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CONSUMER PRICE INDEX

Impact of Commodity Analysts' Decisionmaking Needs to Be Assessed



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The Honorable John L. Mica
Chairman, Subcommittee on Criminal Justice,
Drug Policy, and Human Resources
Committee on Government Reform
House of Representatives

The Honorable Christopher Shays
House of Representatives

One of the most important economic indexes produced by the federal government is the Consumer Price Index (CPI). According to the Bureau of Labor Statistics (BLS), which publishes the index, the CPI is the principal measure of trends in consumer prices and inflation in the United States. The CPI is used by the federal government, businesses, and others. In fiscal year 1998, \$499 billion in federal spending, such as income payments to Social Security beneficiaries, was automatically linked to price changes measured by the CPI. In addition, because it is used annually to adjust various aspects of federal individual income tax for inflation, such as the tax brackets and the amounts of personal exemptions, every individual income taxpayer is affected by changes in the CPI.

The CPI tracks the prices of a fixed market basket of goods and services that consumers purchase. There are thousands of different products and services in the market basket, and BLS attempts to obtain prices on the exact same products and services each month. By tracking the exact same items each month, BLS seeks to avoid capturing price differences that are due to changes in the characteristics of a product or service rather than simply changes in price. However, BLS cannot always find the exact same item each month; and when this happens, BLS price takers in the field "substitute" a new version of the product for the old version. Substitutions occur for a variety of reasons, including changes in technology or style as well as when an item is out of stock at a store in which prices are being collected. In calendar year 1997, according to BLS data, substitutions ranged from 1.4 percent in the food and beverages component to 12.8 percent in the apparel and upkeep component.

After substitutions are made in the field, BLS' commodity analysts in Washington, D.C., decide if there are significant differences in characteristics between the items and their substitutes. When commodity analysts determine that the differences are significant, they make what BLS refers to as quality adjustments to separate pure price changes from price

changes that are due to other factors, such as differences in quality, size, or quantity.¹

The adjustments made by commodity analysts affect the price changes that go into computing the CPI. Evidence indicates that substitutions (those that are adjusted together with those that are not adjusted) have a significant impact on the CPI. A BLS study estimated that, while less than 4 percent of the price quotations used to calculate the CPI in 1995 were substitutions, these substitutions were responsible for about one-half of the price increase in the CPI for the items studied.² To the extent that more than pure price changes are included in the CPI, the index's accuracy is affected.

As you requested, this report describes (1) how commodity analysts decide whether to make adjustments, (2) the adjustment methods they use, and (3) how supervisors of commodity analysts review the analysts' decisions. For this report, we gathered descriptions from commodity analysts on how they made decisions for specific substitutions that ranged across the major components of the CPI.

Results in Brief

Commodity analysts use a combination of professional judgment, general procedures, specific methods, and limited written guidance in deciding whether and how to make adjustments for substitutions. The relative importance of these four elements varies in the analysts' decisionmaking, depending upon the specific substitutions. In some cases, judgment is of primary importance. According to BLS, the commodity analysts' supervisors usually review substitution decisions only when they consider the price increases or decreases that result from the analysts' decisions to be large. Beyond the specific reviews performed by supervisors, BLS does not have a program of assessing the decisionmaking patterns of commodity analysts.

In making adjustments, BLS' objective is to include only pure price change in the calculation of the CPI and, to the extent possible, eliminate price change that is the result of other factors, such as improvements in quality,

¹In this report, we refer to all adjustments—whether for quality or other reasons—simply as adjustments.

²This BLS study included data from about 83 percent of the 1995 item strata. (BLS groups items in the CPI together at broad levels of similarity—food and beverages—and then at sublevels of similarity. Item strata—ground beef, chuck roast—are sublevels.) The study attributed the disproportionate impact of substitutions on the CPI to manufacturers' tendency to increase prices when new products were introduced, and retailers' tendency to discount prices when old products were discontinued.

size, or quantity. Commodity analysts receive and review information about the old and new versions of the commodity from which they make a series of determinations that revolve around whether the two versions are similar and, if not, which adjustment method to apply.

Commodity analysts compare the characteristics of the original item with the replacement and then use their professional judgment to decide if the two are comparable. For example, a commodity analyst who reviewed a substitution of an electric blanket with a 5-year warranty for an electric blanket with a 2-year warranty judged them to be comparable. In calendar year 1997, analysts concluded that a majority—58 percent—of about 29,000 substitutions were comparable. For other than certain food items, no current written guidance was available for commodity analysts to follow in making their decisions. In some instances, according to BLS, the decisions are straightforward and involve little judgment. In other instances, the analysts must exercise a significant degree of judgment to make decisions. For items that are judged to be comparable, no adjustment is made; and the difference between the prices of the new and old versions, expressed as a percentage, is used in the calculation of the CPI for that month.

When a substitution is not comparable with the item it replaces, commodity analysts either use a direct adjustment method to make an adjustment themselves or assign one of two indirect methods, in which case BLS computer programs make the adjustments. In 1997, about one-third of all nonrent adjustments were made directly; about two-thirds were made indirectly. Direct adjustments are made when commodity analysts have data on the ways the old and new versions differ and have information with which to assess the value of those differences. They are made when the specific cost of a quality change can be estimated either by the manufacturer of the items or by using BLS' statistical models that incorporate price data. Direct adjustments are also made when an item's size or quantity changes. Most direct adjustments in calendar year 1997 were for apparel items and new and used vehicles. Although BLS' process for reviewing changes that affect residential rent is somewhat outside the process that it follows for other CPI items, the majority of adjustments made to residential rent are direct adjustments.

When an adjustment is judged to be warranted, but a direct adjustment cannot be made, commodity analysts apply one of two indirect adjustment methods that impute a rate of price change. Both methods impute the pure price change by averaging the rates of price changes experienced by the

same type of items in the CPI. The two methods, “class mean” and linking, differ in terms of the subsets of items included in calculating the rate of price change. The class-mean method is generally used for products where new models or product lines are introduced fairly regularly. It is based on the rate of price changes experienced by other substitutions—of the same type of product or service—in the particular geographic location. These other substitutions are those that the commodity analyst had judged for that month to be comparable or had directly adjusted. Thus, the class-mean method relies exclusively on an analyst’s judgments for related substitutions. The linking method is not limited to price changes resulting from substitutions. This method includes all items of the same type and in the same location as the item in question, and it is most heavily influenced by items that had not changed; that is, those that were not substitutions. The linking method includes a larger array of products and services than the class-mean method.

According to BLS, there are no guidelines or policies in writing for supervisors to follow in selecting and reviewing the substitution decisions of commodity analysts. In practice, according to BLS, there is an unwritten policy that supervisors are to review substitution decisions when they consider the price increase or decrease to be large. Few other adjustments are reviewed. BLS has no policy to randomly or otherwise select and review substitution decisions.

Beyond the specific reviews performed by supervisors, BLS does not have a program to assess the decisionmaking patterns of commodity analysts. However, studies have been conducted from time to time, and three were conducted in the 1980s and early 1990s. The studies found the decisionmaking process to be susceptible to producing errors and inconsistencies and recommended actions intended to promote greater controls over the decisionmaking process. According to officials we interviewed, however, BLS now takes the position that such controls are not required for experienced commodity analysts.

We found no evidence to indicate whether errors or inconsistencies in commodity analysts’ decisions or lack of comprehensive reviews of those decisions has had a material effect on the calculation of the CPI. However, it is sound management practice for BLS to assess, on a periodic basis, whether errors and inconsistencies in commodity analysts decisions materially affect the CPI and we make a recommendation to that effect.

Background

Every month, usually by the middle of the month, BLS, which is a part of the U.S. Department of Labor, publishes a new CPI based on data collected in the previous month. Two CPIs are published, and the data for each are arrayed in various ways, such as by nationwide average for urban areas and by selected local areas.³ To produce these indexes, BLS collects and processes large amounts of data.

According to BLS data, an average of about 77,000 price quotations—price and characteristics about a product or service—were collected each month in calendar year 1997. To obtain these quotations, approximately 30,000 retail and service establishments and nearly 4,000 landlords and tenants were visited or contacted every month. All together, BLS tracked the prices of about 94,000 specific items in 1997, although every item was not priced every month. The many kinds of products and services under which these thousands of items were categorized ranged from white bread to funeral expenses (see app. VIII).

Although some pricing information is gathered by BLS headquarters personnel, most price quotations are collected by BLS field representatives who are also referred to as price takers. According to BLS, each price taker is assigned specific outlets (e.g., supermarkets, department stores, car dealers, housing units, and doctors offices) to visit and a list of goods and services within those outlets to price.

If an outlet does not have the exact item, BLS requires the price taker to select a substitute item in that outlet. Depending on the item, the price taker may visit or contact the outlet more than once to find the missing item before making a substitution. In calendar year 1997, acceptable substitutions were made for about 3.3 percent of the 872,829 nonrent price quotations collected.⁴ Price takers are to select substitutions that are as similar as possible to the items that were not found.

Substitutions are reviewed by commodity analysts who work in the Consumer Prices Branch of the Division of Consumer Prices at BLS' headquarters. The branch, which is headed by a branch chief, is divided

³The two CPIs are the CPI for All Urban Consumers (CPI-U) and the CPI for Urban Wage Earners and Clerical Workers (CPI-W). According to BLS, the CPI-U represents about 87 percent of the U.S. population, and the CPI-W represents about 32 percent of the U.S. population. BLS began publishing the CPI-U in 1978. Until then, it published only the CPI-W.

⁴Upon review, BLS may classify a substitution as an unacceptable replacement if, for example, a substitution occurred outside of the time frame BLS has designated for a seasonal item—a spring or summer raincoat for a fall or winter coat. Unacceptable substitutions are discarded, and BLS does not include them in its statistics on substitutions.

into five sections, each of which is headed by a section chief. There were three supervisors in April 1998 who, in addition to the section chiefs, supervised 29 commodity analysts.

Appendix II provides more information about the general construction of the CPI and the collection of prices.

Scope and Methodology

For our first and second objectives—to describe how commodity analysts decide whether to make adjustments and the adjustment methods they use—we (1) obtained relevant documents and data from BLS; (2) had commodity analysts walk us through selected substitutions that they had reviewed, asking them to explain what they did and why; and (3) discussed the methods used to make adjustments with the supervisors of commodity analysts.

Among the documents we reviewed were BLS manuals and handbooks pertaining to the CPI, such as an instruction manual for price takers,⁵ a handbook that included descriptions of the adjustment methods,⁶ and a handbook that described procedures for reviewing housing rental data.⁷ In addition, we reviewed BLS' descriptions of the adjustment procedures that were published either as internal research papers or in professional journals. With the exception of certain food items, BLS did not have a current set of written procedures that commodity analysts followed when reviewing nonrent substitutions.

At our request, BLS provided us with 1997 summary data on the number of price quotations collected, the number of substitutions, and the number of times the different methods of adjustment were used. These data are reproduced in appendix VIII.

To obtain an understanding of the commodity analysts' decision processes, we talked with analysts about specific substitutions. We interviewed a judgmental selection of 19 out of 28 commodity analysts

⁵Consumer Price Index: C&S Pricing Data Collection Manual, BLS (Washington, D.C.: U.S. Department of Labor, n.d.).

⁶BLS Handbook of Methods, BLS (Washington, D.C.: U.S. Department of Labor, April 1997).

⁷Housing Commodity Analyst Handbook, BLS (Washington, D.C.: U.S. Department of Labor, January 1996).

about their decisions on 120 specific substitutions.⁸ (See appendix I for the details of how we selected the analysts and substitutions.) In addition, we talked to a supervisor about another 16 specific substitutions because the analyst who had reviewed these substitutions no longer worked at BLS. We asked the analysts and supervisor questions, such as what characteristics changed between the substitution and the item it replaced, what led to the decision that a substitution was comparable or not comparable, and why a particular adjustment method was applied.

After these interviews, we judgmentally selected 13 substitutions to serve as illustrative examples for this report. These examples cover (1) substitutions from the six major components of the CPI, (2) comparable substitutions, and (3) the major adjustment methods. See appendix I for the details of how we selected the examples.

For our third objective—to describe how supervisors review commodity analysts' decisions—we interviewed supervisors and reviewed BLS studies that considered issues relating to supervision. We also discussed the methods used to make adjustments with the supervisors. The supervisors we interviewed were the chiefs of the five sections into which the commodity analysts are divided and three supervisors who were not section chiefs. In addition, we also interviewed the Branch Chief for Consumer Prices, who is responsible for all five sections. The studies we reviewed were an assessment of analysts' decisionmaking over time,⁹ a quality assurance report on analysts' decisions,¹⁰ and an evaluation of a project to develop decisionmaking computer software that would assist analysts and supervisors.¹¹

Because the procedures that commodity analysts follow in reviewing substitutions for most CPI items are unwritten, we relied mostly on our interviews with commodity analysts and their supervisors and managers to piece together what those procedures were. To the extent possible, we

⁸One of the 29 commodity analysts had not worked for the CPI in 1997 and was excluded from our survey. Four of the 19 commodity analysts reviewed substitutions connected with residential housing rent. The others reviewed substitutions for various goods and services, such as over-the-counter drugs. Analysts who review residential rent follow different procedures than the others. Appendix VII provides information on the procedures for residential rent.

⁹Jack Galvin, "A Control Chart Analysis of Commodity Analyst Review Activity." Unpublished study, BLS, October 1985.

¹⁰Paul A. Armknecht, "Commodity Analyst Updates During 1985 for C&S Survey Quality Assurance Report." Unpublished study, BLS, May 1986.

¹¹Bob Adkins et al., "The Development and Testing of the CPI Commodities and Services Comparability Expert System." Unpublished study, BLS, February 1993.

verified what we were told by cross-checking what one person said with what another person said. We did not verify the computerized data that BLS provided to us, such as statistics on substitutions. Nor did we verify the studies or any other materials BLS provided to us.

This report describes procedures which, according to BLS, are intended to contribute to the accuracy of the CPI but does not assess the accuracy of the methods BLS uses to make adjustments or estimate the effects of those adjustments on the CPI. Similarly, our work is not intended to evaluate the overall accuracy of the CPI.

We did our audit work in Washington, D.C., from November 1997 through January 1999 in accordance with generally accepted government auditing standards. We requested comments on a draft of this report from the Secretary of Labor or her designee. The Commissioner of BLS provided written comments, which are discussed near the end of this letter and reprinted in appendix IX along with our additional comments.

Description of How Analysts Decide to Make Adjustments and the Adjustment Methods

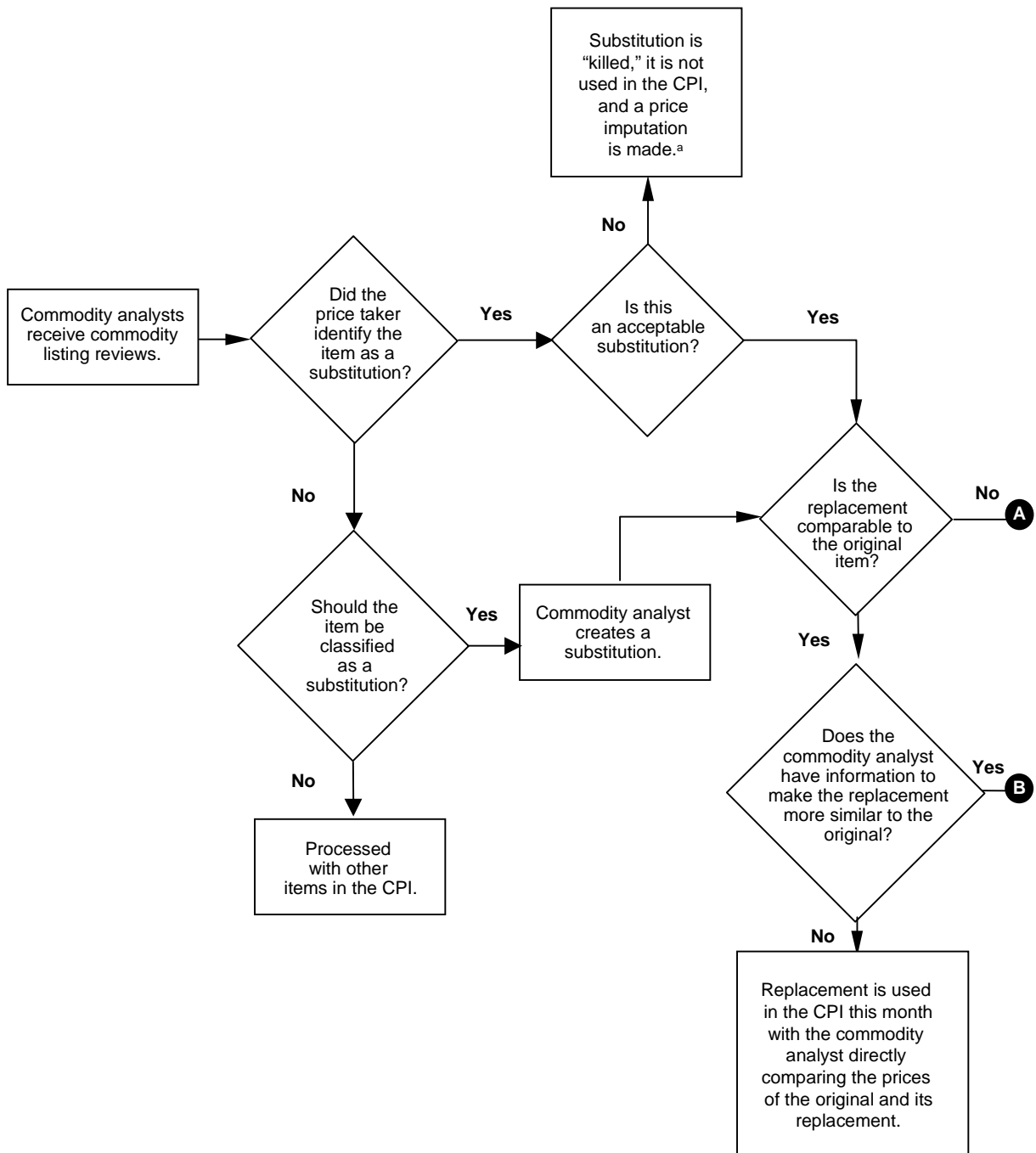
BLS has two processes for reviewing changes in products and services that are in the CPI: one for residential rental units and another for all other items in the CPI. Although BLS does not substitute one residential unit for another, according to BLS officials, changes in a rental unit may cause BLS to adjust the reported rent. For example, if a landlord added a clothes washer and dryer to the unit since BLS last collected data, BLS would adjust the current rent for the value of the addition of the washer and dryer so the rental unit would be comparable to what it was earlier. BLS' process for reviewing changes to rental units is somewhat outside the process that it follows for other CPI items. Appendix VII discusses the procedures and adjustment methods used for residential rent.

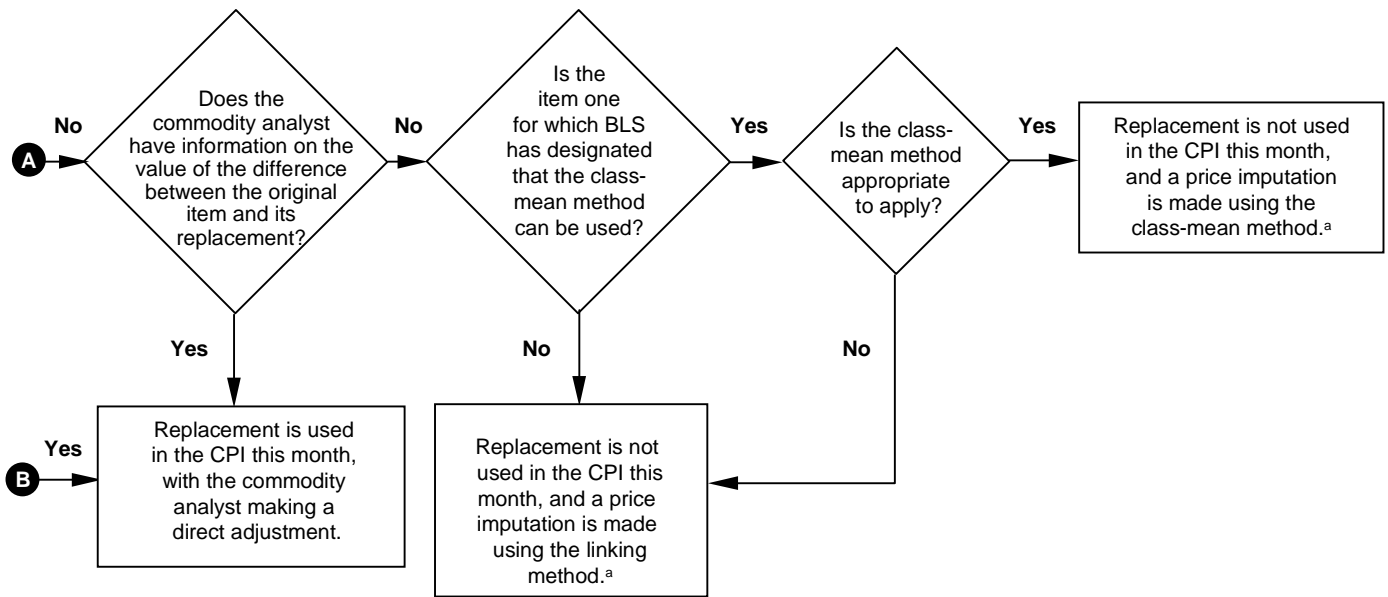
Using information gathered from our interviews with commodity analysts and their supervisors and confirmed by BLS officials, we sketched out how commodity analysts review nonrent substitutions and the adjustments they make. Figure 1 illustrates that process. It begins when commodity analysts receive commodity review listings, after which they make a series of determinations, such as whether a substitution is acceptable, whether an acceptable substitution will be adjusted, and which adjustment method will be applied.

BLS has not documented the process it uses to review and adjust most nonrent substitutions; but BLS officials have agreed that, although there are

probably some exceptions, the figure 1 flowchart reasonably illustrates that process.

Figure 1: BLS' Process for Making Nonrent Substitutions and Adjustment Decisions





ªPrice imputation is a term used by BLS to indicate that the actual price of the substitution is not used. Instead, an average is calculated from the price changes experienced that month by the same type of items in the CPI to handle a missing or unusable price quotation.

Source: BLS.

Commodity Review Listings Provide Analysts With Information for Decisionmaking

Commodity review listings (CRL) provide commodity analysts with information for making various judgments about substitutions and are the primary tool used by analysts in the process of reviewing changes in products and services. CRLs are generated each month from the data that have been collected by price takers. CRLs contain data about a product or service, such as its characteristics (referred to as specifications by BLS) and price history. For example, for a cola soft drink, the CRL may list the packaging (e.g., 12 pack), container construction (e.g., metal can), and caffeine content (e.g., caffeine free). CRLs for items that were reported as substitutions by price takers include the specifications and prices for both the substitution and the item it replaced. All specifications are listed according to a hierarchy of importance for comparing the two versions, and specifications that differ between the two versions are automatically noted.

According to BLS, two conditions usually cause a CRL to be generated for substitution review: (1) the price taker reported an item as a substitution and (2) BLS computers, which have been programmed to identify changes in specific characteristics that the price taker recorded for the item, identify a change in a key specification. Computer routines, according to BLS, compare the item reported one month with the item that was reported the previous month in which the item was priced. In these computer-identified cases, price takers would not have reported the current item to be a substitution.

Upon receiving these CRLs, one of the first judgments that a commodity analyst is to make is (1) whether an item was correctly reported as a substitution or (2) whether the change in specification should cause the item to be treated as a substitution. The analyst may decide that the price taker inappropriately identified an item as a substitution based on the specifications that the price taker provided, in which case, according to BLS, the substitution is deleted and not used in the CPI. If the computer-identified change in specification is significant in the analyst's judgment, the analyst can classify the current month's item as a substitution.

Determining Whether a Substitution Is Acceptable

After the pool of substitutions has been identified, then the commodity analysts determine if each of them is acceptable for use in the CPI. According to a BLS official, there are several reasons why a substitution may be unacceptable. For example, a substitution is deemed unacceptable when the commodity analyst waits to see if the old version is only

temporarily unavailable at the retail outlet. Unacceptable substitutions are “killed” in BLS’ terminology—deleted and not used in the CPI—and, according to a BLS official, excluded from statistics on substitutions (including those presented in this report). This BLS official told us that 1,065 substitutions were killed between October 1997 and September 1998.

In calendar year 1997, commodity analysts determined that 28,881 nonrent substitutions were acceptable and eligible for use in the CPI. These 28,881 substitutions represented about 3.3 percent of the 872,829 nonrent prices collected by BLS in 1997.

Determining Whether the New and Old Versions Are Comparable

For substitutions that are accepted, the next step commodity analysts take is to judge whether the price change resulting from the substitution can be used in the CPI without adjustment or whether an adjustment is necessary to account for differences between the substitution and the item it replaced. BLS officials reported that the analysts make this determination based on the extent of the differences between the old and new versions of the substituted item and the methods and information available to them. In some instances, according to BLS, the decisions are straightforward and involve little judgment. In other instances, a significant degree of judgment is required.

