102	.116
Other fresh vegetables	.251	.236
Processed fruits and vegetables	.303	.331
Canned fruits and vegetables	.157	.177
Frozen fruits and vegetables	.088	.091
Other processed fruits and vegetables including dried	.057	.063
Nonalcoholic beverages and beverage materials	.955	1.092
Juices and nonalcoholic drinks	.699	.831
Carbonated drinks	.285	.348
Frozen noncarbonated juices and drinks	.014	.018
Nonfrozen noncarbonated juices and drinks	.400	.465
Beverage materials including coffee and tea	.256	.261
Coffee	.158	.150
Other beverage materials including tea	.099	.110

Appendix 9. Relative importance of components in the Consumer Price Indexes, 2011−2012 weights: U.S. city average, December 2014—continued

Item and group	U.S. city average	
	CPI-U	CPI-W
Expenditure category		
Other food at home	2.043	2.167
Sugar and sweets	.299	.302
Sugar and artificial sweeteners	.054	.066
Candy and chewing gum	.185	.178
Other sweets	.060	.058
Fats and oils	.245	.270
Butter and margarine	.077	.075
Salad dressing	.062	.067
Other fats and oils including peanut butter	.107	.128
Other foods	1.499	1.595
Soups	.093	.093
Frozen and freeze dried prepared foods	.285	.315
Snacks	.330	.345
Spices, seasonings, condiments, sauces	.292	.302
Baby food	.055	.084
Other miscellaneous foods	.444	.456
Food away from home	5.830	5.793
Full service meals and snacks	2.823	2.361
Limited service meals and snacks	2.413	2.830
Food at employee sites and schools	.212	.233
Food from vending machines and mobile vendors	.064	.092
Other food away from home	.319	.276
Alcoholic beverages	1.015	.959
Alcoholic beverages at home	.597	.564
Beer, ale, and other malt beverages at home	.274	.364
Distilled spirits at home	.073	.055
Wine at home	.250	.145
Alcoholic beverages away from home	.418	.395
Housing	42.173	40.464
Shelter	32.711	31.105
Rent of primary residence	7.159	9.800
Lodging away from home	.839	.461
Housing at school, excluding board	.172	.080
Other lodging away from home including hotels and motels	.666	.380
Owners' equivalent rent of residences	24.339	20.511
Owners' equivalent rent of primary residence	22.918	19.967
Unsampled owners' equivalent rent of secondary residences	1.421	.544
Tenants' and household insurance	.375	.333
Fuels and utilities	5.273	5.903
Household energy	4.051	4.578
Fuel oil and other fuels	.236	.208
Fuel oil	.139	.118
Propane, kerosene, and firewood	.097	.090
Energy services	3.815	4.369
Electricity	2.940	3.436
Utility (piped) gas service	.875	.933
Water and sewer and trash collection services	1.222	1.326
Water and sewerage maintenance	.945	1.037
Garbage and trash collection	.277	.288
Household furnishings and operations	4.189	3.455
Window and floor coverings and other linens	.266	.208
Floor coverings	.047	.028
Window coverings	.053	.040
Other linens	.166	.140
Furniture and bedding	.769	.666
Bedroom furniture	.268	.233
Living room, kitchen, and dining room furniture	.363	.318
Other furniture	.128	.096
Unsampled furniture	.009	.019
Appliances	.271	.276
Major appliances	.147	.152
Other appliances	.120	.118
Unsampled appliances	.004	.006
Other household equipment and furnishings	.479	.443
Clocks, lamps, and decorator items	.257	.267
Indoor plants and flowers	.107	.083

Appendix 9. Relative importance of components in the Consumer Price Indexes, 2011−2012 weights: U.S. city average, December 2014—continued