When the new version and the old version are judged similar enough to preclude the need for an adjustment, they are said by BLS to be comparable. In 1997, commodity analysts judged about 58 percent of the 28,881 nonrent substitutions to be comparable. For example, in one substitution we reviewed, the level of membership in a tennis club changed from “Tennis plus” to “Gold tennis” but the analyst determined that the memberships were essentially the same and comparable. In another substitution, the manufacturer increased the warranty of an electric blanket from 2 years to 5 years, but the analyst concluded that the blankets were comparable.

However, if the new version had characteristics that the commodity analyst considered significantly different from the old version, such as changes in materials, features, or size, the analyst would have to consider whether, and how, to make an adjustment. In such cases, the substitutions and the items they replaced are generally judged by BLS to be not comparable. For example, in one substitution we reviewed, the size of a bed dust ruffle changed from twin (old item) to queen (substituted item), causing the commodity analyst to judge them to be not comparable. In

another case, there were differences in ingredients and size between two packages of soup, and the analyst classified them as not comparable.

When the two versions are judged to be comparable, the price of the old version is compared with the price of the new version and the result, expressed as a percentage, is used to calculate the CPI for that month. For example, if two coats were comparable and the new version cost \$115 and the old version cost \$95, the rate of change for the coat would be 21 percent. However, when an adjustment is made, the percentage price change that results from that adjustment is used in calculating the CPI. If the two coats were not comparable because the new one had a lining and the old one did not, and the cost associated with the lining was \$5, an adjustment of \$5 would be made. The rate of change used in the CPI for that month would be an increase of 15 percent instead of 21 percent.

Most commodity analysts that we interviewed did not have written criteria to guide them in making their comparability decisions. But a few food commodity analysts showed us criteria that they had developed with their supervisors for specific types of products to help them decide whether substitutions are comparable.

Regardless of whether comparability criteria were available, all of the commodity analysts we interviewed indicated that they examine the specifications on the CRL and decide if the differences in characteristics between a substitution and the item it replaced warrant an adjustment. If they decide that the differences are not major, the commodity analysts said they will code the substitution as comparable. Their supervisors stated that, in some instances, the differences did not allow for clear-cut decisions, and that the analysts' judgment had to be exercised.

Adjustment Methods and Determining Which Method to Use

When a substitution is not comparable with the item it replaced, commodity analysts make a direct adjustment or cause an indirect adjustment to be made. When direct adjustments are made, BLS has information on the ways the new version changed from the old version and the value of those changes to adjust the price of the substitution directly. BLS uses several different direct adjustment methods. Indirect adjustments are made when there is insufficient information available with which to make a direct adjustment. Unlike the direct adjustment methods, which are based on information that is specific to the item being adjusted,

the two indirect adjustment methods that BLS uses, class-mean and linking, are based on averages of other price changes experienced that month.¹²

The number of direct and indirect adjustments made to nonrent substitutions in calendar year 1997 totaled 12,131. This number was about 42 percent of the 28,881 nonrent adjustments. Table 1 shows the number of direct and indirect adjustments by major CPI component. As the table indicates, when the number of substitutions is compared to the number of price quotations, substitutions occur unevenly among the CPI components.

Table 1: CPI Price Quotations, Substitutions, and Methods of Adjustment by Major Components for 1997

Major components	Number of price quotations	Number of substitutions (accepted)	Substitutions not adjusted (comparable)	Adjusted substitutions by adjustment method		
				Direct adjustments	Indirect adjustments	
					Class-mean method ^a	Linking method
Food and beverages	459,635	6,485	3,640	107	31	2,707
Housing ^b	136,430	4,047	2,453	132	1,023	439
Apparel and upkeep	76,736	9,797	6,598	1,223	1,796	180
Transportation	94,336	5,660	2,699	1,837	823	301
Medical care	50,237	1,116	355	336	3	422
Entertainment	32,985	1,327	763	95	321	148
Other goods and services	22,440	422	215	40	52	115
All items	872,829	28,881	16,750	3,770	4,049	4,312

^aThis column includes some adjustments made using a method that BLS was phasing out of use. BLS estimated the number of these adjustments to be at least 77.

^bHousing totals exclude residential rent adjustments. The full version of this table, which is contained in appendix VIII, contains data on rent.

Source: BLS.

Regardless of whether an adjustment is direct or indirect, the basic intent is to keep the known differences in characteristics between substitutions and original items from affecting the CPI's measurement of price change. The CPI is designed to include only "pure" price changes, and the adjustments that BLS makes in connection with substitutions are intended to separate pure price increases from increases due to other factors, such as improvements in quality.¹³

¹²BLS refers to these two methods as "imputations." For ease in reading we use the term "indirect adjustments" to refer to the class-mean and linking methods.

¹³The difference in price that remains after pure price is referred to generically as quality by BLS.

Direct Adjustments

About 31 percent of the 12,131 nonrent adjustments in 1997 were made using direct adjustment methods. On the basis of BLS' use, these direct adjustments can be classified into a manufacturers' cost method; a statistical modeling method, which BLS refers to as a hedonic regression method; and a final method that can best be described as a catchall "other," which includes adjustments for changes in size or quantity or for error.

- For the manufacturers' cost method, BLS uses cost information from manufacturers to identify individual characteristics or options that have changed and the cost of those changes. In 1997, all of the manufacturers' cost adjustments were in the new and used vehicle item strata. BLS collects information from automakers on the changes they make each model year and the cost of those changes. After screening these changes to make sure they meet BLS' criteria for quality, BLS then uses the information to make adjustments. BLS collects this change and cost information for a sample of domestically produced models each year. The great majority of the 1,837 direct adjustments made in the transportation component of the CPI used the manufacturers' cost method.

In an automobile substitution that we reviewed, the commodity analyst used an automaker's information to determine that a 1998 model had lower fuel emissions and safer air bags than the 1997 model. Using information from the automaker, the analyst valued these improvements at \$135. The analyst then made a direct adjustment, reducing the difference in price between the 1997 model and the 1998 model by \$135 to account for the change in quality.¹⁴ The remaining difference in price (expressed as a percentage) went into the CPI as the pure price change.

- Under the hedonic regression method, BLS uses statistical models to estimate a value for individual characteristics of a product, such as the value of adding a lining and hood to a coat. According to BLS, in 1997, statistical models were used to make most of the 1,223 direct adjustments to apparel items, which were the only type of item for which BLS had statistical models.¹⁵

¹⁴As of January 1999, BLS no longer treats changes made solely to meet air quality standards as quality improvements for determining the rates of price changes for the CPI.

¹⁵BLS has developed a statistical model for computer items, which it began using in 1998, and another for televisions, which it began using in January 1999.

For one of the apparel substitutions we reviewed, for example, the commodity analyst used a statistical model to assign value to certain differences—design, fiber content, and cleaning method—between two versions of a woman’s coats. Based on information from the model, the analyst assigned these differences a combined value of \$33.85. This value was then, in effect, subtracted from the difference in price between the old and new versions.

- A broad array of direct price adjustments fall within the other direct method, including those for a change in size (e.g., 8 ounces instead of 10 ounces), for a change in the number of units (e.g., 15 tablets instead of 12 tablets), and to correct for errors made by price takers (e.g., to correct an inaccurate recording of the number of ounces in a container). BLS considers adjustments for size or unit count to be direct adjustments because they adjust for a particular countable characteristic of a good or service. Most of the direct adjustments in the major components of the CPI, other than apparel and transportation, were these types of direct adjustments.

Commodity analysts we interviewed who reviewed automobile and apparel substitutions said that they often made direct adjustments to increase the level of similarity between old and new versions. Without these adjustments, the substitutions would have been classified as comparable, according to the analysts, because the differences were minor. For example, the commodity analyst who made the \$135 direct adjustment in the previously mentioned automobile substitution said that the difference in fuel emissions and air bags between the two models would have been insufficient to make them not comparable. In addition, regardless of type of product or service, analysts who have the information available with which to make a direct adjustment may do so without first going through the step of contemplating whether the new and old versions are comparable.

When using the direct adjustment methods based on manufacturers’ cost information or statistical models, BLS first estimates the value of quality changes and then removes that value from the difference in price between the substitution and the original item. The pure price change is the residual after the adjustment for quality is made. For example, in the automobile substitution we discussed previously, the 1998 model cost \$23,180 while the 1997 model cost \$22,104, a difference of \$1,076. If no adjustment had been made, this difference would have constituted a price increase of 4.9 percent. However, an adjustment of \$135 was made for improvements in fuel emission levels and air bag safety. As a result, the

adjusted price difference between the 1998 model and the 1997 model was \$941, or 4.3 percent. Therefore, in this case, 0.6 percent (or \$135) of the unadjusted price difference of 4.9 percent was attributed to quality change, and the remainder of 4.3 percent was attributed to pure price change.

Appendix IV provides more information about the direct adjustment method, including examples that illustrate its use.

Indirect Adjustments

BLS uses either a class-mean method or a linking method to make indirect adjustments. Both of these indirect methods first estimate the pure price change and exclude any residual, which is reverse of what the direct adjustment methods do where price change is the residual. Both methods impute the pure price change by averaging the rates of price changes experienced by the same type of items in the CPI. This averaging is done by computer program. However, the same type of items are defined narrowly for the class-mean method but are defined much more broadly for the linking method.

Because the linking method is, in effect, based on the average rates of price change for all of the same type of items in a geographic location, it cannot affect the average rates of price change for that geographic location. In addition, estimates by BLS researchers indicate that, overall, the linking method causes lower price increases than the class-mean method. The researchers estimated that the average monthly price change for adjustments made with the linking method was less than 1 percent in 1995 while the average monthly price change for adjustments made with the class-mean method was about 5 percent. Because the methods by definition use different sets of goods and services in the calculations, BLS' estimates of 1 percent and 5 percent reflect differences due to the manner in which the calculations were made as well as differences in the type of products used in the calculations. BLS designed the class-mean method with the intention to produce more accurate rates of price change for items involving new models and products than the linking method because in BLS' research, new models and products generally incorporated larger price changes.

Class-Mean Adjustments

According to BLS, the class-mean method is the designated method for item strata where new models or product lines are introduced regularly. These strata have included vehicles and apparel items if direct adjustments could not be made; household appliances; and other household goods.

The item that was substituted is put aside under the class-mean method in computing price changes. Instead, to impute a price change, BLS selects a subset of substitutions from the same item stratum and geographic location as the original item. For example, if a price taker who tracks prices in Urbantown substituted one refrigerator for another, BLS would use this Urbantown stratum (refrigerators and home freezers) to compute the price change rather than specific price information on the refrigerator that the price taker reported. BLS has decided that the most appropriate subset of substitutions for items involving new models or product lines are (1) those that were not adjusted (i.e., those that were comparable) and (2) those that were adjusted through a direct adjustment method. All of the comparable and direct-adjusted substitutions within a stratum are to be used. According to BLS, this subset of substitutions is the best approximation of the pure price changes that come about with the introduction of new models and product lines.

New class-means are computed each month, and the class-mean for a particular item stratum is assigned, in effect, to all class-mean substitutions in that stratum and location. For example, if the class-mean for Urbantown's refrigerators and home freezers stratum was an increase of 10 percent and five class-mean substitutions to that stratum were made, each of those substitutions would reflect a price increase of 10 percent. In turn, that percentage would be used five times in computing the CPI index for Urbantown for that particular month.

In 1997, the class-mean method accounted for about 33 percent of the 12,131 adjustments. One of those class-mean adjustments was for another car substitution that we reviewed. The analyst knew that improvements had been made to the 1998 model but did not have sufficient information to make a direct quality adjustment. In this instance, the 1998 model cost \$14,408 while the 1997 model cost \$14,010, a price change of 2.8 percent. However, the class-mean method set aside this actual price increase and imputed a price increase based on other new automobile models in the same geographic area. There were 11 comparable and directly adjusted new models (substitutions) in that geographic area for which BLS had collected information. As these 11 models had increased in price by an average of 4.0 percent, the price of the 1998 model was imputed to have risen by 4.0 percent.

Appendix V provides more information about the class-mean method, including examples that illustrate its use.

Linking Method Adjustments

According to BLS, the linking adjustment method is to be used when neither a direct adjustment nor a class-mean adjustment can be made. BLS has designated the linking method for item strata where new models or product lines are not introduced fairly regularly, such as food items. It is also the designated method for most services, such as medical services, because, in BLS' opinion, changes in the quality of services are difficult to measure. The linking method was used for about 36 percent of the 12,131 adjustments made in 1997. It was used in nearly all of the nonrent item strata in which an adjustment was made and accounted for a majority of the adjustments in the food and beverage component of the CPI and the medical care component.

As with the class-mean method, substitutions under the linking method are put aside in calculating price changes for the month. Instead, a rate of price change is imputed from the same item stratum and geographic location as the original item. All items in the item strata with usable prices are to be used to compute a weighted-average price change, which is expressed as a percentage.¹⁶ BLS then, in effect, assigns this percentage or rate of change to all linked adjustments in that item stratum and geographic location for the month in which the calculation was made.

The linking method was used for a soup substitution that we reviewed. On a per-ounce basis, the new package of soup cost 34.5 percent more than the old package of soup. However, this price increase was set aside because of differences in soup ingredients and package size. Instead, a price increase of 0.6 percent was imputed under the linking method, based on the items with usable prices in that item stratum and geographic region.

In addition to being used for linked substitutions, this method is also used when a substitution is unacceptable and killed. According to BLS, when a substitution is killed, an imputed rate of price change is assigned to the old item (the item for which the killed substitution was going to replace), and the same calculation that is used in the linking method is used for this price change.

Appendix VI provides more information about the linking method, including examples that illustrate its use.

¹⁶BLS defines items with usable prices as those for which (1) no substitutions were made, (2) substitutions were made and no adjustments were necessary, and (3) substitutions were made and then adjusted using a direct method. Items that do not have usable prices are those, for example, that were temporarily unavailable for pricing because they were out of season.

Description of How Supervisors Review Commodity Analysts' Decisions

BLS relies on supervisors to review the substitutions decisions made by commodity analysts. According to BLS, there are no guidelines or policies in writing for supervisors to follow in selecting and reviewing the decisions made by analysts. In practice, according to the BLS Branch Chief for Consumer Prices, there is an unwritten policy that supervisors each month are to review large price changes going into the CPI. When those changes involve substitutions, the decisions made by commodity analysts are reviewed. Few other adjustments are reviewed. BLS has no policy to randomly or otherwise select and review substitution decisions.

According to BLS officials, supervisors and commodity analysts working together set the levels of price change that trigger a review. These levels can vary by item strata and can differ between price increases and price decreases within a stratum. According to BLS officials, large price changes are reviewed because they are the price changes that could have the greatest impact on the indexes. BLS officials said BLS does not keep count of the number of substitutions receiving supervisory review.

According to BLS officials, supervisors are to examine the reasons for the analysts' decisions for price quotations that produce large price changes. The supervisors reported that they frequently did this by examining the brief explanations that are printed on the price quotations lists that they review. Commodity analysts write these explanations when they review substitutions. If the supervisors are not satisfied with the explanations in these messages, they are to ask the analysts to explain their decisions in person. All the supervisors said that they usually accept the analysts' explanations, either through the written explanations or in person.

Beyond the specific reviews performed by supervisors, BLS does not have a program of assessing the decisionmaking patterns of commodity analysts. However, BLS has studied the process by which commodity analysts make decisions at least three times in the 1980s and early 1990s, and the studies found that the decisionmaking process is susceptible to producing errors and inconsistencies.

As explained by one study, substitution review is potentially prone to (1) visual search errors, as commodity analysts locate information in product descriptions; (2) comprehension errors, as they extract the content of these descriptions; and (3) consistency errors, if they irregularly apply a particular rule. In addition, according to the study, inconsistencies may occur when one commodity analyst does the work of another commodity analyst or when different commodity analysts use different

approaches to substitution of their product groups, resulting in different products being treated in different ways. Each of the three studies recommended actions intended to promote greater control over the decisionmaking process to reduce the potential for errors and inconsistencies. We found that BLS' implementation of these recommendations has varied, with action in most cases diminishing after initial steps were taken. According to officials we interviewed, BLS now takes the position that these controls are not required for experienced commodity analysts.

Appendix III provides further information about how commodity analysts decide whether to make adjustments and how supervisors review those decisions.

Conclusions

BLS faces a difficult task each month of collecting tens of thousands of prices, reviewing those prices, computing the CPI, and ensuring its accuracy in a timely manner. In this process, BLS commodity analysts review the substitutions that price takers make each month for items they cannot find. Substitutions are not inconsequential because BLS has determined that they can have a significant impact on the CPI.

To account for substitutions, BLS has developed a set of procedures and methods to determine whether a substitution is comparable to the item it replaced and, if not, what adjustment to make for its inclusion into the CPI. BLS depends on commodity analysts to make the decisions on whether substitutions are comparable and, to a lesser extent, which adjustment method to apply. By the very nature of the differences that can exist between original and substituted items, commodity analysts must exercise a degree of professional judgment in making decisions, more with some substitutions and less with others. They make these judgments with little or no written criteria to follow. In terms of review or quality controls, supervisors review large price changes and rely on commodity analysts for explanations for their decisions. Beyond these reviews, BLS has no program to review commodity analysts' decisions either preissuance or postissuance of the CPI.

In the past, BLS has studied the process by which the commodity analysts make decisions and found that the decisionmaking process was susceptible to producing errors and inconsistencies. But BLS did not fully act upon the recommendations that came from those studies; its actions on most recommendations diminished after it took initial steps.

We found no evidence to indicate whether errors or inconsistencies in commodity analysts' decisions or lack of comprehensive review of those decisions has had a material effect on the calculation of the CPI. We are not suggesting that the CPI is inaccurate. Indeed, any errors or inconsistencies could be random in nature and in effect cancel each other out without material effect on the CPI. However, prior BLS studies have noted that the decisionmaking process was susceptible to producing errors and inconsistencies—a situation that has not been remedied by sustained corrective action. Given this susceptibility, it is a matter of sound management practice to (1) periodically evaluate the degree to which commodity analysts are actually making errors and inconsistent decisions and (2) evaluate the material effects, if any, of errors or inconsistencies upon the CPI. Moreover, the need for such management practices is underscored by the significant uses made of the CPI in the public and private sectors and the effect those uses can have on individuals and businesses nationwide.

Recommendation

To help ensure that the CPI is protected from potential effects of errors and/or inconsistencies resulting from commodity analysts' substitution decisionmaking, we recommend that the Commissioner of BLS evaluate, on a periodic basis, the degree of consistency and accuracy in analysts' substitution determinations and the resulting effects on the CPI.

Agency Comments and Our Evaluation

In a letter dated April 7, 1999, the Commissioner of BLS provided comments on a draft of this report for the Department of Labor. The Commissioner commented that our descriptions of the procedures will be useful to BLS and to many CPI users. In discussing our recommendation, she said that periodically evaluating the degree of consistency and accuracy in analysts' substitution decisions and the resulting effects on the CPI was certainly a desirable thing to do and that BLS would explore ways it could enhance its existing review processes in that area.

The Commissioner mentioned several ways in which BLS could implement the recommendation. The first two ways were to (1) evaluate enhancements to the data used to monitor commodity analysts' handling of substitutions and (2) review the documentation of commodity analyst procedures to see if it could be made more complete. We agree that these actions would represent good first steps but note that they would not necessarily implement all the parts of our recommendation. For example, more complete documentation of commodity analyst procedures could

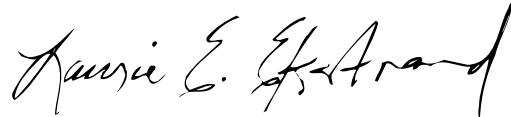
improve the analysts' consistency and accuracy but would not measure the degree of consistency and accuracy.

A third way mentioned by the Commissioner was for BLS to consider the possible use of "expert systems" software (i.e., computer software that helps individuals make consistent and accurate decisions on complex issues) to assist commodity analysts and enhance the consistency of their decisions. BLS developed an expert software system several years ago, which BLS did not subsequently implement for reasons the Commissioner explains in her comments. BLS demonstrated this software to us. While we have not evaluated such software, the demonstration to us showed that such a system could help commodity analysts enhance the consistency of their decisions. In addition, such a system might also help BLS to assess the degree of accuracy in its decisions. However, BLS would have to develop specific methods for using the data from an expert system to meet the second part of our recommendation, which was to evaluate the effect of the analysts' decisions on the CPI.

The Commissioner's letter is reprinted in appendix IX. She made additional comments in her letter, which we addressed as appropriate in appendix IX.

We are sending copies of this report to Alexis Herman, Secretary of Labor; Katharine Abraham, the Commissioner of BLS; Patsy Mink, Ranking Minority Member, Subcommittee on Criminal Justice, Drug Policy, and Human Resources; and other interested parties. We will also make this report available to others on request.

Major contributors to this report are listed in appendix X. If you have any questions about this report, please call me on (202) 512-8676.

A handwritten signature in black ink that reads "Laurie E. Ekstrand". The signature is written in a cursive style with a large, prominent 'L' and 'E'.

Laurie E. Ekstrand
Associate Director, Federal Management
and Workforce Issues

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Abbreviations

BLS	Bureau of Labor Statistics
CAL	Commodity analyst listing
CEX	Consumer Expenditure Survey
CRL	Commodity review listing
CPI	Consumer Price Index
CPI-U	Consumer Price Index representing all urban consumers
CPI-W	Consumer Price Index representing all urban wage earners and clerical workers
ELI	Entry level item
POPS	Point-of-Purchase Survey
PPI	Producer Price Index
PSU	Primary sampling unit
REQ	Homeowners' equivalent rent

Additional Information on Our Methodology

In our scope and methodology section, we explained how we obtained the information necessary to describe the Bureau of Labor Statistics' (BLS) methods and procedures for reviewing substitutions. This work included judgmentally selecting 13 examples of substitution decisions to illustrate the methods. To select these examples, we discussed 136 substitution decisions with 19 commodity analysts¹ in BLS' Consumer Prices Branch. This appendix explains how we selected these examples, substitution decisions, and commodity analysts. We also explain how we administered a questionnaire to BLS' commodity analysts.

Methodology Used to Select Examples, Substitution Decisions, and Commodity Analysts

We judgmentally selected a small number of examples to illustrate the use of BLS' quality adjustment methods across the major components of the Consumer Price Index (CPI). We discussed these examples with the commodity analysts who had reviewed them and requested that the analysts consult their supervisors about our selection. The analysts and their supervisors agreed that the examples we had selected were broadly representative of common situations that analysts encounter when reviewing substitutions. Because substitutions for the nonrent items of the CPI are very different from substitutions for rent items, we used different procedures to select examples for each group.

For the nonrent items, we first obtained a selection of the commodity review listings (CRL) that commodity analysts use when reviewing substitutions and deciding whether an adjustment should be made. BLS automatically generates a CRL each time a substitution is made, and these lists are the main source of information about substitutions and the items they replace. Because BLS made 28,881 substitutions for nonrent items in 1997, we limited our request to 2 months of CRLs. We requested CRLs for substitutions in October and November 1997 because we wanted the most recent months relative to when we began our work, so that the analysts would be most likely to recall the reasons for which they had made their decisions. According to BLS, 6,257 substitutions were made for nonrent items in October and November 1997. BLS provided us with the CRLs for substitutions that had been made in the priced, nonrent item strata of the CPI during those 2 months.²

To arrive at a small number of illustrative examples from the 6,257 nonrent substitutions, we made a series of selections to reduce the number of

¹In one instance, the analyst responsible for the item strata was no longer employed by BLS. However, the analyst's supervisor discussed the substitutions with us.

²According to BLS data, there were 204 nonrent item strata, of which 181 were priced.

substitutions we were considering. First, we selected 18 of the 181 nonrent priced item strata for an in-depth review. We made our initial selection by item strata because the CRLS were organized by item strata and because BLS makes its decisions on which adjustment methods to apply by item strata. We judgmentally selected these item strata to ensure that we covered (1) all of BLS' direct and indirect adjustment methods and (2) all the major components of the CPI with the exception of the other goods and services component.³ The major components of the CPI that we covered were food and beverages, apparel and upkeep, housing, transportation, medical care, and entertainment. In a few instances, our selection of the item strata was influenced by the opinions of experts we had interviewed. For example, we included poultry items because an official at the Department of Agriculture had suggested that poultry would be interesting to study because of recent developments in the ways it was cut and packaged. Our selection of 18 item strata contained 1,212 substitutions.

Having made this selection of 18 item strata, we examined the CRLS for these strata and selected a number of them for discussion with the commodity analysts. We selected CRLS that appeared to illustrate the adjustment methods used in each item stratum. We based our selection on (1) the number of substitutions and types of adjustments that were made in each item stratum and (2) preliminary discussions with commodity analysts.⁴

We met with the 9 commodity analysts and 1 supervisor who were responsible for the 18 item strata and had detailed discussions with them on 106 CRLS. BLS assigns commodity analysts to particular item strata and, therefore, one analyst reviews all the substitutions in an item strata. We discussed the selected CRLS with the analysts and also asked them to explain the procedures they normally follow when reviewing substitutions.

After these interviews, we judgmentally selected 10 nonrent substitutions to serve as illustrative examples for this report. These examples cover the six major components of the CPI. They also cover comparability decisions

³The "other" component was a miscellaneous collection of other items that did not fit into the other major categories of the CPI. It consisted of items such as personal-care appliances and services, school books, and day-care services. The "other" component had fewer than 100 of the 6,257 substitutions that occurred in October and November 1997.

⁴We conducted some preliminary discussions to obtain an idea of what analysts do, so that we would be better able to later hold discussions with the analysts responsible for the 18 item strata. For these preliminary discussions, we simply picked out a few CRLS—25 in 6 additional item strata—that looked as if they would be useful to talk to analysts about (e.g., involved the various adjustment methods)—and then discussed them with the responsible analysts. These 25 substitutions are included in the 136 we report that we conducted. We used information on 2 of these 25 substitutions in the letter portion of this report.

and BLS' direct and indirect adjustment methods. We did not include an example of the only other method that was used, the overlap method, because it was used for less than 100 of the 28,881 substitutions and is being phased out, according to BLS officials. We selected our examples to meet the following criteria: (1) it reflected a common pattern of decisionmaking in that item stratum or item strata, (2) it lent itself to a straightforward description, (3) it was not atypical or unusual in any way, and (4) it did not contain errors made by the analysts. To ensure that our selections did indeed meet these criteria, we showed our examples and criteria to the analysts and their supervisors; and we asked them if our examples were good illustrations of their decisionmaking in those strata, and if the examples met the criteria. The analysts and their supervisors agreed this was the case.

In addition to the 18 nonrent item strata, we also covered 2 rent item strata: residential rent and homeowners' equivalent rent. The procedures used to make adjustments in these item strata differ from those used elsewhere in the CPI. See appendix VII for information about these adjustments.

The procedures we used to select CRLS as illustrative examples for the rent item strata differed from those we used in the nonrent item strata. We randomly selected one example for each of the three main methods of adjustment used in the rent strata. We discussed these examples with the commodity analysts and their supervisor for the rent strata; and, when the analysts and/or their supervisor noted that the initial selections were atypical or problematic, we randomly selected alternative examples. In all, we discussed five rent item CRLS with four commodity analysts and their supervisors.

To select the examples, we discussed 120 specific substitutions (115 nonrent plus 5 rent substitutions) with 19 commodity analysts (15 nonrent plus 4 rent commodity analysts). In addition, we discussed 16 nonrent substitutions with one nonrent supervisor. Following these discussions, we selected 13 substitutions (10 nonrent plus 3 rent substitutions) to serve as illustrative examples in this report.

Survey Methodology

To gain a better understanding of the processes the commodity analysts follow when making substitution decisions and their educational and professional backgrounds, we asked them to complete a written questionnaire. We divided the commodity analysts into two groups: those

Appendix I
Additional Information on Our Methodology

who review residential rent and those who review all nonrent items in the CPI. The analysts who review residential rent follow different procedures than the others; therefore, they could not be asked all the same questions. All four residential rent analysts, as of September 1998, responded to a limited version of this survey. All 24 individuals who were nonrent analysts in October and November 1997 and were still analysts in April 1998 responded to our full survey. Three nonrent supervisors, who also had some responsibilities for deciding whether to make substitution decisions and adjustments, also responded.

Background Information on the Consumer Price Index

BLS produces the CPI by measuring the average change over time in the prices paid by urban consumers for a fixed market basket of consumer goods and services. The selection of items for the market basket is determined from detailed records of purchases made by thousands of individuals and families, as reported on periodic surveys. The items selected for the market basket, such as potatoes, are to be priced each month at specific retail outlets, such as grocery stores and supermarkets, in urban areas throughout the country. According to BLS, in 1997, price takers collected the prices of about 94,000 items (goods and services) in 85 urban areas of the country. These prices were collected from about 30,000 retail and service establishments and from about 46,000 landlords and tenants, who provided data on housing units.

The CPI is used as a measure of price changes to make economic decisions in the private and public sectors. According to BLS, the CPI has three major uses indicated as follows:

Economic indicator of inflation. The administration, Congress, and the Federal Reserve use trends in the CPI as an aid to formulating fiscal and monetary policies. Business and labor leaders as well as private citizens use the CPI as a guide to making economic decisions.

Escalator for wages, benefit payments, and tax brackets. The CPI is used by collective bargaining units to adjust the wages of workers. Also, it is the basis for automatic changes in some federal benefit payments. For example, in December 1997, as a result of changes in the CPI, 44 million Social Security beneficiaries and 6.5 million Supplemental Security Income recipients had their benefits adjusted for inflation. More than 21 million food-stamp recipients in 1997 were affected by changes in the CPI.¹ Also, millions of railroad, military, and federal civilian retirees and survivors are affected by changes in the CPI. The CPI is also used to adjust key elements of the individual income tax to limit the extent to which individuals must pay higher taxes solely because of inflation. For example, the amount allowed for personal exemption, the amount of the standard deduction, and tax brackets are adjusted annually according to changes in the CPI.

Deflator of selected economic statistical data series. The CPI is used to adjust selected economic statistical series for price changes and to translate these series into inflation-free dollars. Examples of data series

¹The federal expenditure estimates given on page 1 of this report do not include the food stamps program or the school-lunch program because these programs are affected by the "food away from home" CPI subindex, whereas the other programs use the overall CPI that includes all items.

that are adjusted by the CPI include retail sales, hourly and weekly earnings, and components of the National Income and Product Accounts.

The CPI was initiated during World War I, when rapid increases in the prices of goods and services, particularly in shipbuilding centers where workers were demanding wage adjustments, made such an index essential for calculating cost-of-living adjustments. In 1921, BLS began regular publication of an index representing the expenditures of urban wage and clerical workers, which was then called the Cost-of-Living Index. The name of the index was changed to the CPI following controversy during World War II over the index's validity as a measure of the cost of living. According to BLS, the CPI has always been a measure of the changes in prices for goods and services purchased for family living.

Major revisions were made to the CPI about once each decade to update the fixed market basket, with the most recent revision occurring in January 1998. Because consumers' buying habits change, new studies were made of what goods and services consumers were purchasing, and major revisions to the CPI were made in 1940, 1953, 1964, 1978, and 1987 as well as 1998.² In the 1978 major revision, BLS began publication of a new index for all urban consumers—the CPI-U. According to BLS, the CPI-U, which represents the expenditures of about 87 percent of the population, takes into account the buying patterns of professional employees, part-time workers, the self-employed, the unemployed, and retired people as well as those previously covered in the CPI. BLS has continued publication of the older index, the CPI-W, which represents the expenditures of urban wage and clerical workers or about 32 percent of the population.

Construction of the CPI

Construction of the CPI begins by selecting a collection of goods and services that is usually bought by the reference population in the index. The collection of goods and services, called items, is known as the market basket. The CPI market basket is developed from detailed expenditure information that is provided by thousands of families and individuals who participate in the Consumer Expenditure Survey (CEX), which is conducted for BLS by the Bureau of the Census over several years. For example, the 1987 CPI revision was based on CEX data collected from 1982 through 1984,

²For this report we reviewed item substitutions that BLS made during October and November of 1997. At that time, the last major revision to the CPI was in 1987. Therefore, the information contained in this report is based on the CPI structure for the 1987 revision rather than the 1998 revision. Although there were changes between the 1987 and 1998 revisions, the general steps BLS follows to construct the CPI described in this appendix did not change between the two CPI revisions.

from about 29,000 individuals and families.³ Expenditure data from the CEX are used to select the categories of items from which specific, unique commodity and service items are selected to be priced for the CPI.

BLS measures price changes each month by checking the prices of the items in the market basket and then comparing the aggregate costs of the market basket with those for the previous month. BLS price takers obtain prices for most of the items by visiting or contacting thousands of retailers, service providers, and landlords and tenants each month.

Classification of Market Basket Items

BLS classified all CEX expenditure items for the 1987 CPI revision into 206 item strata, which are arranged into 7 major components:⁴ (1) food and beverages; (2) housing; (3) apparel and upkeep; (4) transportation; (5) medical care; (6) entertainment; and (7) other goods and services, such as haircuts, college tuition, and bank fees. Taxes that are directly associated with the prices of specific goods and services, such as sales and excise taxes, are also included.⁵

The 206 item strata are divided into specific subcategories, which are called entry level items (ELI). For example, item stratum 0101 flour and prepared flour mixes has two ELIS: flour (01011) and prepared flour mixes (01012). All item strata have at least one ELI, and some strata have more than one. Appendix VIII lists item strata and related ELIS.

Expenditure Weights of Market Basket Items

Expenditure weights are used to give proportionate emphasis for price changes of one item in relation to other items in the CPI. Expenditure weights allow the CPI to distinguish between items that have a major impact on consumers and to provide appropriate emphases to price changes associated with these items. For example, if ground beef were assigned a weight representing about one-third of 1 percent of the expenditures of the typical urban consumer and if sirloin steak were assigned a smaller weight representing less than one-tenth of 1 percent,

³The 1998 CPI revision was based on CEX data collected from 1993 through 1995, from about 36,000 individuals and families.

⁴In the January 1998 revision, the major categories changed from seven to eight and include food and beverages, housing, apparel, transportation, medical care, recreation, education and communication, and other goods and services. The number of item strata also changed from 206 to 211.

⁵The CPI includes various governmental-charged user fees, such as water and sewerage charges, auto registration fees, and vehicle tolls. Taxes not directly associated with the purchase of consumer goods and services, such as income and Social Security taxes, are excluded. In addition, the CPI does not include investment items, such as stocks, bonds, real estate, and life insurance because they relate to savings, not daily living expenses.

then the price changes of ground beef would have about 3 times as much impact on the overall CPI as similar price changes for sirloin steak.

Weights derived from consumers' expenditures, as reported in the CEX, are assigned to the 206 item strata. To compute the weights, BLS first totals the amount spent on an item stratum, such as white bread, during the base weighting period by CEX respondents, who BLS refers to as consumer units.⁶ BLS then divides that total by the number of consumer units, which results in an average expenditure per unit. Next, the average expenditures per unit are weighted with data from the decennial census to represent the U.S. urban population. To do so, the average expenditures per unit are multiplied by certain factors to represent the geographic dispersion of the urban population. Finally, these nationwide urban expenditures on the market basket items are totaled into an aggregate amount. The 206 expenditure weights are the percentages of this aggregate amount that are spent on each of the 206 item strata (e.g., white bread).

Expenditure weights remain fixed until the next major revision of the CPI and serve as a benchmark from which price comparisons are calculated. The weights of the components for the 1987 major revision are those that have derived from the 1982 through 1984 CEX.

Relative Importance of Market Basket Items

Relative importance is related to, but not the same as, expenditure weights. Relative importance can be used to show the direct effect an item has on the overall CPI price change because it shows the share of total expenditure that would occur if consumed quantities of the items remain constant. Although the expenditure weights remain fixed until a major revision, which had occurred about every 10 years, the relative importance changes over time, reflecting the effect of price changes.

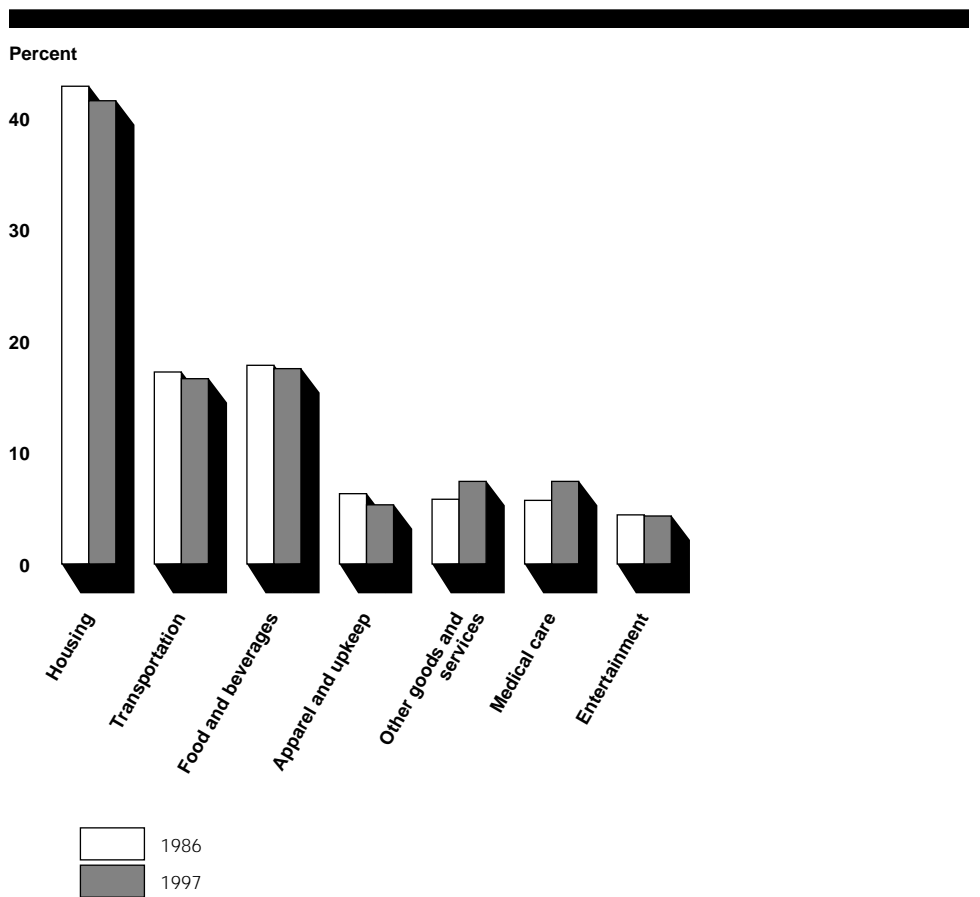
Expenditure weights equal the relative importance percentages at the time of a major revision. But since BLS maintains the quantities of the items as the same amounts that were consumed in the base period, the relative importance percentages change as a result of changing prices. Items registering a greater-than-average price increase become relatively more important. Conversely, items registering a smaller-than-average price increase become relatively less important. Therefore, as the time between major revisions increases, items with higher-than-average rates of inflation have increasing rates of influence upon the CPI. As shown in figure II.1, the

⁶The CEX collects data from "consumer units," which are defined by BLS as either financially independent, unrelated individuals or groups of individuals who pool their resources to make joint consumption decisions.

**Appendix II
Background Information on the Consumer
Price Index**

relative importance of medical care in the index for all urban consumers, which was 5.7 in December 1986, increased to 7.4 in December 1997 because medical prices increased at a greater rate than the rate for the all items CPI—the overall CPI. During the same period, the relative importance of apparel and upkeep fell from 6.3 percent to 5.3 percent because apparel and upkeep prices increased at a lower rate than the all items CPI.

Figure II.1: Relative Importance of Components in the CPI-U, 1986 and 1997



Source: BLS.

Collecting Prices of Market Basket Items

Each month, BLS price takers visit or call thousands of retail stores, service establishments, rental units, and doctors' offices all over the United States. Each month, they record the prices of about 80,000 items.⁷

To determine which retail outlets its price takers should visit to obtain monthly price quotations for nonrent items, BLS sponsors the Point-of-Purchase Survey (POPS), which is conducted by the Bureau of the Census. The survey respondents are asked, by item categories such as doctors, whether they made specific purchases and, if so, the names and locations of all places of purchases and the expenditure amounts. BLS uses the results from the survey to select outlets for pricing.

BLS price takers visit each selected retail outlet to initially select items that will be priced either monthly or bimonthly. For each outlet, categories of items are selected for pricing. Using probability selection methods that are based on revenues and volume information that is provided by the retail outlet, BLS price takers use a table of random numbers to select for pricing a unique item within the specified categories.

BLS collects rent prices for rental units in a different manner than that used to identify and price other items in the market basket. BLS uses monthly price changes of rental units in the CPI housing survey for the residential rent and homeowners' equivalent rent items in the CPI housing component.⁸ Residential rent and homeowners' equivalent rent are estimated from approximately 36,000 rented units and 26,000 owned units in the survey. Each month, BLS price takers obtain information from renter units on the rent for the current month, the previous month, and the services that the landlord provides. These data are used to measure changes in rent prices for residential rent as well as homeowners' equivalent rent. (For detailed information about this process see app. VII).

Replacement of Market Basket Items No Longer Available for Pricing

Because the CPI uses a fixed market basket of goods and services, BLS price takers are instructed to collect price information for the same item (e.g., one dozen pink carnations, with greenery, wrapped in paper, and not delivered) each time they visit the retail outlet or rental unit. However, in many instances, the same identical item is not available for purchase in each subsequent visit. In these situations, price takers are to follow certain

⁷Prices are not collected monthly on all items in the CPI. Some are collected bimonthly and rent is collected every 6 months for housing units.

⁸BLS determines the value of owner-occupied housing by using a rental equivalent method, which estimates the amount of rent that would be paid if it were rented.

procedures to make a substitution—selection of a new version (replacement) that is similar to the old version of the item that is no longer available.⁹ BLS has different procedures for the price takers to follow to bring into the CPI new products or services from the POPS that are not substitutions for items that are in the fixed market basket.

In selecting a substitution the price takers are to follow specific guidance for choosing the new version. In general, the price taker is to select the item with specifications most consistent with the old version. After the price taker selects a new version and records the information about the item, the information is sent to BLS headquarters in Washington, D.C., where it is coded, entered into computer systems, verified, and examined by commodity analysts for inconsistencies. Appendix III describes further the procedures commodity analysts are to follow in examining substitutions.

⁹As described in appendix VII, price takers in the CPI housing survey return to the same address in each collection period and record information about the residential unit at that address. Substitutions do not take place between residential units as they do elsewhere in the CPI. However, as described in appendix VII, adjustments are made to make the current unit similar to what it was at the prior price collection.

How Commodity Analysts Decide to Make Adjustments

Commodity analysts review information collected by the price takers and judge whether the substitution (new version) is an acceptable replacement for the item that disappeared (old version) and, when acceptable, whether it is comparable—similar—to the old version. Where versions are not comparable, the analysts then select a method of adjustment. When the substitutions have large price increases or decreases, supervisors review the outcomes of the commodity analysts' decisions.

According to BLS, the analyst's knowledge and judgment about the comparability of the two versions is very important because the analyst's decision determines the rate of price change that will be used in computing the CPI. BLS further states that bias can enter the index if substitutions are not carefully reviewed by commodity analysts.

This appendix provides information about (1) BLS' procedures and practices that are used by the commodity analysts to make their decisions for substitutions of nonrent commodities and services and (2) the review of those decisions by supervisors. (See app. VII for information about the measurement of residential rent and homeowners equivalent rent.)

Role of Commodity Analysts

According to BLS, when receiving the price information that was collected by the price takers and entered into BLS' computer system, the commodity analysts—who are to have detailed knowledge about the particular goods or services—check the data for completeness, accuracy, and consistency. For example, if there are accuracy questions, analysts are to obtain a copy of the form used by the responsible price taker to record price data to verify that the actual collected values were captured in the system. The analysts then make any necessary corrections. Analysts make adjustments for changes in quality between new and old versions of a product or service. They also make adjustments for differences not necessarily related to quality. For example, they make adjustments to correct for errors, to account for differences in size or quantity between new and old versions, and to account for substitutions that, although acceptable, are dissimilar to the items replaced (e.g., a pizza pan for a pie pan).

BLS describes commodity analysts as economists responsible for validating and analyzing price data and for explaining short-run and long-run price trends. Each analyst is responsible for specific item strata (e.g., the commodity analyst for the pork item stratum would be responsible for bacon, pork chops, ham, and other pork items, including sausage). The analysts are expected to learn as much as they can about the items and the

consumer markets assigned to them. Drawing on that knowledge and considering item-specific information supplied by price takers, commodity analysts decide whether and how certain price information will be used in computing each month's CPI.

As part of our study of the procedures BLS follows to handle substitutions and make adjustments, we collected information from 24 commodity analysts about their educational and professional backgrounds and their job responsibilities. The 24 analysts completed a questionnaire we gave them in April 1998. The survey included all 24 individuals who had been commodity analysts in October and November 1997 (the months in which the substitutions we reviewed were made) and who were still commodity analysts in April 1998.¹

Nearly all of the commodity analysts (22 of 24) reported that they had college degrees, with most of them reporting a bachelor's degree and a major in economics. They varied in terms of job experience from 1 to 27 years as a commodity analyst, 11 years was the median. As a commodity analyst, they also varied from 1 year to 27 years working in the same principal item strata, 9 years was the median.

Commodity analysts have a number of responsibilities, we were told in the survey. The analysts reported that they spent the most time reviewing price quotations, which include substitutions. The median amount of work time they reported spending on these reviews was about 40 percent. The commodity analysts generally said they research the industries in the item strata for which they had responsibility and developed and modified the forms that price takers use to collect price quotes. Some analysts reported doing statistical analyses to develop regression models. In 1997, the commodity analysts also had to prepare for the January 1998 revision of the CPI.

Use of Commodity Review Listings

The primary tool used by commodity analysts in the process for reviewing changes in products and services is the commodity review listing (CRL). After the data have been collected by the price takers and entered into BLS' computer system, CRLs are generated for review by commodity analysts. CRLs are computer printouts of data, such as the characteristics and price history, on items meeting certain conditions. CRLs are generated when

¹These 24 commodity analysts reviewed nonrent substitutions, which are the subject of this appendix. In addition to these 24 analysts, we later surveyed the 4 commodity analysts who were reviewing rent data as of September 1998. These four analysts all had college degrees and had worked 2 to 14 years as commodity analysts.

conditions indicate a substitution (e.g., item was reported as a substitution by the price taker) and for conditions having nothing to do with substitutions.

Among the data CRLs list for an item are the item's specifications, which show various characteristics of the item, such as the packaging (e.g., 12 pack), container construction (e.g., metal can), and caffeine content of cola drinks. If the CRL is for an item that the price taker identified as a substitution, it includes the specifications for both the substitution and the item it replaced. Specifications that changed from the prior price collection are specially noted for the commodity analyst, and all specifications are listed according to a hierarchy of importance for judging the comparability of the two versions. For example, in the "canned fish or seafood" entry level item (ELI), the order of importance is type (e.g., salmon), followed by variety (e.g., pink), and then form (e.g., solid), thereby signaling that type and variety are more important than form of the canned seafood in making comparability decisions. In some apparel ELIS, the specifications are grouped by order of importance into three tiers to guide the price takers in making substitutions and commodity analysts in making their decisions about the substitutions.

Process of Making Decisions About Substitutions

According to BLS officials, the process through which commodity analysts make their decisions about substitutions begins when the commodity analyst receives CRLs. CRLs are generated for substitution review usually for one of two conditions: (1) the item was reported as a substitution by the price taker or (2) a change occurred to a key specification, although the item itself was not reported by the price taker to be a substitution.

According to BLS, there may be a change or modification to an item being priced, such as a change in color, that does not warrant substitution. BLS refers to such changes as specification corrections. However, BLS computers are programmed to identify changes in specific characteristics; and, when any of the key specifications change, a CRL will be printed for substitution review by the commodity analyst.²

The general process for making substitution and adjustment decisions is illustrated in figure 1 in this report, and includes a series of questions that

²Some changes, however, will not generate a CRL for substitution review. According to BLS, commodity analysts have identified the specifications that when changed are least likely to cause the item to be classified as a substitution.

analysts answer in determining how best to deal with substitutions.³ We note, however, that the process is not followed in all cases because many analysts have some leeway in the process as a result of special circumstances related to their respective item strata. The process description that follows is based on our interviews of commodity analysts, their supervisors, and BLS managers. This process has not been thoroughly documented by BLS.

Determining Whether
Substitutions Were
Identified

According to BLS officials, the commodity analysts review CRLS. For the price quotations that the price takers identified as substitutions, the analysts determine whether the price takers appropriately identified them as substitutions. For price quotations that the price taker did not treat as substitutions, the analysts determine whether these should be classified as substitutions.

According to the BLS officials, the majority of CRLS reviewed for substitutions are those identified as such by the price takers. Based on the specifications for an item that the price taker reported, the commodity analyst may decide that the price taker inappropriately identified an item as a substitution; in that case, the CPI will treat it as if there were not a new version. The price-taker-identified substitutions that the commodity analysts deem appropriately identified go to the next stage of substitution processing.

For items that have changed in characteristics but were not identified as substitutions by price takers, the commodity analyst can reclassify them as substitutions by “upping the version.” The commodity analyst uses the changes in specifications and, to a limited extent, the price to judge whether the modification in the item was a significant change. The commodity analyst reclassifies an item as a substitution by making the item priced in the current month a new version and making the item priced in the previous collection period the old version. By doing so, the commodity analyst converts the item into an acceptable substitution.