Item and group	U.S. city average	
	CPI-U	CPI-W
Expenditure category		
Dishes and flatware	.041	.030
Nonelectric cookware and tableware	.074	.063
Tools, hardware, outdoor equipment and supplies	.710	.574
Tools, hardware and supplies	.189	.198
Outdoor equipment and supplies	.367	.247
Unsampled tools, hardware, outdoor equipment and supplies	.154	.129
Housekeeping supplies	.847	.910
Household cleaning products	.337	.391
Household paper products	.247	.273
Miscellaneous household products	.263	.246
Household operations	.848	.378
Domestic services	.279	.073
Gardening and lawncare services	.279	.117
Moving, storage, freight expense	.116	.081
Repair of household items	.066	.055
Unsampled household operations	.107	.052
Apparel	3.343	3.595
Men's and boys' apparel	.834	.973
Men's apparel	.653	.737
Men's suits, sport coats, and outerwear	.104	.095
Men's furnishings	.185	.198
Men's shirts and sweaters	.196	.223
Men's pants and shorts	.160	.207
Unsampled men's apparel	.007	.014
Boys' apparel	.181	.236
Women's and girls' apparel	1.439	1.427
Women's apparel	1.210	1.151
Women's outerwear	.118	.121
Women's dresses	.155	.146
Women's suits and separates	.550	.544
Women's underwear, nightwear, sportswear and accessories	.378	.328
Unsampled women's apparel	.010	.012
Girls' apparel	.229	.276
Footwear	.725	.821
Men's footwear	.218	.297
Boys' and girls' footwear	.178	.220
Women's footwear	.329	.304
Infants' and toddlers' apparel	.135	.193
Jewelry and watches	.211	.181
Watches	.046	.075
Jewelry	.164	.106
Transportation	15.289	18.015
Private transportation	14.167	17.211
New and used motor vehicles	5.720	6.886
New vehicles	3.551	3.527
Used cars and trucks	1.591	2.827
Leased cars and trucks	.397	.353
Car and truck rental	.073	.048
Unsampled new and used motor vehicles	.109	.130
Motor fuel	3.979	5.214
Gasoline (all types)	3.904	5.100
Other motor fuels	.075	.114
Motor vehicle parts and equipment	.435	.532
Tires	.285	.320
Vehicle accessories other than tires	.150	.213
Motor vehicle maintenance and repair	1.168	1.206
Motor vehicle body work	.057	.066
Motor vehicle maintenance and servicing	.492	.494
Motor vehicle repair	.587	.607
Unsampled service policies	.032	.040
Motor vehicle insurance	2.300	2.837
Motor vehicle fees	.565	.535
State motor vehicle registration and license fees	.312	.336
Parking and other fees	.235	.186
Unsampled motor vehicle fees	.018	.013
Public transportation	1.122	.805
Airline fare	.702	.442
Other intercity transportation	.157	.090

Appendix 9. Relative importance of components in the Consumer Price Indexes, 2011−2012 weights: U.S. city average, December 2014—continued

Item and group	U.S. city average	
	CPI-U	CPI-W
Expenditure category		
Intracity transportation	.260	.267
Unsampled public transportation	.004	.006
Medical care	7.716	6.308
Medical care commodities	1.772	1.423
Medicinal drugs	1.696	1.378
Prescription drugs	1.345	1.108
Nonprescription drugs	.351	.270
Medical equipment and supplies	.076	.045
Medical care services	5.944	4.885
Professional services	3.032	2.474
Physicians' services	1.590	1.303
Dental services	.804	.699
Eyeglasses and eye care	.284	.237
Services by other medical professionals	.354	.235
Hospital and related services	2.159	1.738
Hospital services	1.853	1.634
Nursing homes and adult day services	.174	.080
Care of invalids and elderly at home	.132	.024
Health insurance	.753	.673
Recreation	5.750	5.131
Video and audio	1.847	2.054
Televisions	.133	.148
Cable and satellite television and radio service	1.468	1.668
Other video equipment	.029	.031
Video discs and other media, including rental of video and audio	.090	.099
Audio equipment	.066	.054
Audio discs, tapes and other media	.044	.040
Unsampled video and audio	.016	.015
Pets, pet products and services	1.058	.959
Pets and pet products	.659	.680
Pet services including veterinary	.399	.279
Sporting goods	.400	.430
Sports vehicles including bicycles	.181	.214
Sports equipment	.214	.211
Unsampled sporting goods	.005	.006
Photography	.120	.095
Photographic equipment and supplies	.058	.034
Photographers and film processing	.062	.059
Unsampled photography	.001	.002
Other recreational goods	.381	.387
Toys	.277	.291
Sewing machines, fabric and supplies	.050	.048
Music instruments and accessories	.042	.031
Unsampled recreation commodities	.011	.017
Other recreation services	1.724	1.063
Club dues and fees for participant sports and group exercises	.602	.325
Admissions	.640	.501
Fees for lessons or instructions	.211	.128
Unsampled recreation services	.271	.109
Recreational reading materials	.220	.144
Newspapers and magazines	.123	.081
Recreational books	.094	.062
Unsampled recreational reading materials	.002	.000
Education and communication	7.062	6.875
Education	3.325	2.544
Educational books and supplies	.203	.202
Tuition, other school fees, and childcare	3.122	2.342
College tuition and fees	1.853	1.183
Elementary and high school tuition and fees	.377	.253
Child care and nursery school	.725	.772
Technical and business school tuition and fees	.039	.042
Unsampled tuition, other school fees, and childcare	.128	.092
Communication	3.737	4.332