Determining Whether a
Substitution Is Acceptable

According to BLS officials, when the commodity analysts review the CRLS, they determine if the price quotation that the price taker identified as a

³The decisions leading to the application of the overlap method are not included in the figure or in this appendix because, according to a BLS official, this method was used for a small number of substitutions in 1997. BLS estimated that at least 77 substitutions were adjusted with this method in 1997. In addition, BLS was phasing out the use of this method of adjustment for substitutions at the time of our study.

substitution is eligible for use in the CPI. In 1997, commodity analysts determined that 28,881 price quotations that they reviewed were acceptable substitutions for use in the CPI. This number excludes price quotations for rent.

If in the analyst's opinion it is not an acceptable substitution, the new version is "killed" or deleted by the analyst. In these instances, the price taker in the next collection period must select another replacement for the item that disappeared. A BLS official said that the reasons for killing a substitution included when

- the new version is out of scope (outside the definition of possible substitutions in the item's ELI);
- the substitution occurred outside of the time frame for making a substitution for an item that has been designated by BLS as a "seasonal" item, such as substituting a spring or summer raincoat for a fall or winter coat;
- the commodity analyst waits to see if the old version is only temporarily unavailable in the outlet. The commodity analyst bases this decision on knowledge of the item and its price history;
- the commodity analyst, using industry and item knowledge, believes that the price taker did not follow selection criteria to find the closest substitution to the item that disappeared; and
- the specifications recorded by the price taker for the new version are unclear or incomplete.

When a substitution is killed, it is deleted and is not used in the CPI and an imputed price is assigned to the item that disappeared.⁴ The imputation for a killed substitution is the same as that used in the linking method (see app. VI). That is, a rate of price change is calculated based on other similar items that were priced in the killed substitution's item stratum and geographic location. The calculated rate of price change is applied to the previous price of the item that disappeared, and the imputed price for that item will be used to calculate the CPI in the next collection period.

BLS was unable to provide us with the number of substitutions that were killed in 1997. However, BLS reported that over 12 months from October 1997 through September 1998, 1,065 substitutions were killed. Since killed substitutions are not regarded as substitutions by BLS, they are not reflected in any of the tables presented in this report.

⁴Imputed price is a term used by BLS to indicate that the actual price of the substitution is not used. Instead, an average is calculated from the price changes experienced that month by similar items in the CPI to handle a missing or unusable price quotation.

Determining the Need to Make an Adjustment

According to BLS officials, after substitutions are accepted, they go through additional steps to determine if adjustments are necessary to account for differences between them and the items they replaced. The first determinations after acceptance, we found, depend on a substitution's item stratum and the nature of any difference between the two versions. If the substitution is in an automobile or apparel stratum where information about the value of the differences is available to make a direct adjustment, the commodity analysts are likely to consider whether to make a direct adjustment. This is also the case, regardless of stratum, if the analyst is correcting a past recording error or making adjustments to account for changes in the size of a product or in the number of items.

If a direct adjustment cannot be made, then another set of processes comes into play regardless of item stratum. In this case, the first question usually asked is whether the two versions of the item are comparable—similar.

Determining Whether a Substitution Is Comparable

When the analysts determine that the new version is comparable to the old version, no adjustment is made; and the ratio of the new version's price in the current period to the old version's price in the previous period is used in the calculation for the CPI for that month. This process is similar to the way the CPI calculation uses the ratio of current-period price to the previous-period price of items in the CPI that were not substitutions. In 1997, of the 28,881 nonrent substitutions reviewed by commodity analysts, 16,750, or 58 percent, were determined to be comparable without adjustments. The rate of comparability differed among the CPI's seven components, with the highest rate in the apparel and upkeep component (67 percent) and the lowest rate in the medical care component (32 percent).

BLS uses computer codes—called comparison codes—to control the way a CPI price change calculation handles a price quotation. BLS' computers are programmed to generate comparison codes to provide the commodity analysts an initial basis for making their comparability decisions. Based on the degree of difference between the "effective" prices of the old and the new versions, one of three comparison codes appears on the CRLS. An effective price is the price taker's reported price that is adjusted, if appropriate, for the size of the item, such as price per ounce of a food item. If the price change, which is expressed as a percentage, is within a specified interval,⁵ then BLS' computers are programmed to generate a

⁵The upper and lower levels of these tolerance intervals are determined by the respective commodity analysts and their supervisors.

code indicating that the two versions are comparable. However, if the difference in effective prices is outside the specified interval, then the computer generates either one of two adjustment codes (class mean or linking) signaling that the versions may not be comparable. In our survey of commodity analysts, how often the analysts agreed with the computer-generated codes varied widely. The range of agreement was from 25 percent to 100 percent of the CRLs reviewed for substitutions that were made in calendar year 1997, 70 percent agreement with the codes was the median.

In the limited number of ELIS that we studied, most commodity analysts did not have written comparability criteria to guide them in making their decisions. But a few food commodity analysts showed us criteria that they had developed with their supervisors for specific ELIS to help them decide whether substitutions are comparable. The analysts used these criteria as guides to identify the characteristics (shown as specifications on the CRL) that, if different between the old and new versions, indicated that the new version was not comparable to the old version. For example, if a can of sardines replaced a can of salmon, the analyst would determine that the two versions were not comparable.

These comparability criteria also identified the specifications that were less important in deciding comparability. That is, the old and new versions might differ with regard to these characteristics, but that condition would not usually warrant a decision of not comparable. For example, if the change between two cans of salmon was only the origin (e.g., from imported to domestic), the analyst most likely would determine that the two versions were comparable.

Regardless of whether comparability criteria were available, all of the commodity analysts we interviewed indicated that they examine the specifications on the CRLs for substitutions and decide if the differences in the characteristics indicate a difference in quality between the old and new versions. If the commodity analysts determine that the differences do not indicate a major change in quality, they said they would leave the comparison code for the substitution as comparable or code the substitution as comparable if a different code was assigned by the computer.

Comparable Substitution Decision

The following example of a comparable substitution decision comes from our interview with a commodity analyst's supervisor. According to the supervisor, this example is illustrative of an analyst's comparability

**Appendix III
How Commodity Analysts Decide to Make
Adjustments**

decisions for this ELI and shows an analyst's decision when it is fairly easy to make.

The example includes a price calculation, showing the percentage change in price that went into the CPI for that month as a result of no adjustment being made. This percentage change in price is applicable only to the particular case illustrated. It is not intended to be representative of the percentage change in price that occurred for similar kinds of comparable substitutions. Nor is the percentage of change intended to be representative of the impact on the CPI of not making an adjustment.

The example includes (1) a table showing the specifications of the old version and the new version that replaced it (differences in the specifications between the old and new versions are highlighted by shading), (2) the analyst's reasons for judging the two versions to be comparable, and (3) the calculation of price change that was made for use in the CPI calculation.


**Example - Club Membership
(Under the Club Membership
Dues and Fees Item Stratum)**

A new version of club membership was substituted for the old version and, as shown in table III.1, the "level of membership" differed. The analyst concluded that the two versions were comparable even with the difference in type of membership.

**Appendix III
How Commodity Analysts Decide to Make
Adjustments**

**Table III.1: Characteristics of Two
Tennis Club Memberships**

Description	Old version	New version
Specifications		
Type of enrollment	Family	Family
Type of member	Existing	Existing
Level of membership	Tennis plus	Gold tennis
Length of period covered	Per month	Per month
Type of organization	Health club	Health club
Bathing facilities	Yes	Yes
Towels	Yes	Yes
Pool	Yes	Yes
Exercise facilities	Yes	Yes
Lessons	Yes	Yes
Other clarifying data	Husband, wife, and 2 children	Husband, wife, and 2 children
Price information		
Amount	\$148.00	\$150.00
As of	September	October
Collected/imputed	Collected	Collected

 Specifications that differ between old and new versions

Source: BLS.

**Analyst's Reasons for
Comparable Decision**

A field message from the price taker informed the commodity analyst that the level of membership had not changed. To confirm the field message, the analyst reviewed the other specifications and found no changes except for a \$2 increase in price. Accordingly, the analyst determined that this was a comparable substitution.

Calculation of Price Change

The calculation of price change for comparable substitutions is done entirely by computer routine without direct involvement by commodity analysts. For this item the computer calculated a 1.4 percent rate of change for October 1997, and the CPI in October reflected the same percentage increase for this tennis club membership, as it would have done if the name of the membership level had not changed.

**Directly Adjusting for
Differences**

According to BLS officials, the commodity analyst, after deciding that the substitution is acceptable and in conjunction with the comparability determination, will determine if information is available to do a direct

adjustment. If the information is available, the commodity analyst is to make a direct adjustment.

Because the information is often available, direct adjustments are commonly made for automobiles and most apparel items. BLS works with automakers each year to obtain information on improvements made to new vehicles and the costs of those improvements. Also, BLS has built statistical models to help it value the various features of most apparel items.

Commodity analysts also make direct adjustments to correct errors and to account for changes in an item's size or quantity. For example, a direct adjustment may be made for a change in the number of events covered by a season ticket. These kinds of adjustments are not limited to any one stratum or group of strata, and the information to make them is usually available from the CRL. BLS does not consider adjustments made only to correct an error or account for a change in size or quantity to be true adjustments for quality.

In 1997, of the 28,881 substitutions, 3,770, or 13 percent, were directly adjusted by commodity analysts. As appendix VIII shows, the majority of these direct adjustments were for automobile and various apparel items. The adjustment amount is applied to the price of the old version. Then the adjusted price of the old version is compared with the price of the new version and the change, if any, expressed as a percentage, goes into calculating the CPI. Appendix IV further describes direct adjustments.

Making Direct Adjustments to Increase Comparability

Previously, we said commodity analysts compared old and new versions of items to determine whether they were comparable. When analysts working with automobile and apparel substitutions make these comparisons, they do so with a different twist from those working with other substitutions. The analysts we interviewed who reviewed automobile and apparel substitutions said that they may consider the new and old versions of an item to be essentially comparable but will still make a direct adjustment.⁶ In these cases, the analysts said, the adjustments are relatively minor and are made to increase the already high level of similarity between the old and new versions. For example, an apparel commodity analyst said that an adjustment was made for a minor difference in the fiber content of a coat, even though the difference would have been insufficient to make the old

⁶BLS research on direct adjustments that were made in selected apparel item strata for 6 months in 1991 indicated that more than two-thirds of the substitutions would have been deemed comparable if they had not been directly adjusted. See Paul R. Liegey, Jr., "Apparel Price Indexes: Effects of Hedonic Adjustment," *Monthly Labor Review*, Vol. 117 (May 1994), p. 40.

coat and new coat not comparable. The new coat had 15 percent less wool than the old coat. The analyst used a statistical model to estimate the value associated with less wool and then reduced the price of the old coat by that amount, making the two coats more alike.

According to the analysts, when they make a direct adjustment, the substitution is counted with other not-comparable items. However, BLS could not identify the number of times this happened because it does not track whether quality-adjusted price comparisons would have otherwise been comparable. Since information that is used to make adjustments to increase comparability is restricted to automobile and apparel ELIs, for which the commodity analysts have information to make direct adjustments, only a limited number of comparable substitutions would be directly adjusted for quality changes.

Using Class-Mean and Linking Methods to Adjust for Differences

In 1997, 29 percent of the nonrent substitutions were not comparable and could not be directly adjusted for differences between the old and new versions. Two indirect methods—linking and class mean—were commonly used to adjust these 8,361 substitutions. In both methods the price of the new version is set aside for the current month, and an adjustment determined from price movements of the same type of items is applied to the previous price of the old version. The class-mean method is to be used in item strata where new models or product lines are introduced regularly, whereas the linking method is to be used where new models or product lines are not regularly introduced. In 1997, BLS had designated the class-mean method to be applicable to 53 of the 206 item strata. Of the substitutions that were not directly adjusted in 1997, the substitutions were almost equally divided between the linking and class-mean methods.⁷

As previously described in this appendix, when there is a substitution, BLS' computers will indicate one of three codes on the CRL. One code indicates that the computer will apply the class-mean method of adjustment if the substitution is in an item stratum for which BLS has designated the class-mean method. Another code indicates that the linking method will be applied if the substitution is not in a class-mean designated item stratum. The third code indicates that the substitution and the item it replaced are comparable and, therefore, no adjustments are needed. However, the commodity analysts can overrule these computer-generated codes. When

⁷BLS officials also noted that substitutions are not equally distributed across all ELIs. As shown in appendix VIII, some ELIs experience more substitutions than others.

commodity analysts overrule those substitutions coded as comparable, they are to determine if the substitution is in an item strata for which the class-mean method has been designated in deciding the adjustment method to apply.

Although the new version is set aside when the linking or class-mean method is applied, it is used beginning in the following collection period. The substituted product or service will become the item that the price taker is to price for the CPI in future price collection periods.

Applying the Class-Mean Method

If the commodity analyst decides that the class mean is the appropriate adjustment method for the substitution, then the price of the new version is set aside for the current month, and a procedure is followed by BLS computers to impute a rate of change. This imputation is based on a particular subset of items in the CPI that BLS considers to be most appropriate for the calculation. The class mean imputation is described in detail in appendix V. In 1997, of the 28,881 substitutions, 4,049, or 14 percent, were adjusted with the class-mean method.

Applying the Linking Method

According to BLS, if the substitution that the commodity analyst deemed as not comparable resides in an item stratum that is not a class-mean designated item stratum and was not directly adjusted for quality change, then the linking method will be applied. In the linking method, the price of the new version is set aside, and a procedure is followed by BLS computers to impute a rate of change that is based on all the other items with usable prices in the geographic area and item stratum. This procedure is further described in appendix IV.

Some of the commodity analysts who work on class-mean designated item strata told us that under certain circumstances, they use the linking method for substitutions that are in class-mean designated item strata. For example, the analyst for new automobiles reported that he used the linking method when the price taker appeared to have collected incorrect information.

Of the 28,881 substitutions in 1997 that commodity analysts reviewed, 4,312 (about 15 percent) were adjusted with the linking method. Of these linked-adjusted substitutions, 371 were in class-mean item strata.

BLS Processes and Procedures for Reviewing Substitution Decisions

BLS relies on supervisors to review the substitution decisions made by commodity analysts. Although there are no written guidelines for supervisors to follow in selecting and reviewing the decisions made by analysts, BLS officials stated that the supervisors follow unwritten policies. There is no unique set of procedures for selecting and reviewing these decisions. The reason for most supervisory reviews, according to BLS, is a large price change, with the definition of large varying among and within item strata. Supervisory reviews are scheduled three times during the month's pricing periods and after all of the pricing information has been collected. For those substitutions selected for review, supervisors normally rely heavily on commodity analysts in carrying out the scope of their reviews.

Supervisors Review Substitutions That Result in Large Price Changes

According to BLS, supervisors are to review large price changes going into the CPI each month, with the definition of large varying among and within item strata. Large price changes are reviewed because they are the price changes that could have the greatest impact on the indexes. As part of this review, substitution decisions made by commodity analysts are reviewed when those decisions produce large price changes. Substitution decisions that produce price changes that are too small to meet the selection criteria are usually not subject to review. The branch chief for consumer prices reported that there is no random review of analysts' decisions. According to BLS, it does not track the percentage of substitution decisions that are reviewed because of large price changes.

A BLS official reported that supervisors and analysts working together set the levels of price change that trigger a review. Levels are set for each individual item stratum. To establish these levels, the analyst and supervisor responsible for an item stratum consider that stratum's current and historical price data but also rely on their own judgment and industry knowledge. As a result, the levels of price change that require a supervisory review can vary by item strata and can differ between price increases and price decreases within the same stratum. For example, the supervisor for the household-goods item stratum reviews price increases or decreases of 15 percent or more. However, in the women's coats and jackets item stratum, price increases of 25 percent or more are to be

reviewed, while price decreases require a change of 20 percent or more. Price changes that do not meet or exceed these levels are not reviewed.⁸

Supervisory Reviews Occur After Data Collection Periods End

For the purpose of collecting CPI prices, BLS divides each month into three collection periods, which it calls pricing periods. At the end of each pricing period, BLS officials stated, all the price quotations in which a price change meets or exceeds the trigger levels for supervisory review are identified by computer routines, including some that resulted from the substitution decisions of commodity analysts. At the end of each pricing period, computer routines produce lists of these quotations, called supervisory query review lists, that are organized by each commodity analyst, item stratum, and geographic region. These lists, which are produced at the end of each pricing period, provide basic information for each price quotation that was flagged for review. This information includes the old and new prices of the items, the percentage of price change, and any short messages the analysts provided to explain the change.⁹ The lists can be lengthy; one chief of a section said that the three supervisor query lists have generated a total of more than 1,000 price quotations in some months.

The Branch Chief for Consumer Prices reported that BLS does not have any written policies or guidance for supervisors to follow when reviewing analysts' decisions. However, the branch chief stated that the unwritten policy requires supervisors to review and approve every price change that appears on the supervisory query lists. One section chief said that, in general, each of the three reviews was completed in about a day.

Review Also Occurs After Preliminary Indexes Are Produced

After the supervisory review of price changes is complete, BLS computer routines produce preliminary basic indexes for each item stratum and geographic area. The supervisors are required to review these preliminary indexes. According to BLS, review of these preliminary basic indexes is an additional quality control that has been built into the CPI to identify and verify large price changes. After any changes that result from the review of the preliminary basic indexes are entered into the computer, the final

⁸These levels were for "regular" prices of women's coats and jackets (i.e., the prices of items that were not on sale). BLS normally set different levels of price change for regular and sale prices. For example, substitutions for women's coats and jackets at regular prices were reviewed if the new version had decreased by 20 percent. However, substitutions for women's coats and jackets at sale prices were reviewed only if the new version decreased by 75 percent or more.

⁹The lists do not routinely include information about whether the price quotation was a substitution and, if so, what decision the analyst made. However, this information might be included in the analysts' explanatory messages.

basic indexes are calculated and combined to form the CPI indexes that are published.

More than 8,000 preliminary basic indexes were produced each month in 1997, according to BLS officials.¹⁰ The production schedule was supposed to allow supervisors about 2 days each month to review all preliminary basic indexes.¹¹ However, because of production delays, supervisors often had much less time to review the indexes, BLS officials said.

The Branch Chief of Consumer Prices stated that the supervisors are to identify large price changes in the preliminary indexes, and investigate the price quotations responsible for those changes. According to BLS officials, there are no set levels of price changes that require investigations. Instead the supervisors are to decide what levels require investigation. By way of illustration, one section chief stated that the rates of price change that would prompt him to investigate an index varied by item stratum, and could change over time, but generally ranged between 12 to 20 percent at the time of our interview.¹²

During an investigation, the supervisors typically are to identify the quotations that are causing increases from a list containing all the price quotations for the month.¹³ This list, which is called the Commodity Analyst Listing (CAL), contains basic information for each quotation, and includes the old and new prices, the percentage price change, the analyst's decision, and any short explanatory messages provided by the analyst.

According to the Branch Chief for Consumer Prices, when the supervisors identify quotations that cause large changes in a preliminary basic index, they can ask the commodity analyst responsible to explain what had occurred. However, it is possible that, because of the three supervisory query reviews that occurred earlier in the month, quotations with large price changes may have already been examined.

¹⁰The preliminary basic indexes were produced for each of BLS' 183 priced item strata in each of its 44 geographic regions. Following the 1998 revision of the CPI, the number of preliminary basic indexes diminished because the number of geographic regions decreased to 38.

¹¹The chiefs of the Consumer Price Branch's four Commodities and Services sections were responsible for the supervisory review. However, at the time of our field work, two of the chiefs also had a supervisor in their sections who assisted them in the review.

¹²The levels of price change that prompt supervisors to review an index can be different from the levels of price change that require supervisors to examine a price quotation during the earlier supervisory query review.

¹³About 80,000 price quotations were collected each month in 1997. The section chiefs of the Consumer Price Branch received information for all the price quotations in their sections.

Normal Scope of Supervisory Review

The Chief of the Consumer Prices Branch stated that the supervisors are required to examine the reasons for the analysts' decisions for price quotations that produce large price changes. The supervisors reported that they frequently did this by examining the short messages that commodity analysts attached to each price quote and that are printed on the supervisory query and CALS. These messages were short, in large part, because the computer system limits messages to 128 characters. We found the following examples of short messages for price quotations that were substitutions for apparel items in October and November 1997:

- "Approximately same specs;"
- "Price change O.K.;"
- "Same regular price;" and
- "Change in fiber."

If the supervisors are not satisfied with explanations in the short messages, they are to ask the analysts to explain their decisions in person. All of the supervisors said that they usually accept the analysts' explanations, either through the short messages or in person. Three of the four supervisors stated that it was very rare for them to formally review an analyst's decision by examining the characteristics and price histories of the quotations themselves. One supervisor stated that he did not review the characteristics and price histories because of the confidence he had in his commodity analysts.

Direct Adjustments

A direct adjustment is a price adjustment for specific differences between the characteristic of a good or service that the CPI priced in one collection period and the characteristics of a substitute good or service that the CPI priced in the next collection period. Direct adjustments can be classified on the basis of BLS' use into the following:

- a manufacturers' cost method, which uses cost information from manufacturers to identify the cost of individual characteristics or options that have changed;
- a hedonic regression method, which uses statistical models to estimate a value for (or implicit "price" of) the individual characteristics of a good, such as the cost of adding a lining and hood to a coat; and
- an "other" method, which covers a broad array of direct price adjustments, including those made for a change in the number of units (e.g., 15 tablets instead of 12 tablets) or the size of an item (e.g., 8 ounces instead of 10 ounces), and to correct data-entry errors made by BLS.

Similar to the indirect adjustment methods of linking and class mean that BLS uses, the direct adjustment methods divide the total price change into a pure price change component and a quality change component. The CPI is to incorporate only the pure price component.

A fundamental difference between the indirect and the direct adjustment methods is that the indirect methods first estimate the pure price change and then assign any remaining or residual portion of the price difference to quality. The direct methods do the opposite. They first estimate the value of quality changes and, in essence, remove that value from the price difference. The pure price change is the residual after the adjustment is made. Hence, unlike the appendixes on the class mean and linking methods, this appendix first describes how quality changes are estimated before discussing how price changes are calculated as a residual.

Manufacturers' Costs

BLS uses manufacturers' cost information to make direct adjustments for changes in quality in the new and used vehicles item strata. Each year, BLS collects information from the manufacturers of automobiles and trucks on the costs of the new features in each model and uses this information to make adjustments. For used vehicles, BLS uses data from prior years' new vehicles.

All of BLS' manufacturers' cost adjustments were in the new and used vehicle item strata. In 1997, BLS made 1,828 direct adjustments in these

items. According to BLS officials, about 90 percent of these adjustments were made using manufacturers' cost information, and the remainder were made using the other method.

Background on Manufacturers' Costs

Since 1967, BLS has asked the major domestic automobile and truck manufacturers for information about the cost of quality improvements in the new models that are used for the Producer Price Index (PPI).¹ BLS requests all manufacturers of domestically produced vehicles to participate in this process. Domestically produced vehicles include those produced in the United States by both U.S. and foreign automobile manufacturers. The manufacturers are very cooperative, according to BLS. Manufacturers that produce their models overseas and import them into the United States are not included in this annual information gathering process.

For the 1998 model year (introduced in the fall of 1997), BLS requested information on the 20 car models it had selected for pricing in the PPI. Manufacturers provided information on only 15 models in time for the BLS press release on 1998 models published in October 1997. According to BLS, the five models lacking information either had so many changes that the manufacturer could not accurately break out the cost associated with each change, or the information, while usable for direct adjustments when reviewing substitutions, was provided too late to be incorporated in the press release.

The manufacturers provide BLS with lists of improvements they have made to the new models in the PPI sample and the cost of producing those improvements. According to BLS, the manufacturers often claim that improvements in style, comfort, and convenience are quality improvements. However, BLS does not consider such improvements to be quality improvements unless they are presented with evidence of functional improvements. BLS has developed criteria for quality improvements that include improvements in safety, durability, and performance. BLS analysts use these criteria to review the manufacturers'

¹BLS bases the PPI on producers' output. According to BLS the PPI sample of new model vehicles was representative in the sense that it included the platforms that accounted for the automakers' largest outputs. The PPI sample selection process focuses on vehicle platforms, officials stated, because a single platform usually includes a number of nameplates, and each nameplate may have numerous models. For example, the H platform for General Motors has three nameplates: the Buick LeSabre, Oldsmobile Eighty-Eight, and Pontiac Bonneville, each of which has its own models. All of the models are built on the same platform and have basically the same power trains. The differences between the models include styling and equipment changes. According to BLS, it generally uses one model to represent an entire platform because of the similarity between the models.

lists of improvements and decide whether they are, in fact, quality improvements. Through their review, BLS analysts developed lists detailing every quality improvement and the cost of every quality improvement for all models in the model-year sample.²

For the 15 new domestic passenger cars in the 1998 PPI sample, according to BLS, the average increase in the manufacturers' suggested retail price over the 1997 versions of these models was \$363.27. Of this increase, BLS attributed \$230.81 (or 63.5 percent) to quality changes. BLS estimated that \$52.14 of the \$230.81 was for changes in accordance with the 1990 Clean Air Act Amendments and \$178.67 was for other quality changes, such as powertrain improvements, corrosion protection upgrades, and changes in the levels of standard or optional equipment.³

The CPI program applies this information to models that were in the PPI sample and to similar models that were outside the PPI sample. CPI commodity analysts use information from the manufacturers and publicly available publications, such as Automotive News, to help determine whether models outside the PPI sample shared the same platform as models inside the PPI sample.

In some cases, BLS analysts apply manufacturers' information from the sample to models outside the sample that do not share the same platform with a model in the PPI sample. For example, if a rear defogger was added to a new model outside the sample, the analyst might estimate the average price of defoggers added to models inside the sample and use the estimate to make an adjustment to the model outside of the sample, even though it did not have the same platform. Sample information might also be used to make adjustments to foreign manufacturers' models imported into the United States, in instances where the domestic manufacturer's information appeared applicable. In cases such as the ones just described, BLS analysts rely on judgment rather than a set of uniform rules and procedures.

How Quality Changes Are Calculated Using Manufacturers' Costs

The CPI's commodity analyst for new cars uses the lists of quality changes when reviewing substitutions. If the substitution (a 1998 model) is in the PPI sample, the analyst looks for improvements that have been made in the model under review. The analyst may find, for example, that the engine of

²According to BLS, officials from the CPI and the International Price Program also participate in the review process that determines whether improvements are, in fact, quality improvements.

³As of January 1999, BLS no longer treats changes made solely to meet air quality standards as quality improvements in the CPI.

a particular model has been upgraded. The manufacturer's information in the sample also lists the costs of producing the improvement. For example, the engine upgrade might cost \$100. The analyst will then multiply this cost by a factor to adjust for the difference between producer and retail prices. For example, if the analyst used 20 percent as a factor, the result would be \$120 ($\$100 \times 1.20 = \120).

Using this methodology, an adjustment of \$120 would be made to ensure that the new (1998) and old year's (1997) models were comparable in terms of quality. If the price of the new model was \$11,750 and the price of the old model was \$11,500, BLS would add \$120 to the price of the old model so that the comparison would be between \$11,750 and \$11,620 instead of between \$11,750 and \$11,500.

According to BLS, if a model priced in the CPI sample is not in the PPI sample, the analyst is to use the manufacturers' and publicly available information to determine whether the price is similar to one of the models in the sample. For example, the available information may show that a Ford Escort is built on the same platform as a Mercury Tracer. If the Ford Escort was in the sample, but the Mercury Tracer was not, and the analyst concludes that the two models are sufficiently similar, the manufacturer's information on the Ford Escort could be applied to the Mercury Tracer.

If a model is not in the PPI sample and is not built on the same platform as a model in the PPI sample, the analyst may still be able to use some manufacturer's information obtained in the sample. However, in the absence of manufacturer's information, it is much more likely, according to BLS, that the analyst will use the class-mean method of adjustment.⁴ In general, prices of new foreign models manufactured abroad and imported to the United States are more likely than domestically produced items to be adjusted using the class-mean method.

Direct adjustments for used vehicles rely on manufacturers' information that was obtained in previous years. The CPI used-car index is based on the prices of vehicles that are between 2 and 6 years old. For example, the used-car index in 1998 might include the substitution of a 1995 for a 1994 Chevrolet Cavalier. In that instance, the BLS analyst would make adjustments if the manufacturers' information for the 1995 and 1994

⁴BLS officials report that, if a new model has been significantly redesigned, they may consider it too different to be compared to the old model. Under those circumstances, BLS will not use the manufacturers' information—if it is available—to make direct adjustments, but will use the class-mean method of adjustment.

Chevrolet Cavaliers indicated that quality changes had occurred between the model years.

A direct adjustment for used cars relies on the information collected in earlier years for new cars, with the dollar amount of the adjustment translated into percentage terms. In the above example, the estimated \$120 quality improvement equals 1.0 percent of the \$11,500 price for the model of prior year (1997). If BLS uses the two models in the price index 3 years in the future (2001), a 1.0 percent quality adjustment would be added to the used-car price collected for the 1997 model before it is compared with the used-car price collected for the 1998 version.

How Price Changes Are Calculated After Making an Adjustment Using Manufacturers' Costs

In the example above, an adjustment of \$120 would be added to the price of the previous year's model to make the new and old year's models comparable with the terms of quality. Then the adjusted price of the old model (\$11,620) would be compared to the price of the new model (\$11,750). The CPI would incorporate an increase of 1.1 percent to reflect the \$130 difference between the two prices. Of the \$250 total price difference between the two models in the example, BLS procedures allocate \$120 to quality and \$130 to price.

BLS' Use of Manufacturers' Costs

The following example results from our interviews with a BLS commodity analyst. According to the commodity analyst and supervisor, it is representative of the adjustments that employ manufacturers' costs to adjust for quality improvements in vehicles.

The example includes a price calculation that shows the percentage change in price that went into the CPI for that month, as a result of the direct adjustment. This percentage change in price is applicable only to the particular case illustrated. It is not intended to be representative of the percentage changes in price that occurred for similar kinds of substitutions in which direct adjustments are made. Nor is the percentage change in price intended to be representative of the impact that direct adjustments have on the CPI.


The example includes (1) a table showing the characteristics of the old version and the new version that replaced it (differences between the old and new versions are highlighted by shading), (2) the analyst's reasons for judging the two versions to be comparable, (3) the rationale for selecting the method of adjustment, and (4) the price calculation that was made.

Example 1 - New Car (Under the New Cars Item Stratum)

Although the specifications for the 1998 and 1997 models were alike, the commodity analyst made an adjustment because the analyst had been provided with information by the automaker that showed improvements had been made to the 1998 model.

Table IV.1: Characteristics of Two Versions of a New Car

Description	Old version	New version
Specifications		
Model year	1997	1998
Model	4-door sedan	4-door sedan
Engine size	3.8 liter engine	3.8 liter engine
Number of cylinders	Six cylinders	Six cylinders
Transmission	4-speed automatic	4-speed automatic
AM/FM radio and cassette	Yes	Yes
Rear window defroster	Yes	Yes
Power-assisted driver seat	Yes	Yes
Price information		
Amount	\$22,104	\$23,180
As of	September	October
Collected/imputed	Collected	Collected

 Specifications that differ between old and new versions

Source: BLS.

Analyst's Reasons for Deciding the Items Were Comparable

Even though the specifications of the old model and the new model were unchanged, the analyst knew that changes had been made to the new model because of information provided by the automaker. This information showed that the engine had been improved to reduce fuel emissions and that the air bags had been depowered to improve passenger safety. In the analyst's opinion, despite the improvements, the new and old models were broadly comparable. Nevertheless, the analyst concluded that an adjustment for the engine improvements and depowered airbags would make them even more comparable.

Rationale for Selecting the Method of Adjustment

To make the adjustment, the analyst had to override another adjustment code that was computer generated. A computer routine automatically calculates any change in prices between the old and new versions of a

substitution. If the price change is below a predetermined level, the computer is programmed to default to a comparable substitution code. If the price change exceeds the predetermined level, the computer defaults to a not-comparable code. In the new cars item stratum, the not-comparable code would indicate that the class-mean method should be used. The computer routine cannot default to a direct adjustment code. In this case, the computer generated the code for a comparable substitution.

If the analyst had not made the adjustment the models would have been considered comparable, and the 4.9 percent difference between the collected price of the new model and that of the old model would have been incorporated into the CPI. However, the analyst had the necessary data from the sample of manufacturers to make an adjustment and believed that an adjustment would make the new and the old models more comparable in terms of quality.

Calculation of Price Change

The automaker had reported that the wholesale cost of the engine improvements was \$105, and the cost of depowering the airbags was \$10. The analyst added these two costs together ($\$105 + \$10 = \$115$), and then multiplied the total by 118 percent to account for the difference between the wholesale costs and their retail equivalent. The analyst used a markup factor of 118 percent because, according to BLS, the available data indicated this was the most appropriate markup for this type of vehicle in 1998. The cost total of \$115 multiplied by 118 percent was \$135.70, which the analyst rounded to \$135.

To make the adjustment, the analyst added the \$135 to the price of the 1997 model ($\$22,104 + \135), creating an adjusted price of \$22,239. As a result of this action, BLS' computer routines compared the adjusted price of \$22,239 for the old model with the actual price of the new model, \$23,180, and recorded a price increase of 4.3 percent for the new model. This price increase was included in the CPI calculations for October 1997.

Hedonic Regression Estimates

BLS first introduced the use of adjustments based on hedonic regression estimates into the CPI in 1988 to adjust for the effect of aging on housing units. In 1991, hedonic regression estimates were applied to adjust apparel items. According to BLS, the extensive and frequent seasonal and style-driven changes in characteristics of apparel items pose numerous problems for the maintenance of a constant quality market basket of

apparel items in the CPI. The use of hedonic regression methods in apparel, BLS reported, has helped address these problems.

In 1997, BLS used hedonic regression estimates exclusively for apparel items. According to BLS officials, at least 95 percent of the 1,223 direct adjustments that were made for apparel items in 1997 used hedonic regression estimates; the remainder used the other method.

BLS is undertaking a major research program with the goal of applying adjustments based on hedonic regression estimates to other consumer items where satisfactory models can be developed. The effort will place particular emphasis on consumer durable goods, such as electronic products, likely to experience significant quality change over time. In January 1998, hedonic regression models that were initially developed for the PPI began to be used for computer items in the CPI. Effective with the release of the CPI for January 1999, BLS introduced hedonic adjustments in the television stratum of the CPI.

Background on Hedonic Regression Estimates for Adjustments

Hedonic regression estimates are used to make direct adjustments to the price of an item when it is replaced by a substitute item so that BLS can compare its price with the price of its replacement. The values, or the implicit prices, of the various quality characteristics that affect the total price of a particular good are estimated using regression techniques.

A fundamental assumption underlying the hedonic price framework, according to economists, is that an individual good can be viewed as a combination of a number of observable characteristics.⁵ The hedonic modeling technique—based on the prices paid by consumers for the goods for which the CPI collects prices—provides an estimate of the value or implicit price of each characteristic of the good that is modeled in the hedonic regression equation.

The implicit prices for individual product characteristics that are estimated using hedonic regressions can be used to adjust the prices of two items with different characteristics. After these adjustments, the remaining difference between the prices of the two items can be considered as an estimate of the pure price difference between them. This pure price change can then be incorporated in a constant-quality price index such as the CPI.

⁵See, for example, Triplett, Jack E., "The Economic Interpretation of Hedonic Methods," *Survey of Current Business*, January 1986, p. 40, and Berndt, Ernst R., *The Practice of Econometrics: Classic and Contemporary*, Addison-Wesley, New York, 1991, p. 117.

How Quality Changes Are Calculated Using Hedonic Regression Models

For the period reviewed in our report (October and November 1997), the application of hedonic techniques among nonrent items was limited to apparel items. BLS has found that measuring price change for goods such as apparel items presents considerable problems because these items undergo numerous changes in characteristics as fashions evolve.⁶ Since January 1991, BLS has been using hedonic regression models to make direct adjustments for quality differences in apparel items. According to BLS, the hedonic regression models develop estimates for the values of product features. These estimates are then used to make adjustments to the prices of apparel items for the changes in quality. Previously, BLS relied heavily on the linking method to adjust apparel items.

Hedonic regression modeling in apparel utilizes the general framework in which an item can be viewed as a collection of characteristics, which, taken together, provide satisfaction or value to the consumer. A woman's jacket, for example, can be considered an aggregation of its features, such as its fiber content (e.g., percentage wool) and type of closure (button or zipper), each of which contributes to the value of the jacket in the eyes of the consumer.

Figure IV.1 describes the hedonic regression equation that BLS uses for apparel items.

Figure IV.1 Description of a Hedonic Regression Equation for Apparel Items

The standard hedonic regression equation for apparel commodities uses the natural logarithm of the item's price as the dependent variable and several independent variables capturing different characteristics of the apparel item. The values of the independent variables are measured linearly (i.e., measured in levels, rather than logarithms). The coefficients in such a semilog specification provide an estimate of the proportional change in price that results from a one-unit change in a quality characteristic. In most cases, an independent variable representing a characteristic is dichotomous, in the sense that it indicates whether or not the item possesses the characteristic. The value of the variable is 1 for an item with the characteristic and 0 for an item without it. In some cases, an independent variable measures a continuous quantity, such as the content of a particular fiber. An item's percentage of wool, for example, would range from 0 to 100. Additional variables called control variables usually also are included to capture the effect of price variations by city size, region, and type of business.

Source: BLS.

Determining the best set of characteristics to explain prices in apparel poses a challenge because fashion influences price. BLS analysts found,

⁶BLS Handbook of Methods, U.S. Department of Labor, BLS, (April 1997) p. 184.

however, that fashion can be approximated to some extent through such characteristics as whether the item is a store or national brand and the type of closure (e.g., zipper or buttons). According to BLS, other characteristics such as lining and fiber are always included in the apparel regression models because they are fundamental to the price of an apparel item. According to BLS, all these characteristics can be observed and tested to see the degree of influence, if any, they exert on price.

For example, a 1997 version of the hedonic regression model for women's coats provides estimates of the effect on price of almost 30 different characteristic and control variables. These estimates included dichotomous variables indicating whether or not the item was one of several types of coats, such as a windbreaker, a parka, a trench coat, among others. Continuous variables included the percentage content of cashmere, camel hair, wool, cotton, and other fibers. The equation included variables to control for other factors, such as whether the price was collected at a discount department store, in a large city, and from the Northeast.

According to BLS guidelines, the value to consumers of particular product attributes change over time. Hence, the hedonic regression estimates need to be updated periodically. For example, BLS' detailed written guidelines for the apparel modeling process include a requirement that the apparel regression models be updated at least every 12 to 15 months. Should a sharp market change occur, however, BLS' guidelines call for earlier updating.

How BLS Accounts for Quality Change Using Hedonic Regression Estimates

BLS' exclusion of quality differences using the hedonic regression estimates can be demonstrated with a hypothetical case based on a woman's trench coat. For example, assume that the new version of the trench coat had a lining, but the old version did not, and the two versions had no other differences. In this example, assume that the BLS commodity analyst determined that the two versions were not comparable but was able to use the estimated hedonic regression equation for women's coats to adjust for the effect of the difference.

For this illustration, assume that the price of the old trench coat was \$100 and that the price of the new version was \$125. The estimated hedonic regression coefficient for the lining characteristic was .13470725, which represents the lining's logarithmic effect on the price of the coat. To determine the quality adjusted price of the old version, the logarithmic

price effect is exponentiated and multiplied by the old price: $\$100 \times \exp(.13470725) = \114.42 .

The hedonic quality adjustment has the effect of adding \$14.42 (\$114.42 - \$100.00) to the price of the old item to make it comparable to the new item. In effect, the hedonic regression adjustment implies that if the old version had a lining, the lining would have added \$14.42 to its price.

How BLS Calculates a Price Change After Making a Hedonic Regression-Based Adjustment

Following the hedonic regression adjustment described above, the old item's adjusted price of \$114.42 is compared with the new item's price of \$125.00. The 9.2 percent difference between the two prices is incorporated in the calculation of the CPI as a pure price increase. Thus, of the \$25 actual price difference between the two versions of the coat, \$14.42 was allocated to a quality difference; and the remaining \$10.58 was determined to represent a pure price increase.

Example of BLS' Use of the Hedonic Method

The following example results from our interviews with a BLS commodity analyst. According to the commodity analyst and supervisor, it is representative of the methods in which they use hedonic regression estimates to adjust for quality change in apparel items.

The example includes a price calculation that shows the percentage change in price that went into the CPI for that month as a result of the direct adjustment. This percentage change in price is applicable only to the particular case illustrated. It is not intended to be representative of the percentage changes in price that occurred for similar kinds of substitutions in which direct adjustments are made. Nor is the percentage change in price intended to be representative of the impact that direct adjustments have on the CPI.

The example includes (1) a table showing the characteristics of the old item and the new item that replaced it (differences between the old and new versions are highlighted by shading), (2) the analyst's reasons for judging the two versions to be not comparable, (3) the rationale for selecting the method of adjustment, and (4) the price calculation that was made.

Example 2 - Woman's Coat (Under the Women's Coats and Jackets Item Stratum)

A new version of heavyweight woman's coat was substituted for the old version and, as shown in table IV.2, several important characteristics of the two versions differed. The analyst decided that the two versions were not comparable, and made a direct adjustment by using values from a hedonic regression.

Table IV.2: Characteristics of Two Versions of a Woman's Coat

Description	Old version	New version
Specifications		
Type	Heavyweight	Heavyweight
Design	Shirt jacket/Battle jacket	Parka
Body fiber	100 percent cotton	60 percent cotton and 40 percent polyester
Brand/label name	Local brand name	Different local brand name
Size range	Junior/misses	Junior/misses
Length	Waist	Waist
Cleaning method	Machine washable	Dry clean only
Type of pockets	2 slot	^a
Lining	Yes	Yes
Method of closure	Button closure	Zipper and button closure
Color	Biscuit (Tan)	Ivory/Hunter green
Other information	Corduroy	Drawstring waist
Price information		
Amount	\$32.028	\$125.00
Type of price	Sale	Regular
As of	August	October
Collected/imputed	Imputed	Collected

 Specifications that differ between old and new versions

^aThere was no information about the type of pockets in the new version.

Source: BLS.

Analyst's Reasons for Deciding the Items Were Not Comparable

The commodity analyst noted that there were several major differences between the old and new versions in the design, body fiber, and method of cleaning. The analyst said that BLS research had shown that these differences had a significant effect on the price of women's coats and

jackets. The differences were sufficient for the analyst to determine that the items were not comparable. The analyst used hedonic regression estimates to adjust for the quality differences and make the items comparable. Without the adjustments the class-mean method would have been applied to the item by default.

Rationale for Selecting the Method of Adjustment

To make the adjustment, the analyst had to override another adjustment code that was computer generated. A computer routine automatically calculates any change in prices between the old and new versions of a substitution. If the price change percentage is within a predetermined interval, the computer is programmed to default to a comparable substitution code. If the price change is outside the interval, the computer defaults to a not-comparable code. In the women's coats and jackets item stratum, the not-comparable code would indicate that the class mean should be used. Because the computer routine is based on price change, it cannot default to a direct adjustment code. In this case, the computer-generated the code for a not-comparable substitution, which means that the class-mean method of adjustment would have been used.

However, the hedonic regression model for women's coats and jackets provides estimates of the price effects of differences in design, body fiber, and method of cleaning. Therefore, the analyst was able to apply the hedonic regression estimates to adjust for quality differences and make the substitution comparable.

Calculation of Price Change

The analyst used the results of the hedonic regression to calculate the adjustment attributable to the quality change in design, body fiber, and method of cleaning. The analyst calculated this to be \$33.850 and added this value to the price of the old version to derive an adjusted price of \$65.88 (\$32.028 + \$33.850).⁷ The difference between the adjusted price of the old version (\$65.88) and the price of the new version (\$125.00) represented a pure price increase of 89.7 percent, which was incorporated into the CPI.

⁷In this instance, the price of the old version was an imputed price. Imputed price is a term used by BLS to indicate that the old version did not have a usable price. Instead, an average was calculated from the price change experienced in the previous collection period by the same type of items in the CPI to handle a missing or unusable price quotation.

Other Direct Adjustments

A third method of direct price adjustments includes adjustments for an item's size or the number of units it includes. BLS considers adjustments for unit count or size to be direct adjustments because they adjust for a particular characteristic of a good or service. BLS also includes data-entry corrections for individual items in this direct adjustment method.

In 1997, BLS made direct adjustments to at least 719 items to account for unit-count changes, size differences, or data errors, which represented about 6 percent of the 12,131 adjusted substitutions in 1997 that involved nonrent items. Of these 719 direct adjustments, 336 involved medical-care items, 132 were for housing-related items, 107 were in food and beverage items, 95 involved entertainment items, and the remaining 49 were in transportation and the "other" goods and services ELIS.

According to BLS, a large number of adjustments for unit count or size differences are made automatically in the CPI. For example, most food and beverage prices are automatically converted to an effective price on a per-ounce basis. These conversions are not counted as substitutions and are not reflected in the count of direct adjustments.

How BLS Accounts for Quality Changes Associated With Differences in Unit Count or Size, and Corrections

For purposes of measuring the price change of an item of constant quality, the item should remain the same in unit count or size between collection periods. Before calculating the price change between two versions of an item that have experienced a size or unit count change, BLS adjusts the price of the old version to the level it would have been if the old version had the same unit count or size as the new version.

How BLS Calculates Price Changes After Direct Adjustments for Differences in Unit Count or Size, and Corrections

To illustrate a price calculation with an "other" direct adjustment method, suppose for example, that a package of gum has five sticks in one period and sells for 50 cents, and at the next price collection period the package has six sticks of gum and sells for 60 cents. According to BLS, the difference in unit count would make this substitution not comparable. However, the BLS commodity analyst can make a direct quality adjustment to the price of the old version to account for the difference in unit count. The analyst would calculate the price per stick of gum in the previous collection period as 10 cents. The 10 cents is added as a direct adjustment to the 50 cents price of the old version to price it as if it had six sticks. After the adjustment, the old price for the pack of gum is 60 cents. The 10 cents is what BLS would count as quality change in the context in which BLS

generally uses the term quality—all changes that are not pure price changes.

If no adjustment for unit count had been made, the price difference between the two packages of gum would have been reflected as a 20-percent increase (the increase from 50 cents to 60 cents per pack). However, after the direct adjustment to the price of the old version, based on the price per stick of gum in the package, the price of the old version was 60 cents. Because the price of the new version was also 60 cents, the CPI would reflect no price change (0 percent) for the item.

Examples of BLS' Use of Direct Adjustments for Size or Unit Count, and Corrections

The following two examples of BLS' use of direct adjustments for unit count or size, or corrections come from our interviews with BLS commodity analysts. According to the commodity analysts and supervisors, these examples are illustrative of the substitutions in which they use such direct adjustments in their respective CPI components. These examples show analysts' decisions when the difference in unit count or size between versions are large enough to make the items not comparable, even though, according to BLS, it also makes such adjustments when the differences are not as large. In addition, in these examples the analyst has sufficient information to make a direct adjustment to the price of the old version, and compare that adjusted price with the price of the new version.

The examples include a price calculation that shows the percentage change in price that went into the CPI for that month as a result of the direct adjustments. These percentage changes in price are applicable only to the particular cases illustrated. They are not intended to be representative of the percentage changes in price that occurred for similar kinds of substitutions in which direct adjustments are made. Nor are the percentage changes in price intended to be representative of the impact that direct adjustments have on the CPI.


Both examples include (1) a table showing the specifications of the old version and the new version that replaced it, (2) the analyst's reasons for judging the two versions to be comparable or not comparable, (3) the rationale for selecting the method of adjustment, and (4) the price calculation that was made. Within each table, differences in specifications between the old and new versions are highlighted by shading.

Example 3 - Season Ticket (Under the Admission to Sporting Events Item Stratum)

The new version of the season ticket included 44 hockey games, while the old version included 43 games. The analyst decided to make a direct adjustment to account for the difference in the number of games.

Table IV.3: Characteristics of Two Versions of a Season Ticket Package

Description	Old version	New version
Specifications		
Type of event	Hockey	Hockey
Level of competition	Professional	Professional
Admission type	Season ticket for 43 events	Season ticket for 44 events
Seating location	Middle price	Middle price
Type of purchase	In person	In person
Price information		
Amount	\$1,617.432	\$1,677.00
As of	September	October
Collected/imputed	Imputed	Collected

 Specifications that differ between old and new versions

Source: BLS.

Analyst's Reasons for Deciding the Items Were Not Comparable

The commodity analyst decided that, because the number of tickets in the season ticket package increased from 43 to 44 hockey games, a direct quality adjustment could be made. According to BLS, it is not clear whether the analyst would have decided this was a comparable or a not-comparable substitution if a direct adjustment had not been made.

Rationale for Selecting the Method of Adjustment

To make a direct adjustment in this case, the analyst overrode the default comparison code that the computer had generated. For items in the entertainment component of the CPI, a computer routine automatically sets the comparison codes so that the prices of the old and new versions will be compared unless the analyst sets them to another value. This computer routine also calculates the percentage change in the versions' prices for the convenience of the analyst. When there is a change that meets or exceeds a predetermined amount, the computer is programmed to calculate a price increase (or decrease) and a commodity listing review is

forwarded to the commodity analyst. In this case, the computer defaulted to a comparable adjustment code signifying that the old and new versions were alike, and the computer generated a price increase of 3.7 percent. However, the analyst overrode this adjustment code to make the direct adjustment. The analyst calculated the quality adjustment factor by calculating the incremental difference in the increase in the number of hockey tickets and then entered this factor ($1/43 = 0.233$) as part of the adjustment procedure.

**Calculation of Price
Change**

The price calculation for the direct quality adjustment method is done by computer using the adjustment factor. According to BLS, the price of the old version was increased by 2.33 percent to have it represent what a 44-event season ticket would have cost. Using this increased cost of the old version, the computer compared it with the cost of the new version of the season ticket.⁸ In doing so, according to BLS, the computer calculated a 1.3 percent increase for this season ticket, and this percentage increase was incorporated into the CPI for October 1997.