Appendix 9. Relative importance of components in the Consumer Price Indexes, 2011−2012 weights: U.S. city average, December 2014—continued

Item and group	U.S. city average	
	CPI-U	CPI-W
Expenditure category		
Postage and delivery services	.144	.104
Postage	.130	.095
Delivery services	.014	.009
Information and information processing	3.593	4.228
Telephone services	2.462	3.030
Wireless telephone services	1.624	2.199
Land-line telephone services	.837	.831
Information technology, hardware and services	1.132	1.198
Personal computers and peripheral equipment	.272	.249
Computer software and accessories	.068	.054
Internet services and electronic information providers	.711	.819
Telephone hardware, calculators, and other consumer information items	.068	.062
Unsampled information and information processing	.012	.014
Other goods and services	3.394	3.600
Tobacco and smoking products	.718	1.187
Cigarettes	.661	1.111
Tobacco products other than cigarettes	.050	.066
Unsampled tobacco and smoking products	.006	.009
Personal care	2.676	2.413
Personal care products	.724	.709
Hair, dental, shaving, and miscellaneous personal care products	.369	.375
Cosmetics, perfume, bath, nail preparations and implements	.348	.325
Unsampled personal care products	.007	.008
Personal care services	.638	.576
Haircuts and other personal care services	.638	.576
Miscellaneous personal services	1.122	.953
Legal services	.316	.250
Funeral expenses	.173	.123
Laundry and dry cleaning services	.276	.288
Apparel services other than laundry and dry cleaning	.034	.022
Financial services	.228	.189
Unsampled items	.095	.080
Miscellaneous personal goods	.192	.176
Special aggregate indexes		
All items	100.000	100.000
Commodities	37.880	41.147
Commodities less food and beverages	22.608	25.136
Nondurables less food and beverages	13.658	15.131
Nondurables less food, beverages, and apparel	10.315	11.536
Durables	8.950	10.005
Services	62.120	58.853
Rent of shelter	32.336	30.772
Transportation services	5.625	5.784
Other services	11.955	11.005
All items less food	85.743	84.948
All items less shelter	67.289	68.895
All items less medical care	92.284	93.692
Commodities less food	23.623	26.095
Nondurables less food	14.673	16.090
Nondurables less food and apparel	11.330	12.495
Nondurables	28.930	31.142
Apparel less footwear	2.619	2.774
Services less rent of shelter	29.784	28.081
Services less medical care services	56.176	53.968
Energy	8.030	9.792
All items less energy	91.970	90.208
All items less food and energy	77.713	75.156
Commodities less food and energy commodities	19.408	20.672
Energy commodities	4.215	5.423
Services less energy services	58.305	54.484
Domestically produced farm food	7.094	7.761
Utilities and public transportation	10.089	11.197