**Example 4 - Canned
Soup (Under the
Canned and Packaged
Soup Item Stratum)**

The analyst concluded that two soups were not comparable and made a direct adjustment to correct for the size of the container.

⁸In this instance, the price of the old version was an imputed price. BLS officials said that, when prices are unavailable (e.g., because the item is out of season), they impute the prices of those items, using the same imputation that is used for the linking method. BLS imputes prices using averages calculated from the price changes experienced in the same month by the same type of items in the CPI to handle missing or unusable price quotations.

Table IV.4: Characteristics of Two Versions of a Canned Soup

Description	Old version	New version
Specifications		
Where purchased (in store)	Shelf	Shelf
Type	Condensed	Condensed
Brand classification	Nationally marketed brand	Nationally marketed brand
Flavor	Chicken	Chicken
Other major ingredients	Noodles	Noodles
Packaging	Canned	Canned
Weight	10.375 oz.	10.75 oz.
Price information		
Amount	\$1.324	\$0.95
As of	October	November
Collected/imputed	Imputed	Collected

 Specifications that differ between old and new versions

Source: BLS.

Analyst’s Reasons for Deciding the Items Were Not Comparable

The commodity analyst decided that the two versions were the same soup, but a message from the price taker indicated that the size of the container had been corrected. The size of the soup was previously reported incorrectly as 10.375 ounces and was now being reported correctly as 10.75 ounces. To make a correction for this weight error, the commodity analyst made the two soups not comparable.

Rationale for Selecting the Method of Adjustment

To make a direct adjustment in this case, the analyst had to override another adjustment code that was computer generated. In this case, the computer defaulted to a comparable adjustment code signifying that the old and new versions were alike, and the computer generated a price decrease of 30.75 percent. However, because the analyst wanted to correct the weight error, the analyst overrode this adjustment code. The analyst calculated the quality adjustment factor by calculating the percentage that represents the proportion of the price of the old version that was in error to make it the same as the larger-size new version and then entered this factor (-0.0597) as part of the adjustment procedure.

For not-comparable substitutions in this item stratum, BLS designated the linking method as the standard method of adjustment when other methods are not usable. However, in this instance, the analyst had enough information to make a direct adjustment to equate the two sizes of soup. The analyst said that if the linking method had been selected, the soup would have been excluded from the calculation for the CPI that month. According to the analyst, a quality adjustment would allow a continuation of the same item in the CPI and allow the analyst to correct the weight error.

**Calculation of Price
Change**

The price calculation for the direct quality adjustment is done by computer using the adjustment factor. According to BLS, the effective price per ounce of the old version was decreased by 0.0597 percent to have it priced at the correct weight. Using this decreased cost of the old version of the soup, the computer compared the corrected unit price with the unit price of the new version. In doing so, according to BLS, the computer calculated a 26.4 percent decrease for this canned chicken soup, which was incorporated into the CPI for November 1997.

Class-Mean Method of Adjustment

According to BLS, the class mean is an indirect method of adjustment that is used for not-comparable substitutions in item strata where price changes are closely associated with annual or periodic introductions of new models or product lines. For example, BLS uses the class-mean method for the new cars item strata because researchers noted that automobile manufacturers often increase the prices of their automobiles when they introduce the new year's models. Although BLS officials said they would prefer to make a direct adjustment under these circumstances, often they do not have the information they need to do so. (See app. IV for a discussion about direct adjustments.) When a direct adjustment cannot be made for a new model, the class-mean method is used because, according to BLS, it more accurately reflects the manufacturers' price increase than the linking method, the other available method of imputation.¹

BLS reported that the class-mean method is similar to the linking method in several ways (see app. VI). Both methods use imputations to estimate rates of price change when an item in the CPI is replaced by a not-comparable substitution and a direct adjustment cannot be made. (BLS also refers to these rates of price change as price relatives.) Both methods depend upon two fundamental assumptions: (1) the price change applicable to the not-comparable substitution cannot be directly calculated and (2) the best available estimate of this price change is the rate of price change that occurs for the same type of items in the same geographic area.

The class-mean differs from the linking method in that it is based on the price changes of a much more specific group of price quotations. Whereas the linking method is based on all price quotations in the same item stratum in the same geographic area, the class-mean method is based on a specific subset that includes only quotations for substitutions, which are judged comparable and/or to which direct adjustments are made in the same item stratum in the same geographic area.²

Background

BLS officials said they developed the class-mean method in response to a problem they perceived in the linking method in the late 1980s. Until the class-mean method was developed, the linking method was the only

¹Imputation is a term used by BLS to indicate that the actual price of the substitution is not used. Instead, an average is calculated from the price change experienced that month by the same types of items in the CPI to handle a missing or unusable price quotation.

²BLS refers to an item stratum in a geographic area as an item stratum-index area.

method of imputation available to BLS for most substitutions that were judged to be not comparable.³ In BLS' opinion, the linking method tended to understate the degree of price increase for items for which new models or product lines were frequently introduced.

According to BLS, its original research indicated that manufacturers usually raised the price of an item when they introduced a new model or product line. As a result, BLS officials stated, new models and products usually had higher average price increases than unchanged models and products. However, because the linking method was heavily influenced by unchanged models and products, it tended to understate the level of price increase when it was applied to new models and products.⁴

In response to this problem, BLS developed a method for calculating a price relative that was based on comparable and directly adjusted substitutions because the prices of these substitutions, BLS officials said, were more likely to have changed due to the introduction of new models or products. BLS officials relied on both logic and research to justify their use of this subset of substitutions for the class mean.

BLS made several assumptions in arriving at this subset of substitutions for the class mean. It assumed that this subset of substitutions contained a large percentage of new models or products lines. BLS further assumed that the not-comparable substitutions in these item strata also contained a large percentage of new models or product lines but that the unchanged items did not.⁵ Under these circumstances, BLS officials stated, it is more appropriate to impute the prices of not-comparable substitutions from a subset of comparable and directly adjusted substitutions than from all price quotations, most of which consist of items that were not substitutions and whose characteristics were unchanged.

³The only other method of imputation available at the time, the overlap method, could only be applied to substitutions for items that had been on sale. The purpose of the overlap method, BLS officials stated, was to prevent biases from entering the CPI as a result of substitutions for items that had been on sale. BLS officials said that, as a result of the introduction of other methods for preventing biases from sale price items entering the CPI, the overlap method had almost entirely been phased out by December of 1997.

⁴According to BLS officials, the class mean was developed in the late 1980s to address the higher than average price increases that usually accompanied the introduction of new models or product lines. However, in recent years, BLS has reported that some manufacturers have decreased the prices of new models or product lines. If this decrease was lower than the average decrease that would have occurred if the linking method was used, the price changes of the adjusted items would be overstated if the linking method was used.

⁵By unchanged items, we mean items that were not substitutions and whose characteristics had not changed.

To check these assumptions, BLS conducted research, in the early 1990s, the average price changes for (1) comparable and directly adjusted substitutions and (2) unchanged items. BLS looked at each item stratum individually, and compared average price changes. BLS reported that it found the rates of price change for comparable and directly adjusted substitutions higher than for unchanged items in many item strata where their industry knowledge indicated that new models and products were regularly introduced. The reason for this, BLS officials decided, was that the new models and products in these item strata generally had higher rates of price increase than the unchanged items.

In the early 1990s, BLS conducted a broad review of the CPI item strata. Following this review, it decided that the class-mean method would be used in item strata where (1) new models or products were known to be introduced on a regular basis and (2) the average price increase for the comparable and directly adjusted items was significantly higher than for unchanged items. Under these circumstances, BLS officials stated, the class mean was a better method of imputation than the linking method.

BLS commodity analysts used the class-mean method in 33 percent of the 12,131 not-comparable substitutions in 1997. In December 1997, the class mean was designated for 53 of the 183 priced item strata.⁶ These included most apparel item strata, some transportation item strata, such as new trucks and cars, and many household-goods item strata. The household-goods item strata included furniture, kitchen appliances, electrical goods, utensils, linens, and cleaning agents and tools. In addition, the class mean was designated for a variety of other items, such as printed items, boats, bicycles, outdoor equipment, photographic goods, pet food, and auto repair services.

How Price Changes Are Calculated With the Class-Mean Method

In the class-mean method, the replacement version is put aside in calculating the price change. Instead, a computerized procedure is followed to impute a rate of change that is based on items similar to the old version. A first step in this procedure is for the computer to identify the substitution's item stratum and geographic area. For example, if a price taker in Urbantown made a not-comparable replacement for a new car in November 1997, the class-mean method would use the new cars item stratum for Urbantown, November 1997.

⁶After the 1998 revision of the CPI, the class mean was designated for 51 of the 186 priced item strata.

The next step in the computerized procedure is to identify all the comparable and direct adjusted substitutions and calculate a price change rate for the applicable item stratum. As a result, the class-mean method—unlike the linking method—excludes all items that are not substitutions from its calculations.⁷ Because the great majority of the items are not substitutions each month, this means that the class mean often is based on a fairly small number of items.⁸ In the three illustrations that follow this section, the class means were based on as few as 1 substitution and as many as 11 substitutions. If there are no comparable or directly adjusted substitutions in the item stratum for the geographic area in question, BLS said the computer routines would search other item strata or geographic areas that had been defined as similar until an item stratum with at least one comparable and/or directly adjusted substitution is found. For example, if there were no comparable or directly adjusted substitutions in women's coats and jackets in Urbantown in November 1997, the computer would search for comparable or directly adjusted substitutions in women's separates and sportswear stratum in Urbantown in November 1997.⁹

When comparable and/or directly adjusted items are identified, either in the original item stratum in the original geographic area or in similar strata or areas, a weighted-average price change is determined. BLS then assigns this weighted average to all class-mean replacement items, in that item stratum, in that geographic area, in that month. For example, assume an item stratum in a geographic area contained eight items with equal weights. Of those eight items, one is the item under review, which is a not-comparable substitution. The other seven are one comparable substitution whose price has increased by 5 percent, one directly adjusted substitution whose price has increased by 1 percent, and five items that are not substitutions. Only the comparable and the directly adjusted

⁷Because the class-mean method only includes comparable and/or directly adjusted substitutions, it also excludes all linked substitutions from its calculations.

⁸Less than 4 percent of the 872,829 monthly or bimonthly price quotations in the CPI were substitutions in 1997. However, the rate of substitutions varied by major components, ranging from 12.8 percent for apparel items to 1.4 percent for food items.

⁹According to BLS officials, judgment was used to establish fairly elaborate search routines for the class mean. Officials said they ordered the item strata in terms of their similarity with the item stratum in the geographic area under consideration. For example, in the example given here, if there were no comparable or directly adjusted substitutions in the women's separates and sportswear item stratum, the routine would perform a search on the women's dresses item stratum. If there were no comparable or directly adjusted substitutions in that item stratum, the computer would perform a search on the women's underwear, nightwear, and accessories item stratum. In other item strata, such as new cars, the computer routine would search other geographic areas for comparable or directly adjusted substitutions. For example, if there were no comparable or directly adjusted substitutions for new cars in the New York City suburbs, the routine would search New York City.

substitutions would be used to calculate the class mean. The percentage changes would be added together for a total of 6 percent, and divided by the number of substitutions used. The result would be an average increase of 3 percent, which would be the price relative for all class-mean substitutions in that item stratum in that geographic region for that month.

Of course, the computations that BLS makes to obtain a weighted-average price change are more complex than those in the illustration. For example, BLS assigns a weight to each item in a stratum to reflect its relative importance to consumers. (The weights are based on consumer spending patterns with the larger weights assigned to items on which consumers spend the most.) BLS uses these weights in calculating the overall net price change (price relative) for the class-mean method. Because the price change of each item is multiplied by the weight of the item, price changes in items with large weights are likely to have a greater impact on the overall net price change than price changes in items with smaller weights.

Price relative calculations for the class-mean method are made by computer routine after all of the month's prices have been collected and the replacement items have been reviewed by the commodity analysts. Each month, a single price relative is computed for each item stratum in each of the CPI geographic areas that BLS has designated for the class mean and that has at least one not-comparable substitution.

How Quality Improvements Are Accounted for in the Class-Mean Method

Quality improvements are accounted for in the class-mean method exactly as they are in the linking method (see app. VI). Conceptually, under the class-mean method, BLS divides any difference in price between the old item and the replacement item into two parts—pure price and quality. BLS makes the implicit assumption that the pure price change is an amount that can be estimated by the rate of price change that occurred for a subset of the same types of items in the same geographic area. In other words, BLS assumes that the pure price change is the price relative calculated through the class-mean method. BLS assumes that any remaining difference in price—the residual—reflects differences in quality between the old item and its replacement. This residual is excluded from the price relative calculation because the CPI is designed to reflect only pure price change.

Examples of BLS' Use of the Class-Mean Method

The following three examples of BLS' use of the class-mean method come from our interviews with three BLS commodity analysts. See appendix I for a detailed discussion of how these examples were selected. According to the commodity analysts and their supervisors, these examples illustrate how the class-mean method works. These examples show analysts' decisions when the replacement is different from the old version and is viewed as a dissimilar item.

Each example includes a price calculation, showing the percentage change in price that went into the CPI for that month as a result of the class-mean adjustment. Each percentage change in price is applicable only to the particular case illustrated. The examples are not intended to be representative of the percentage changes that occurred for similar kinds of substitutions in which class-mean adjustments are made. Nor are the percentage changes intended to be representative of the impact that class-mean adjustments have on the CPI.

Each example includes (1) a table showing the specifications of the old version and the new version that replaced it, (2) the analyst's reasons for judging the two versions to be not comparable, (3) the rationale for selecting the method of adjustment, and (4) the calculation of price change that was made. Within each table, differences in specifications between the old and new versions are highlighted by shading.

Example 1 - Bedroom Linens (Under the Linens, Curtains, Drapes, and Sewing Materials Item Stratum)

The analyst decided that the new version of a bed dust ruffle was not comparable with the old version. The substitution was adjusted using the class-mean method, which was the designated method of adjustment for this item stratum.

Appendix V
Class-Mean Method of Adjustment

Table V.1: Characteristics of Two Versions of a Dust Ruffle

Description	Old version	New version
Specifications		
Quality	First	First
Item priced	Dust ruffle	Dust ruffle
Style	Ruffles	Ruffles
Size	Standard, twin, or single	Queen
Fabric	Woven	Woven
Fiber	90 percent cotton	90 percent cotton
Backing	No backing	No backing
Brand/label name	Different from the new version	Different from the old version
Price information		
Amount	\$39.12	\$199.99
Type of price	Sale	Regular
As of	August	October
Collected/imputed	Imputed	Collected

 Specifications that differ between old and new versions

Source: BLS.

Analyst's Reasons for Deciding the Items Were Not Comparable

The analyst said that the new version of the ruffle was different in size from the old version because it was a queen-size dust ruffle, as compared to the old version which was a single-size dust ruffle.¹⁰ Therefore, the versions were not comparable, and an adjustment had to be made.

Rationale for Selecting the Method of Adjustment

For not-comparable substitutions in this item stratum, BLS designated the class-mean method as the standard method of adjustment for substitutions that were not comparable. In this instance, the class-mean adjustment code was generated by computer routines because the price difference between the two versions exceeded a predetermined level. As the analyst decided that this substitution was not comparable, the class-mean adjustment code was not changed, and the class-mean method of adjustment was used.

¹⁰BLS price takers can report that the bedroom linens fall into one of five sizes: (1) standard, twin, or single, (2) full, (3) queen, (4) king, or (5) other. Throughout this discussion, we refer to the standard, twin, or single-size dust ruffle as a single-size dust ruffle.

Calculation of Price Change

The price calculation for the class-mean method is done entirely by computer routines without the direct involvement of the analyst. The method calculates a rate of price change based on the price movement of comparable and/or directly adjusted prices in the same item stratum in the same geographic area. In this instance, according to BLS, there was only one comparable substitution in the same item stratum in the same geographic area, and that served as the class mean. The comparable substitution was for a quilt and comforter whose price had changed from \$179.99 to \$179.00. Therefore a -0.5 percent rate of change was calculated for this item stratum in this geographic area for use with class-mean adjustments for October 1997, and the price of the old version of the dust ruffle was adjusted by -0.5 percent, from \$39.12 to \$38.91.¹¹ This means that the CPI in October 1997 reflected the same percentage change for this dust ruffle.

Example 2 - Woman's Parka (Under the Women's Coats and Jackets Item Stratum)

The analyst decided that the new version of a woman's parka was not comparable with the old version. The substitution was adjusted using the class-mean method, which is the designated method of adjustment for this item stratum when direct adjustments cannot be made.

¹¹The price for the old version was an imputed price. BLS officials said that, when prices are unavailable (e.g., because the item is out of season) they impute the prices of those items using the same imputation method that is used for the linking method.

Appendix V
Class-Mean Method of Adjustment

Table V.2: Characteristics of Two Versions of a Woman’s Parka

Description	Old version	New version
Specifications		
Type	Heavyweight	Heavyweight
Design	Parka	Parka
Body fiber	Leather	Leather
Brand/label name	Local brand name	Different local brand name
Size range	Junior/misses	Junior/misses
Length	Fingertip length	Fingertip length
Details/ features	Hood	No hood
Other information	Fur-like lining	Fur-like lining
Other information	Gold	Brown
Price information		
Amount	\$153.45	\$79.99
Type of price	Regular	Regular
As of	August	October
Collected/imputed	Imputed	Collected

 Specifications that differ between old and new versions

Source: BLS.

Analyst’s Reasons for Deciding the Items Were Not Comparable

The analyst noted that there was a big difference in the prices of the old and the new versions (\$153.45 compared with \$79.99). The analyst also said that the research BLS had conducted to develop hedonic models for direct adjustments had found that hoods could influence the price of a coat. Furthermore, he was not familiar with the brand names of the old and new versions and did not know how they might differ in terms of quality. According to BLS, there are thousands of brands of women’s coats, and it is not possible for commodity analysts to be familiar with all of them. Even though there is a hedonic regression model for the women’s coats and jackets item stratum, the analyst could not make a direct adjustment because the model did not contain any cost factors for differences in brand names. Taking all of this into consideration, the analyst decided this substitution needed to be adjusted by an indirect method.

Rationale for Selecting the Method of Adjustment

For not-comparable substitutions in this item stratum, BLS has designated the class-mean method as the standard method of adjustment if a direct

adjustment could not be made. In this instance, the computer routine had generated a class-mean adjustment code because the price difference between the two versions exceeded a predetermined level. As the analyst decided that the substitution was not comparable, and a direct adjustment could not be made, the computer-generated code was not changed, and the substitution was adjusted using the class-mean method.

Calculation of Price Change

The price calculation for the class-mean method is done entirely by computer routines without the direct involvement of the commodity analyst. The method calculates a rate of price change based on the observations for comparable and/or directly adjusted substitutions in the same item stratum in the same geographic area. In this case, a BLS computer routine found three comparable substitutions in the original item stratum and geographic area. These were substitutions for (1) a heavyweight leather jacket, for which the price had risen by 1.9 percent, (2) a heavyweight polyester jacket, for which the price had fallen by 29.8 percent, and (3) a heavyweight leather anorak, for which the price had risen by 69.2 percent. There were no directly adjusted substitutions in this item stratum and geographic area.

The class mean, which is a weighted average of these three items, was calculated to be 6.1 percent for October 1997. Therefore, the price of the old version was adjusted by 6.1 percent, from \$153.45 to \$162.81. This means that the CPI in October 1997 reflected the same percentage change for this version of a woman's jacket.


Example 3 - New Car (Under the New Cars Item Stratum)

The analyst decided that the new version of a new car was not comparable with the old version. The substitution was adjusted using the class-mean method, which was the designated method for not-comparable substitutions in this item stratum when direct adjustments could not be made.

Appendix V
Class-Mean Method of Adjustment

Table V.3: Characteristics of Two Versions of a New Car

Description	Old version	New version
Specifications		
Model year	1997	1998
Number of doors	4-doors	4-doors
Body type	Sedan	Sedan
Number of cylinders	4	4
Engine displacement or size	1.6 liters	1.6 liters
Transmission	3-speed standard ^a	1722 ^a
Options package		
Rear defogger	Yes	Yes
Power steering	Yes	Yes
AM/FM cassette	No	Yes
Tilt wheel	No	Yes
Power windows, locks, and mirror	No	Yes
Air conditioning	Yes	Yes
Price information		
Amount	\$14,010	\$14,408
As of	August	October
Collected/imputed	Collected	Collected

 Specifications that differ between old and new versions

^aAlthough this information was reported on the CRL, the analyst for new cars stated that, in fact, both the old and new models of this car had 4-speed automatic transmissions.

Source: BLS.

Analyst's Reasons for Deciding the Items Were Not Comparable

A 1998 model of a car had replaced the 1997 model. According to the commodity analyst, the characteristics of the new version, and publicly available industry information, showed that the 1998 model contained significant quality changes over the 1997 model. However, the analyst did not have the information that would have allowed a direct adjustment to be made because the automaker had not provided sufficient information to BLS, and the information provided by other automakers could not be applied to this model.

Rationale for Selecting the Method of Adjustment

In this case, the computer-generated default comparison code was comparable based on the level of the price change. If the analyst had judged the substitution to be comparable, the price change would have been 2.8 percent. However, the analyst stated that publicly available industry information indicated that there were significant differences in the features of the old and new versions. In the analyst's opinion, quality changes had been made, but the automaker had not provided the information necessary to make a direct adjustment; and the information provided by other automakers was not applicable to this model. Therefore, the analyst inserted a code indicating that the class-mean method should be used. In the new cars item strata, the analyst stated, the class mean is always used when the manufacturer makes significant quality changes to a new year's model but does not provide the information to allow BLS to make direct adjustments.

Calculation of Price Change

The price calculation for the class-mean method is done entirely by computer routines without direct involvement by the commodity analyst. The method calculates a rate of price change based on other changes in the same item stratum in the same geographic area. In this instance, a BLS computer routine searched for all the comparable and directly adjusted substitutions in the item stratum of the substituted item in its geographic area. Of the 11 substitutions that were found, 5 were comparable substitutions and 6 were directly adjusted substitutions. The 11 substitutions, which had price changes ranging from a 0.3 percent decrease to a 10.5 increase, were all used to calculate a weighted-average price increase of 4.0 percent. Therefore, the price of the 1997 model was imputed to have risen by 4.0 percent, from \$14,010 to \$14,570. This means that the CPI in October 1997 incorporated the same percentage change for this car.

Linking Method of Adjustment

BLS' linking method is an indirect adjustment method. It uses imputations¹ to produce rates of price change when an item in the CPI is replaced with a substitution that is not comparable and no other adjustment method can be used. (BLS also refers to these rates of price change as price relatives.) With the linking method, BLS makes two fundamental assumptions: (1) the price change applicable to the not-comparable substitution cannot be directly calculated and (2) the best available estimate of this price change is the rate of price change that occurs for the same type of items in the same geographic area. If prices for these items went up or down 5 percent, then the price of the item in question is imputed to go up or down 5 percent as well.

Background

According to BLS, the linking method is one of several adjustments that can be used when a BLS price taker submits a replacement—a new version—that a commodity analyst judges to be very different from the old version (the versions are not comparable). The difference between the new and old versions is so large, in the analyst's view, that a determination cannot be made as to whether it is due solely to pure price change. In addition to such a difference, two other conditions must also exist for a commodity analyst to designate the linking method: (1) data are not available to use a direct adjustment method and (2) BLS has not designated use of the class-mean method for the item's-in-question item strata. In other words, analysts are to use linking when they cannot use any other adjustment method. (The direct adjustment and the class-mean methods are discussed in apps. IV and V, respectively.)

When faced with not-comparable substitutions in 1997, BLS commodity analysts used the linking method to determine price changes for 36 percent of the 12,131 adjusted substitutions in 1997 involving nonrent items. The use of linking was also widespread. It was used in nearly all of the nonrent item strata in which an adjustment was made in 1997. In addition, a majority of the adjustments for two CPI components—food and beverages and medical care—were calculated using the linking method.

¹Imputation is a term used by BLS to indicate that the actual price of the substitution is not used. Instead, an average is calculated from the price change experienced that month by the same type of items in the CPI to handle a missing or unusable price quotation.

How Price Changes Are Calculated With the Linking Method

In the linking method, the new version is put aside in calculating the price change. Instead, a procedure is followed to impute a rate of change that is based on the remaining items priced in the appropriate item stratum. A first step in this procedure is to identify the item strata category, which contains items that are similar by definition to the old version. There are over 200 of these categories, and they are replicated for each geographic area in which BLS collects CPI data. The item stratum that is used must be for the same geographic area and month in which the replacement occurred. For example, if a price taker in Urbantown made a not-comparable replacement for a soup in November, the linking method would use the canned and packaged soups item stratum for Urbantown for November.

Next, an average of price change rates is calculated for the applicable item stratum. In essence, BLS excludes from this computation all items that entered the item stratum during the month through the linking method, as well as those items that for various reasons do not have a usable price, such as a seasonal item that is temporarily unavailable. BLS includes all other items in that stratum in the computation—those with a price change and those with no change in price. For these items a price relative, which BLS refers to as a weighted-average price change, is determined for the item-stratum index for that geographic area.² This weighted-average price change, expressed as a percentage, is assigned to all linked replacement items for that item stratum, month, and geographic location.

The calculations for a weighted-average price change are complex but basically involve two concepts: determining an average and weighting the items that are averaged. For example, assume an item stratum in a geographic area contained six items with equal importance in the CPI. Of those 6 items, 4 had no change in price during the month, 1 had a price increase of 20 percent, and 1 was a replacement that was going to be adjusted by the linking method. The replacement item would be put aside, and the total of the price change for the 5 items (20 percent) would be divided by 5, the number of items remaining with usable prices. The result would be an average increase of 4 percent—the price relative for the geographic area's item-stratum index for the replacement item, which would be used only for that month.

Before calculating the average price change, BLS assigns a weight to each item in an item stratum to give proportionate emphasis to it in relation to

²Each month BLS calculates indexes for each item stratum and geographic area, which total to more than 8,000 indexes. BLS refers to these as "item stratum-index areas," which are aggregated into a U.S. city average index for all items.

other items in the item stratum. (The weights are based on consumer spending patterns with the larger weights assigned to items on which consumers spend the most.) BLS uses these weights in calculating the overall weighted-average price change (price relative) for the linking method. Because the change in the price of each item is multiplied by the item's weight, price changes in items with large weights are likely to have greater impact on the overall net price change than price changes in items with smaller weights.

Price relative calculations for the linking method are made by computer routine after all of the prices for the month have been collected and the replacement items have been reviewed by the commodity analysts. A single price relative is computed for each item stratum as appropriate for the month. Normally, this price relative is most heavily influenced by items that were not substitutions in the item stratum, which generally are most items.

According to BLS, the use of the linking method is the same as setting aside the individual price quotation from the CPI calculations for the period. That is, although the collected price of the item is not used in the CPI that month, it is still represented in the CPI through a weighted average of the same type of items that are in the CPI for that month. Then in the following pricing period the price that was previously set aside is used for the price comparison in the next month.

How BLS Accounts for Quality Change in Using the Linking Method

When using the linking method, BLS makes the implicit assumption that the pure price change is an amount that corresponds to the rate of price change that occurred for the same type of items in the same geographic area. In other words, BLS assumes that the pure price change is the price relative calculated through the linking method. BLS assumes that any remaining difference in price—the residual—reflects differences in quality between the old version and its new version. This residual is excluded because the CPI is designed to reflect only true changes in price.

BLS' exclusion of quality in the linking method can be demonstrated using example 1 at the end of this appendix. There was a difference of \$0.128 in the effective (per ounce) price of the two soups.³ If the commodity analyst had determined that the two soups were comparable, a 34.5 percent

³To make reading the appendix easier, we rounded the effective price per ounce amounts. The numbers we used for rounding appeared on the listing that the commodity analysts use to review the substitutions. For instance, the difference in effective price for these two soups was \$0.12760—the price per ounce of the new version (\$0.49737) minus the price per ounce of the old version (\$0.36977).

increase would have entered into the CPI as a pure price change. Or, if the commodity analyst had determined that the soups were not comparable and the \$0.128 difference between the soups was entirely due to better ingredients (quality improvement), a direct adjustment would be made. If under this adjustment the entire difference in price was deemed to have resulted from better ingredients, no price increase would have entered into the CPI. But neither of these events occurred.

Instead, the two soups were considered by the commodity analyst to be not comparable because there was a weight change and a change in ingredients between the two versions and through the linking method a price relative increase of 0.58 percent was computed. To conceptually allocate the \$0.128 difference to pure price and quality, BLS first applies the rate of change for this soup (0.58 percent) to the effective price of the old version (\$0.370) to obtain an imputed price (\$0.372). Then by subtracting the price of the old version from its imputed price BLS obtains the change in pure price ($\$0.372 - \$0.370 = \$0.002$). BLS then assumes that the residual ($\$0.128 - \$0.002 = \$0.126$) is a quality increase. According to BLS, \$0.002 is included in the CPI as a price increase; whereas the \$0.126 is excluded from the CPI because it is the quality difference between the two soups.

Examples of BLS' Use of the Linking Method

The following two examples of BLS' use of the linking method come from our interviews with two BLS commodity analysts. According to the commodity analysts and supervisors, these examples are illustrative of the substitutions in which they use the linking method in their respective CPI components. These examples show analysts' decisions when the replacement is extremely different from the old version and is viewed as a dissimilar item.

Each example includes a price calculation that shows the percentage of changes in price that went into the CPI for that month as a result of using the linking method. They are applicable only to the particular cases illustrated. They are not intended to be representative of the percentage of changes that occurred for similar kinds of substitutions in which the linking method was used. Nor is the percentage change intended to be representative of the impact that the linking method has on the CPI.

Each example includes (1) a table showing the characteristics of the old version and the new version that replaced it, (2) the analyst's reasons for judging the two versions to be not comparable, (3) the rationale for selecting the method of adjustment, and (4) the calculation of price


change that was made. Within each table, differences in specifications between the old and new versions are highlighted by shading.

Example 1 - Packaged Soup (Under Canned and Packaged Soup Item Stratum)

A new version of packaged soup was substituted for the old version and, as shown in table VI.1, certain characteristics of the two versions differed. The analyst concluded that the two versions were not comparable and designated linking as the method of adjustment.

Table VI.1: Characteristics of Two Versions of a Packaged Soup

Description	Old version	New version
Specifications		
Where purchased (in store)	Shelf	Shelf
Type	Dried	Dried
Brand classification	Nationally marketed brand	Nationally marketed brand
Flavor	Chicken	Chicken
Other major ingredients	Pasta and beans	Pasta and herbs
Packaging	Envelope	Envelope
Weight	4.3 oz.	3.8 oz.
Other features	Just add water Cooks in about 15 minutes	Just add water Cooks in about 15 minutes
ZZ99 ^a	Chicken flavor with pasta and beans	New country chicken with pasta and herbs
Price information		
Amount	\$1.59	\$1.89
As of	October	November
Collected/imputed	Collected	Collected
Effective price per ounce	\$0.36977	\$0.49737

 Specifications that differ between old and new versions

^aA designated line for the price taker to put information that may not belong elsewhere on the checklist.

Source: BLS.

Analyst's Reasons for Deciding Items Were Not Comparable

The analyst said that the change in "other" major ingredients from beans to herbs indicated a change in the item. According to the analyst, this was

confirmed in the “ZZ99” specification, which reiterated that the ingredients had changed from beans to herbs.

A weight change also indicated to the analyst that these versions were not comparable. The commodity analyst said that a decrease from 4.3 to 3.8 ounces suggested a change from one standard size to another and that made the versions not comparable. The comparability criteria that BLS established for this item stratum allow the analyst to exercise judgment in determining if the change in weight is substantial enough to make the version not comparable.

The comparability criteria for the item stratum, to which the analyst referred in making the comparability decision, indicated whether a change in various specifications between the old and the versions would make the versions not comparable. According to the criteria, a substantial change in either weight or “other” major ingredients would make the versions not comparable.

Rationale for Selecting the Method of Adjustment

Because the class-mean method had not been designated for the item strata and adequate information needed to make a direct adjustment was not available, the analyst chose the linking method. To designate the linking method in this case, the analyst had to override another adjustment code that was computer generated. A computer routine automatically calculates any change in the effective prices (the unit prices) between the old and new versions. When there is a change that meets or exceeds predetermined amounts, the computer is programmed to use particular comparison codes. In this case, the computer defaulted to a comparable comparison code signifying that the old and new versions were alike, and the computer generated a price increase of 34.5 percent. However, because the analyst judged the old and new versions to be not comparable, the analyst overrode this comparison code.

Calculation of Price Change

The calculation of price change for the linking method is done entirely by computer routine without direct involvement by the commodity analyst. The method calculates a rate of price change based on the price movement of usable collected prices in the item-stratum index for the area. For the canned and packaged soup item stratum in this soup’s geographic location, a 0.58 percent rate of change was calculated for November 1997. This means that the CPI in November 1997 reflected the same imputed increase (0.58 percent) for this package of chicken soup.

Example 2 - Multivitamin Tablets (Under Internal, Respiratory, and Over-the-Counter Drugs Item Stratum)

A new version of multivitamin tablets was substituted for the old version and, as shown in table VI.2, certain characteristics of the two versions differed. The analyst concluded that the old and new version were not comparable and designated the linking method to adjust the price of the old version.

Table VI.2: Characteristics of Two Versions of Multivitamin Tablets

Description	Old version	New version
Specifications		
Type	Vitamins	Vitamins
Form	Plain tablets	Plain tablets
Brand	Store brand	Store brand
Size	130 tablets	100 tablets
Units of vitamin C, per tablet	60	60
Units of vitamin D, per tablet	400	400
Units of vitamin E, per tablet	30 international units	45 international units
Labeling	"one daily plus minerals"	"for mature adults"
Price information		
Amount	\$6.49	\$6.49
As of	September	October
Collected/imputed	Collected	Collected

 Specifications that differ between old and new versions

Source: BLS.

Analyst's Reasons for Deciding Items Were Not Comparable

The commodity analyst decided that the two versions were not comparable because there were so many important differences between their specifications. These differences included the number of tablets in the bottles, the potency of vitamin E, and the labeling of the bottles.

Rationale for Selecting the Method of Adjustment

For substitutions that are not comparable in this item stratum, BLS designated the linking method as the standard method of adjustment when other methods are not usable. In accordance with this procedure, the

analyst marked this case for adjustment by the linking method. To do so, the analyst had to override a comparable comparison code that generated a price change of 0.0 percent (no price change).

The analyst considered the possibility of using an adjustment method to directly adjust the price of the old version rather than using the linking method. According to the analyst, a direct adjustment would have been made to the price of the old version if the only change had been the number of tablets. (This would have been done by computing the cost per tablet of 130 tablets and then multiplying that cost by 100 tablets.) However, according to the analyst, the changes in vitamin E potency and label information prevented a direct adjustment because there was no sensible way to directly adjust the price of the old version for these changes. Also, because a class-mean method had not been designated for the item stratum, this method of adjustment could not be used. The analyst was therefore left with only the linking method.

Calculation of Price Change

The calculation of price change for the linking method is done entirely by computer routine without direct involvement by the commodity analyst. The method calculates a rate of price change based on other changes in the item stratum in the same geographical area. For over-the-counter drugs in the same geographical area, a minus 0.58 percent rate of change was calculated for October 1997. The CPI in October 1997 effectively reflects the same percentage decrease for this item, even though the old version of vitamins has been replaced by a new, not comparable bottle of vitamins.

Measurement of Residential and Homeowners' Equivalent Rents

The housing component of the CPI includes residential rent and homeowners' equivalent rent. Residential rent measures the changes in rents paid by renters in the United States. Homeowners' equivalent rent measures the changes in rental value of owner-occupied houses or apartments. BLS determines this value using a rental equivalence method, which estimates the amount of rent that would be paid for owner-occupied housing if it were rented.¹ BLS refers to homeowners' equivalent rent as REQ.

In comparison to changes in the prices of other items in the CPI, price changes in residential rent and REQ have the greatest influence upon the CPI. For example, as of December 1997, the relative importance (a concept explained in app. II) of these two rent items combined to almost 26 percent (19.9 percent for REQ and 5.8 percent for residential rent). This means that changes in rent directly affected slightly more than one-quarter of all of the price changes that were measured in the CPI in 1997. No other item in the CPI has as much influence as either residential or homeowners equivalent rent items (new cars was the next item in importance in 1997 at less than 4 percent).

BLS collects and processes residential rent and REQ in several ways that are different from other items in the CPI, including those in the rest of the housing component. For example, the selection of housing units from which rent prices are obtained is done using a survey that is separate from the survey used to select other housing and CPI items. This appendix provides information about BLS' procedures and practices for residential rent and REQ.

Background

The CPI housing survey is used to estimate changes in rent for both renters and home owners if they were to pay rent for the use of their homes. The CPI housing survey sample is made up of approximately 36,000 rental units and 26,000 owner units. The housing units in the sample were selected from two sources: the 1980 Decennial Census for units built before 1980 and the U.S. Bureau of Census' sample of building permits for units built

¹The rental equivalence method seeks to measure the costs of consuming housing services over time rather than the value of housing as an asset that might appreciate over time. The latter approach was used before 1983. For further information about this earlier method, see *Consumer Price Index: Cost-of-Living Concepts and the Housing and Medical Care Components* (GAO/GGD-96-166, Aug. 26, 1996).

after 1980.² A sample of renters has been chosen from 85 geographic areas, which BLS refers to as primary sampling units (PSU).

The CPI uses the rental units in the CPI housing survey to determine the price change for both residential rent and REQ. In the rental equivalence method that is used for REQ, rental units are matched to owner units in the CPI housing survey, and the change in the rents reported for those rental units is used to adjust the REQ for the matching homeowner units. In matching rental units with homeowner units, BLS takes into account their locations (must be in the same PSU), structure type (e.g., single-family dwellings), and whether the units have air conditioning.

The basis for determining REQ, however, is different from that used for residential rent in one important way. The rental value of homeowner units excludes utilities; the rents of residential renters include any utilities paid by landlords. A BLS official said that approximately 20 percent of the rental units have their utilities provided by the landlord. Therefore, according to the official, the cost of landlord-provided utilities is subtracted from the rent whenever it is used to calculate REQ.

BLS divides the rental units in the housing survey into six groups, with the units in each group to be contacted twice a year. For example, units in one group are priced in January and again 6 months later in July; units in a second group are contacted in February and again in August. BLS price takers are to record basic information about the rental unit, any extra charges paid for the unit, rent subsidies, and other information, such as any familial relationship between the renter and the landlord.

After the data have been collected by the price takers and entered into BLS' computer system, CRLs are generated for review by commodity analysts. CRLs are computer printouts of data for the units that have certain problems, inconsistencies, or changes requiring a commodity analyst's attention. Current and historical data are printed for each unit as well as the reason why a CRL was triggered.

The reasons that trigger the printing of a CRL include

- rent increases or decreases of 20 percent or more;

²In January 1999, BLS revised the CPI housing survey with a sample of housing units based on the 1990 Decennial Census and will update the sample with building permits for units built after 1990.

- a message from the price taker, such as the rent increased because a new tenant moved in, or the rent did not go up as much for one tenant as for other tenants because of the number of years the tenant had been renting;
- inconsistencies, such as a rental unit with “owner” data reported for it;
- a change in housing tenure, such as from renter to owner occupied;
- dollar values reported to questions in the survey instrument about free rent, rent reductions, or any extra charges;
- changes in utilities;
- any differences in house trailers, such as a new trailer on the same lot;
- structural changes, such as an addition of a bathroom; and
- anything that the commodity analyst has asked to be programmed for review in order to follow up on an unusual circumstance.

The housing commodity analysts use the CRLS to (1) review the units' eligibility for use in the CPI, (2) determine whether adjustments should be made for changes in the units, (3) identify problems that the price takers have in locating units or answering the questions on the CPI housing survey questionnaire, and (4) communicate with the price takers, (e.g., follow up on a particular issue). After the analysts have reviewed the CRLS and approved the information or made corrections, adjustments, or changes, the units are ready to be used in calculating the CPI.

The CPI measures rent price changes by comparing the rents tenants pay with the rent they paid 6 months earlier. Before the comparison is made, any necessary adjustments to the current rent for the month are to be made. Some adjustments are automatically identified and made during computer processing of the data. Others are identified by commodity analysts.

Adjustments for Changes in Units

Adjustments are made so that the same unit with the same features is priced each time (every 6 months). If a feature of the rental unit has changed, BLS makes a dollar adjustment to the current rent so the unit is comparable to what it was earlier. This adjustment is for that month and is not retained for future comparisons.

BLS does not make adjustments for ordinary maintenance (e.g., painting or replacing an appliance) as these mostly restore the unit to its earlier condition. However, when the landlord provides an appliance or service, BLS lowers the current rent because the cost to live in the unit has gone down. This situation would occur, for example, if the landlord installed a

clothes washer and dryer in the unit. The tenant would no longer have to use a laundromat (or privately owned washer and dryer).

However, if the landlord stops providing an appliance or service, BLS raises the current rent because the cost to live in the unit has gone up. This situation would occur, for example, if the rent for a unit no longer included the cost of electricity and the tenant had to begin paying for it separately.

BLS makes these adjustments even when the landlord adds or removes a feature but does not change the rent. It also makes these adjustments when the landlord raises the rent for adding an appliance or service or lowers the rent for removing something. In all of these cases, BLS is attempting to make the current unit comparable to what it was 6 months earlier when data were last collected. (This is the reverse of the adjustments made elsewhere in the CPI where adjustments are made to the previous version to make it comparable to the current version of the replacement.)

Any adjustments made to the current unit to make it comparable with what it was 6 months earlier are dropped after the comparison is made. Whatever features the current unit now includes become the basis against which the unit will be compared to 6 months in the future. For example, if an appliance were newly installed, BLS would adjust current rent, in effect, to remove the appliance. However, the data records for the unit would include this appliance for future comparisons because the renter's cost of living in the unit will have decreased.

BLS makes adjustments for changes to features of the rental unit; it does not make adjustments for changes in the tenants. For example, the landlord may charge a pet fee if a tenant has a pet and the previous tenants paid a fee. BLS would not show a decrease in rent if the new tenants did not have a pet and did not pay the fee. However, if the landlord stopped charging pet fees altogether, this decrease in rent would appear in the CPI.

In summary, if the value of the unit has gone up since data were last collected, a subtraction to the current month's rent is made. If it is costing more for the tenants to live there (by getting less than before), an addition to the current month's rent is made.

Adjustments Are Made by Computer and by Analysts

In calendar year 1997, approximately 6,180 adjustments were made because of changes in rental units. Nearly all (91 percent) of the adjustments were made automatically by computer routine without direct involvement of the housing commodity analysts. The other adjustments (9 percent) were made by housing commodity analysts. In addition to these adjustments, every rental unit is adjusted by computer routine for age depreciation.

Automatic Adjustments by Computer

The rent adjustments that are automatically identified and made by computer routine involve only direct adjustments. That is, the item or service in the housing unit that changed is clearly identifiable, and its cost can be reasonably calculated. According to BLS, automation of these direct adjustments saves the time and efforts of commodity analysts and enables calculations and adjustments to be made on a consistent basis. Computer routines adjust the rent automatically whenever the rental unit has a change in facilities, utilities, or structure.

Changes in Facilities

Prior to January 1999, facilities adjustments included additions or subtractions of dollar amounts for changes in the provision of appliances and parking. To determine the dollar amounts for changes in appliances, BLS used studies published in trade journals. The published average cost of the appliance was divided by its published average life in months to arrive at its monthly value. Example 1 at the end of this appendix provides an illustration of such an automatic adjustment.

Off-street parking costs are based on the PSU's average of such charges paid by tenants in the CPI housing survey. This adjustment is made, for example, if off-street parking is no longer provided by the landlord. According to BLS, adjustments are no longer made for changes in furnishings because apartments, BLS concluded, do not change in the provision of furnishings. They tend to stay furnished or unfurnished.

According to a BLS official, the data BLS used to make appliance adjustments are not up to date, and there is no cost-effective way to update them. He said that since the revision of the housing component in January 1999, BLS makes facilities adjustments for changes only in parking and air conditioning equipment. Since the majority of automatic direct adjustments are for changes in the provision of appliances, this will reduce the number of direct adjustments made to rental units.

Changes in Utilities

Utility adjustments are made when the landlord alters the provision of a utility, such as installing a separate meter for an apartment and making the tenant responsible for payment of the utility. BLS calculates the dollar amount of utility adjustments in two steps. First, BLS uses Department of Energy data to determine average consumption amounts by housing unit for electricity, gas, propane, and oil. These estimated amounts are based on the rental unit's location, number of heating and cooling degree days, number of rooms, and type of structure. Second, to compute the monthly cost, BLS multiplies the consumption amounts by the average price of electricity, gas, natural gas, or oil paid by households in the unit's PSU. The average price is based on data BLS collects monthly for the CPI.³

BLS calculates water and sewer utility adjustment dollar amounts by determining average bills from housing units in the CPI housing survey for each PSU. The survey gathers data from renters on the amount of their water and sewer bills.

As previously noted in this appendix, utility adjustments are only made to the residential rental units. No adjustment is made to REQ because it already excludes the cost of utilities.

**Depreciation and Changes in
Structure**

The dollar amounts for various structural changes (e.g., the addition of a bedroom or bathroom) and depreciation are based on estimates that come from regression-based formulas. The formulas account for the age of the unit and a number of structural characteristics. The dollar amounts from these formulas are then used to adjust residential rent and REQ for structural changes in the rental units. BLS recomputes these estimates annually.

Regression-based formulas have been used since January 1988 to account for the small loss in quality as housing units age (depreciate) over time. According to a BLS official, the age-bias regression is recomputed every year, and one-twelfth of the annual bias is applied by computer routine to every unit in the housing sample each month.

**Adjustments by
Commodity Analysts**

The housing commodity analysts make three types of adjustments: "pricing-links-cancel," "links-pause," and direct. Of the three types, the links-pause adjustment is by far the most frequently used. About

³BLS makes approximations of average costs for wood and coal heat by converting the standard amount of energy from a cord of wood or ton of coal into gallons of oil, and then using the average consumption and cost estimations for oil.

80 percent of the adjustments made by commodity analysts in 1997 were links-pause adjustments.

Pricing-Links-Cancel Adjustment

In the pricing-links-cancel adjustment, the analyst determines that the unit is no longer comparable to the unit for which the rent was collected 6 months earlier or that the old rent is no longer accurate for comparison. Examples of units that, according to BLS, are no longer comparable include: a house trailer that is replaced with a different trailer, a unit in which the price taker discovers that BLS has been pricing the wrong unit, or a unit in which a major structural change has occurred (e.g., the addition of a swimming pool) and BLS does not have a way to make an adjustment.

Examples cited by BLS of units for which the old rent is no longer accurate for comparison include: (1) a unit that the price taker recorded as government subsidized and for which the renter was not paying the full rent that was recorded 6 months earlier or (2) a unit in which the renter was related to the landlord and was not paying the full rent that was recorded 6 months earlier. Example 2 at the end of this appendix provides an illustration of a pricing-links-cancel adjustment for a rental unit whose old rent had been imputed because of a long-term vacancy and was therefore no longer appropriate for a price comparison.

The pricing-links-cancel adjustment treats the rental unit in the same way that the linking adjustment treats commodities and services substitutions that are not comparable (see app. VI). In the pricing-links-cancel adjustment, the weight of the rental unit is redistributed to housing units in the PSU of that rental unit. To do this redistribution, BLS uses the rental units in the PSU of the pricing-links-cancel that have usable prices—units that had a rent 6 months earlier from which a price change could be calculated—and a computer routine then calculates the average percentage change of these rents for that PSU. In effect, BLS assigns the PSU's average percentage change to the unit that is adjusted by the pricing-links-cancel method.

Links-Pause Adjustment

In the links-pause adjustment, the commodity analyst is suspicious of the accuracy of the current rent. In this adjustment, the current month's rent is not used in the CPI that month. The current month's rent is replaced with an imputed value that is based on rent changes of a subset of housing units in the unit's geographic location. In the next pricing cycle, the analyst will determine the accuracy of the reported rent.

Until confirmed, the unit's rent that was collected 6 months earlier is adjusted by computer routine. First, the computer calculates the average change in rent for units in a subset of housing units, which BLS refers to as a cell. All rental units are assigned to 1 of 18 cells in a PSU. These cells contain units that have similar characteristics based on the renter-owner ratio (e.g., the unit is in a location that has equal proportions of owners and renters) and on the level of rent paid (high, medium, and low). Next, the computer routine then applies the cell's rate of change to the unit's rent that was collected 6 months earlier. Any difference from a comparison of the imputed rent and the rent from 6 months earlier goes into computing the CPI for the current month.

Six months later, the analyst will use rent reported in that period to confirm the previous rent that the analyst thought was suspicious. If the two rents are dissimilar (that is, the suspicious rent is not confirmed and the rent 6 months later is similar to what it was a year earlier), the computer routine will compare the rent that was imputed 6 months earlier with the rent most recently collected. Alternatively, if the two rents are similar (that is, the previous rent is confirmed), then the commodity analyst will allow the large price change to enter the CPI at this time.

A links-pause adjustment is shown in example 3 where the unit in the Urbantown PSU had a May 1997 rent of \$513 and a November 1997 rent of \$158. The analyst questioned the accuracy of the current month's (November) rent because the information about the unit did not indicate a reason for such a decrease. As a result, the analyst decided to make a links-pause adjustment. Using the units with usable rents for November 1997 in that unit's cell, the computer routine calculated an average price increase of 3.3 percent. Next, the computer applied that increase to the unit's May 1997 rent and imputed a rent of \$530.208 ($\513×1.033). In this example the CPI calculations for November 1997 reflected a 3.3 percent increase for this rental unit and the additional rental and owner-occupied units it represents.

As further explained in example 3, BLS collected rent data on the unit again in May 1998 and generated a CRL for the unit for analyst review. The analyst used the May 1998 information about the unit to confirm the accuracy of the reported November 1997 rent. The information indicated that the tenancy of the unit changed from renter occupied to owner occupied. Since BLS does not use owner-occupied units in the CPI calculations, the unit was excluded from CPI calculations.

According to BLS officials, for the units where the links-pause adjustment is used, the price increase (or decrease) occurs but with a delay of 6 months (or, as in our example, does not occur). Nonetheless, BLS said the adjustment prevents large increases or decreases if the rent 6 months earlier was incorrect. They noted that the size of the inaccuracies during the lag is smaller than the errors that would be incorporated into the CPI if erroneous rents were used.

Direct Adjustment

According to a BLS official, the housing analysts also directly adjust a negligible number of units for changes in extra charges that result from unusual situations. He said these instances are the only occasion in which a commodity analyst directly enters in a dollar adjustment in the CPI. For example, a renter may have been paying an additional monthly fee to have a pet living in the apartment. If the pet dies, the renter no longer pays the pet fee. In these situations, the analyst will look in the historical data for the unit to determine the amount of the fee and add the extra charge to the current rent to make it comparable to the rent of 6 months earlier.

Addition and Deletion of Housing Units

The sample of housing units that BLS uses in calculating the CPI is not static and represents the housing stock of the urban population. Rental units are removed from the sample, and new units are added to the sample. According to a BLS official, rental units are removed when they no longer exist because they represent units that drop out of the housing stock. New rental units are added through new construction. According to BLS, the new units are not added to replace units that were removed; the new units are not considered to be substitutions, as would be the case for replacement of other nonrent items in the CPI.

In 1997, according to a BLS official, 14 rental units were removed from the housing survey because they no longer existed. Another official determined that about 15 percent of the rental units in the housing survey in 1997 entered the survey from new construction permits.

Rental units are lost to the housing sample for various reasons, such as destruction by floods, tornadoes, and urban renewal. Whenever a rental unit is lost, BLS does not replace it with another unit. In these instances, BLS removes the unit and, implicitly, the residential rental and REQ units it represents, from the computer system. However, according to BLS, if the building foundation for the lost unit still exists, the address is retained in the system and price takers are periodically sent to the address to see if the unit has been rebuilt.

Units are added to the CPI housing survey by using information that is collected by the Bureau of the Census. New construction permit information is obtained by Census from the appropriate government entities. Census then samples from that population of permits and sends the addresses of these new permits to BLS. BLS then adds the addresses to the housing sample with representation (weighting) for both residential rent and REQ in the same manner that it subtracts units that have been destroyed. Once the address is added, BLS continues to survey that location.

Accounting for Quality Change

Whenever a substitution is not comparable to the CPI item it replaced, BLS will make an adjustment to separate pure price change from price changes that are due to other factors, such as differences in quality. (BLS refers to these other factors under the general term quality.) Although BLS has accounted for this separation when making adjustments to nonrent items, it has not accounted for such a separation for the types of adjustments described in this appendix.

Nonetheless, we believe a case can be made for attributing part of a change in rent to price and another part to quality. We draw this view from two sets of similarities that exist between the types of adjustments BLS makes for rent and the adjustment methods it uses for nonrent items. One set of similarities involve rent adjustments made automatically by computer routine and the direct adjustment methods used for nonrent items. In order for these automatic adjustments to be made, there must be sufficient information about the change to a rental unit and its associated cost to directly adjust the rent. This is the case for the direct adjustments used elsewhere in the CPI; there must be sufficient information to directly adjust the price of the item. If BLS were to consider these adjustments to rent as direct adjustments, then the assumptions used to account for price and quality with the direct adjustment method would likely apply as well. As such, the implicit assumption would be that the entire amount of the adjustment could be accounted for as quality change. For example, in example 1 at the end of this appendix, 29 cents was subtracted from the unit's rent and this could be accounted for as a change in quality.

The second set of similarities involves the pricing-links-cancel and the links-pause adjustment methods used to adjust rent and the linking method used to adjust nonrent prices. Under each method, an average rate of price change is computed using other rents or other prices. Under the linking method, BLS assumes that any difference between the imputed

price and the price of the substitution is reflective of quality and, therefore, not to be included in the CPI. If BLS were to make this same assumption for the pricing-links-cancel and the links-pause adjustment methods, any difference—the residual—between the unit's recorded rent and the imputed rent could reflect quality differences between the current unit and what was recorded for it 6 months previously.

As previously stated, BLS has not made this accounting to price and quality for residential rent and REQ, which represent more than one-quarter of the CPI.

Examples of BLS' Adjustments for Residential Rent and REQ

The following three examples of BLS' adjustments to residential rent and REQ come from our interviews with three BLS housing commodity analysts. According to the commodity analysts and their section chief, these are examples of the adjustments that are made in residential rent and REQ. One example is of an adjustment made by computer routine without direct involvement of the housing commodity analysts. The other examples are of analysts' decisions to use two variations of the linking method. Generally, these are used when a rental unit is no longer comparable to the same unit for which the rent was collected 6 months earlier. In the table for each example, changes between the current unit and its characteristics 6 months earlier are shaded.

The examples include a calculation that shows the percentage changes in price that went into the CPI for that month as a result of the adjustments. These percentages are applicable only to the particular cases illustrated. They are not intended to be representative of the percentage changes that occurred for similar kinds of adjustments that are made. Nor is the percentage change intended to be representative of the impact that these adjustments have on the CPI.


Example 1 - Automatic Adjustment

As shown in table VII.1, the landlord made changes in the appliances furnished in the apartment. To account for the changes in the unit's appliances a direct adjustment was made by computer routine without the direct involvement of a commodity analyst.

**Appendix VII
Measurement of Residential and
Homeowners' Equivalent Rents**

Table VII.1: Characteristics of the Rental Unit

Description	6 months earlier	Current
Specifications		
Number of bedrooms	2	2
Number of bathrooms	1	1
Utilities included in rent	No	No
Heating fuel	Oil	Oil
Hot water fuel	Oil	Electricity
Dishwasher	Yes, supplied by landlord	None
Washing machine	None	Yes, supplied by landlord
Dryer	None	Yes, supplied by landlord
Price information		
Amount	\$500.00	\$500.00
As of	April	October

 Specifications that differ between old and new versions

Source: BLS.

Analyst's Reasons for Not-Comparable Decision

BLS has developed computer routines to identify changes in a rental unit's appliances and, when identified, to calculate with preprogrammed data the dollar value associated with those changes. Commodity analysts are not involved in making these adjustment decisions.

Rationale for Selecting the Method of Adjustment

Selecting a method of adjustment was not necessary.

Calculation of Price Change

According to BLS, a computer routine automatically added 50 cents to the unit's current rent for the removal of the dishwasher and subtracted 79 cents for the addition of a washing machine and clothes dryer. Since the landlord did not provide the utilities, a utility adjustment was not made by the computer. The computer then compared the adjusted current rent of the unit (\$499.71) to the rent for the unit 6 months earlier (\$500.00). The new rent was 29 cents less than the rent 6 months earlier, a decrease of 0 percent. In effect, no price change was entered for this unit into the data with which the CPI was computed for October 1997.

Example 2 - Pricing-Links-Cancel Adjustment

The rent for the unit increased significantly, as shown in table VII.2. The commodity analyst determined that the imputed April rent for the unit was not appropriate for comparison purposes and designated the pricing-links-cancel method to calculate the rate of price increase between April 1997 and October 1997.

**Table VII.2: Characteristics of the
Rental Unit**

Description	6 months earlier	Current
Specifications		
Number of bedrooms	3	3
Number of bathrooms	1 and a half bath	1 and a half bath
Landlord furnishes utilities	No	No
Price information		
Amount	\$271.325	\$400.00
As of	April 1997	October 1997
Collected/imputed	Imputed	Collected

Source: BLS.

Analyst's Reasons for Not-Comparable Decision

A lengthy period of vacancy for the unit suggested to the commodity analyst that the rental amounts for the unit for the two collection periods should not be compared. The CRL for the unit indicated that the rent had been imputed for more than 2 years; BLS has no standard or limit on how long rent can be imputed for a unit. The CRL did not indicate the origin of the rent on which the imputations were based. The analyst said that the price comparison for the CPI should not be based on a comparison of a collected rent with an imputed rent whose origin is unknown.

The analyst said another reason for not using the April rent was that the unit was in a small geographic area and that a large price increase of about 150 percent (increase from \$271 to \$400) could cause an upward bias in the CPI for that area.

Rationale for Selecting the Method of Adjustment

The analyst first looked at the percentage change in rent to see if it exceeded what BLS terms a "flinch point," a mathematically determined percentage change rate indicating that the change in rent is doubtful and should not be used in calculating the CPI for that month. According to BLS,

the use of the flinch point is a main criterion for making a links-pause adjustment—the other linking adjustment method used for rental units. The analyst noted that a percentage change of about 150 percent was about 3 points above the flinch point. Although this met the criterion, the amount of difference did not clearly indicate that holding the unit's October rent for 6 months was appropriate, which would occur with the other linking adjustment method.

Another factor the analyst considered was the geographic location of the unit. The two-story duplex was located in a small geographic area in which rental units were difficult to keep in the CPI housing survey. The analyst said that it was desirable to have units with collected rent data, rather than imputed rental amounts, included in CPI calculations. Therefore, the analyst chose the pricing-links-cancel method so the unit would be used in the next pricing period.

Calculation of Price Change

The calculation of price change for the pricing-links-cancel method is done automatically by computer routine without direct involvement of the commodity analyst. The method calculates a rate of price change based on other units that had usable rents and were located in the unit's geographic area. For these rental units, a 0.12 percent rate of change was calculated for October 1997. This means that the CPI in October 1997 reflected this same percentage of increase for this rental unit and the owner-occupied units it represents.

Example 3 - Links-Pause Adjustment

As shown in table VII.3, the rent for the unit increased significantly. The commodity analyst determined that the November rent for the unit could be inaccurate and designated the links-pause method to calculate the rate of price increase between May 1997 and November 1997.

**Appendix VII
Measurement of Residential and
Homeowners' Equivalent Rents**

Table VII.3: Characteristics of the Rental Unit

Description	6 months earlier	Current
Specifications		
Number of bedrooms	1	1
Number of bathrooms	1	1
Landlord furnishes utilities	Yes	Yes
Price information		
Amount	\$513.27	\$157.78
As of	May 1997	November 1997

Source: BLS.

Analyst's Reasons for Not-Comparable Decision

A rent decrease of 69 percent suggested to the commodity analyst that the unit in November had changed in some major way from what was recorded for it in May and was no longer comparable.

Rationale for Selecting the Method of Adjustment

The analyst used two criteria to determine which linking method to use. The first was whether the percentage change in rent exceeded the flinch point. The rent change met this first criterion. The second consideration was whether the same tenants lived there. The analyst indicated that a change in tenants might explain a large change in rent. The information on this housing unit indicated that these were the same tenants. Since both criteria were met, the analyst indicated that the links-pause method would be used for this unit.

Calculation of Price Change

BLS took two actions, 6 months apart, that affected the calculations of price change for this rental unit. For the current month (November 1997), the links-pause designation caused a computer routine to calculate a rate of price change based on a subset of other units that were similar to this rental unit. These similar units were in Urbantown and had usable rents. For the subset of units, a 3.3 percent increase was calculated for November 1997. This means that the CPI in November 1997 reflected a 3.3 percent increase for this rental unit and the owner-occupied units it represents.

BLS collected information on this unit again in May 1998 and, on the basis of this information, decided that no calculation should be made. BLS

**Appendix VII
Measurement of Residential and
Homeowners' Equivalent Rents**

learned that the tenancy for the unit changed from renter occupied to owner occupied. Because BLS does not use owner-occupied units in making the monthly CPI calculations, it excluded the unit from the May 1998 CPI calculation. According to BLS, the unit will remain excluded from the CPI as long as it is owner occupied. However, the unit would be returned to the CPI calculation if it again becomes a rental unit.

CPI Price Quotations, Substitutions, and Methods of Adjustment for 1997

Table VIII.1 contains information on the relative importance and summary data on CPI price quotations; substitutions; and methods of adjustment by major component, expenditure class, item stratum, and entry level item (ELI) for 1997.

While most column headings in the table are self-explanatory, we believe that three require some explanation. They are the columns on relative importance, percent of quotations with price changes, and class mean and/or overlap. Relative importance shows the share of total expenditures that would occur if consumed quantities of the items at the stratum level remained constant. Relative importance is a concept that is related to expenditure weights, but unlike those weights, which have been recomputed only about every 10 years or so, BLS computes relative importance at least annually to reflect the effect of price changes. Relative importance can be used to show the direct effect an item has on the overall CPI price change. (See app. II for further information about relative importance and expenditure weights.)

The price quotations represented by the percent of quotations with price changes include both those where an increase in price occurred and those where a decrease in price occurred. Also, these changes in prices were for goods and services for which a substitution was made and those for which no substitution was made.¹

The class-mean and/or overlap column combines the number of adjustments made by both methods. BLS was unable to separate the number of each of these methods by ELI, but officials told us that nearly all of the substitutions listed in this column were adjusted by using the class-mean method. This is because BLS has been phasing out use of the overlap adjustment method.

Table VIII.1 includes two overall totals: all items with residential rent units and all items without residential rent units. Because the adjustments made by BLS to residential rent differ from those made elsewhere in the CPI, we present the totals separately. See appendix VII for information on how adjustments are made to rental units. In table VIII.1 these adjustments are reported in the residential rent ELI under the housing component.

Table VIII.1 is further organized as follows: The broadest of the categories are the seven major components. Components are indicated as totals (e.g.,

¹According to BLS, this column excludes substitutions for which there was no price change between the two versions of the item.

food and beverages component totals). Under each component is the expenditure class category, the next broadest category. Expenditure class appears bolded in the table (e.g., cereal and cereal products). Adding all of the numbers in the expenditure class for a given column will equal the major component total. Under expenditure class are the item strata, which when totaled in a given column will equal the reported subtotals for expenditure class. For example, under the expenditure class of cereal and cereal products the item strata are “flour and prepared flour mixes”; “cereal”; and “rice, pasta, and cornmeal.”

The final category, as well as the most specific, is the ELI. For example, under the item stratum of flour and prepared flour mixes are the two ELIS, “flour” and “prepared flour mixes.” In some cases, only one ELI existed for a single item stratum. When the item stratum and the ELI were the same and the stratum was not broken down into additional ELIS, we deleted the ELI from the table. By doing so, we avoided duplication of information, since the numbers for both the stratum and the ELI were identical. ELIS do not have relative importance assigned to them; and, where noted in the table, some ELIS are not priced.

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Table VIII.1: Relative Importance and Summary Data on CPI Price Quotations, Substitutions, and Methods of Adjustment by Categories for 1997

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
All items (with residential rent units)	100.000%	918,561	n/a	35,061
All items (without residential rent units)	74.309	872,829	n/a	28,881
Food and beverages component total	17.465	459,635	n/a	6,485
Cereal and cereal products	0.449	19,574	25.0%	279
Flour and prepared flour mixes	0.075	6,507	27.0	90
Flour	a	2,027	29.0	14
Prepared flour mixes	a	4,480	26.1	76
Cereal	0.272	6,516	23.8	116
Rice, pasta, and cornmeal	0.102	6,551	24.4	73
Rice	a	3,085	23.2	37
Macaroni, similar products, and cornmeal	a	3,466	25.4	36
Bakery products	1.027	24,431	26.2	494
White bread	0.260	6,249	23.3	78
Other breads, rolls, biscuits, and muffins	0.239	6,124	24.3	142
Bread other than white	a	3,538	27.8	70
Rolls, biscuits, and muffins, excluding frozen	a	2,586	19.5	72
Cakes, cupcakes, and cookies	0.249	6,274	27.7	141
Cakes and cupcakes, excluding frozen	a	2,433	19.5	64
Cookies	a	3,841	32.9	77
Other bakery products	0.279	5,784	29.9	133
Crackers	a	2,279	39.7	27
Bread and cracker products	a	140	25.7	3
Sweetrolls, coffee cake, and doughnuts, excluding frozen	a	1,404	18.1	47
Frozen bakery products, frozen and refrigerated doughs, and batters	a	1,241	26.8	22
Pies, tarts, and turnovers, excluding frozen	a	720	27.9	34
Beef and veal	0.933	47,442	46.4	312
Ground beef	0.309	6,302	43.0	35

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
3.8%	n/a	n/a	18,311	9,411	4,049	4,851
3.3	16,750	58.0%	12,131	3,770	4,049	4,312
1.4	3,640	56.1	2,845	107	31	2,707
1.4	163	58.4	116	6	2	108
1.4	57	63.3	33	2	1	30
0.7	9	64.3	5	0	1	4
1.7	48	63.2	28	2	0	26
1.8	65	56.0	51	3	1	47
1.1	41	56.2	32	1	0	31
1.2	23	62.2	14	0	0	14
1.0	18	50.0	18	1	0	17
2.0	229	46.4	265	15	1	249
1.3	45	57.7	33	2	0	31
2.3	67	47.2	75	2	0	73
2.0	29	41.4	41	0	0	41
2.8	38	52.8	34	2	0	32
2.3	48	34.0	93	4	0	89
2.6	17	26.6	47	0	0	47
2.0	31	40.3	46	4	0	42
2.3	69	51.9	64	7	1	56
1.2	17	63.0	10	1	0	9
2.1	0	0.0	3	0	0	3
3.4	19	40.4	28	2	1	25
1.8	10	45.5	12	2	0	10
4.7	23	67.6	11	2	0	9
0.7	87	27.9	225	0	7	218
0.6	19	54.3	16	0	0	16

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Chuck roast	0.083	5,910	53.5	40
Round roast	0.048	5,824	51.5	31
Round steak	0.076	5,989	46.6	41
Sirloin steak	0.072	5,924	47.3	33
Other steak, roast, and other beef	0.345	17,493	43.0	132
Other roasts, excluding chuck and round	a	2,521	40.1	23
Other steak, excluding round and sirloin	a	10,900	46.4	74
Other beef	a	4,072	35.8	35
Pork	0.595	29,378	42.3	446
Bacon	0.112	6,056	38.6	93
Pork chops	0.137	6,249	46.9	18
Ham	0.138	5,298	44.6	179
Ham, excluding canned	a	5,013	46.3	173
Canned ham	a	285	14.0	6
Other pork, including sausage	0.208	11,775	40.7	156
Pork roasts, picnics, and other pork	a	6,718	44.8	88
Pork sausage	a	5,057	35.1	68
Other meats	0.393	12,020	27.6	261
Frankfurters	a	2,627	35.4	55
Bologna, liverwurst, and salami	a	2,852	24.5	43
Other lunchmeats, excluding bologna, liverwurst, and salami	a	5,521	26.3	143
Lamb, organ meats, and game	a	1,020	23.1	20
Poultry	0.439	17,348	36.9	463
Fresh whole chicken	0.148	5,996	37.0	118
Fresh or frozen chicken parts	0.205	6,092	39.3	78
Other poultry	0.086	5,260	34.0	267
Fish and seafood	0.373	12,036	32.1	215
Canned fish and seafood	0.072	6,469	26.4	102
Fresh or frozen fish and seafood	0.301	5,567	38.7	113
Shellfish, excluding canned	a	1,646	32.6	34

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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
0.7	6	15.0	34	0	1	33
0.5	6	19.4	25	0	2	23
0.7	9	22.0	32	0	1	31
0.6	12	36.4	21	0	1	20
0.8	35	26.5	97	0	2	95
0.9	5	21.7	18	0	1	17
0.7	21	28.4	53	0	1	52
0.9	9	25.7	26	0	0	26
1.5	247	55.4	199	0	5	194
1.5	62	66.7	31	0	0	31
0.3	5	27.8	13	0	2	11
3.4	95	53.1	84	0	0	84
3.5	93	53.8	80	0	0	80
2.1	2	33.3	4	0	0	4
1.3	85	54.5	71	0	3	68
1.3	45	51.1	43	0	3	40
1.3	40	58.8	28	0	0	28
2.2	160	61.3	101	0	0	101
2.1	35	63.6	20	0	0	20
1.5	20	46.5	23	0	0	23
2.6	90	62.9	53	0	0	53
2.0	15	75.0	5	0	0	5
2.7	398	86.0	65	0	2	63
2.0	109	92.4	9	0	0	9
1.3	59	75.6	19	0	1	18
5.1	230	86.1	37	0	1	36
1.8	124	57.7	91	3	1	87
1.6	67	65.7	35	3	0	32
2.0	57	50.4	56	0	1	55
2.1	18	52.9	16	0	0	16

(continued)

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CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Fish, excluding canned	a	3,921	41.3	79
Eggs	0.187	6,500	63.1	38
Fresh milk and cream	0.61	12,970	34.5	125
Fresh whole milk	0.352	6,545	35.1	56
Other fresh milk and cream	0.257	6,425	34.0	69
Processed dairy products	0.608	19,066	31.6	308
Cheese	0.338	6,380	31.5	123
Ice cream and related products	0.157	6,396	29.0	96
Other dairy products, including butter	0.113	6,290	34.4	89
Butter	a	2,152	50.0	21
Other dairy products	a	4,138	26.3	68
Fresh fruits	0.740	43,203	51.3	118
Apples	0.116	8,460	41.5	21
Bananas	0.067	6,493	37.8	1
Oranges, including tangerines	0.084	7,531	53.9	40
Other fresh fruits	0.474	20,719	58.6	56
Fresh vegetables	0.631	31,291	53.4	62
Potatoes	0.100	6,320	46.3	23
Lettuce	0.077	6,396	55.3	1
Tomatoes	0.115	6,204	66.4	18
Other fresh vegetables	0.339	12,371	49.5	20
Processed fruits	0.349	19,567	28.3	354
Fruit juices and frozen fruit	0.273	12,963	33.0	229
Frozen orange juice	a	2,415	33.0	21
Other frozen fruits and fruit juices	a	1,154	26.8	12
Fresh, canned, and/or bottled fruit juices	a	9,394	31.5	196
Canned and dried fruits	0.077	6,604	22.2	125
Processed vegetables	0.261	13,020	26.6	200
Frozen vegetables	0.087	6,434	29.5	104
Processed vegetables, excluding frozen	0.174	6,586	23.9	96
Canned beans other than lima	a	926	24.3	10
Canned cut corn	a	854	28.9	9
Other processed vegetables	a	4,806	22.9	77

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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
2.0	39	49.4	40	0	1	39
0.6	22	57.9	16	0	0	16
1.0	102	81.6	23	0	0	23
0.9	46	82.1	10	0	0	10
1.1	56	81.2	13	0	0	13
1.6	180	58.4	128	0	3	125
1.9	72	58.5	51	0	1	50
1.5	56	58.3	40	0	2	38
1.4	52	58.4	37	0	0	37
1.0	12	57.1	9	0	0	9
1.6	40	58.8	28	0	0	28
0.3	80	67.8	38	0	0	38
0.3	14	66.7	7	0	0	7
0.0	0	0.0	1	0	0	1
0.5	32	80.0	8	0	0	8
0.3	34	60.7	22	0	0	22
0.2	43	69.4	19	0	0	19
0.4	15	65.2	8	0	0	8
0.0	0	0.0	1	0	0	1
0.3	16	88.9	2	0	0	2
0.2	12	60.0	8	0	0	8
1.8	242	68.4	112	0	1	111
1.8	145	63.3	84	0	1	83
0.9	13	61.9	8	0	0	8
1.0	6	50.0	6	0	0	6
2.1	126	64.3	70	0	1	69
1.9	97	77.6	28	0	0	28
1.5	146	73.0	54	0	3	51
1.6	76	73.1	28	0	0	28
1.5	70	72.9	26	0	3	23
1.1	7	70.0	3	0	0	3
1.1	6	66.7	3	0	0	3
1.6	57	74.0	20	0	3	17

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Sugar and sweets	0.332	11,935	19.2	187
Sugar and artificial sweeteners	0.085	5,810	21.8	74
Sweets, including candy	0.247	6,125	16.7	113
Candy and chewing gum	a	4,675	14.8	91
Other sweets, excluding candy and gum	a	1,450	22.8	22
Fats and oils	0.241	13,191	24.6	137
Margarine	a	1,999	25.7	22
Other fats and oils	a	7,583	23.3	83
Nondairy cream substitutes	a	1,571	22.3	13
Peanut butter	a	2,038	29.9	19
Nonalcoholic beverages	0.747	19,262	31.7	267
Carbonated drinks	0.348	6,639	35.3	69
Cola drinks	a	4,046	38.5	26
Carbonated drinks other than cola	a	2,593	30.2	43
Coffee	0.263	6,314	37.8	83
Roasted coffee	a	3,685	44.3	50
Instant and freeze dried coffee	a	2,629	28.8	33
Other noncarbonated drinks	0.136	6,309	21.9	115
Noncarbonated fruit-flavored drinks	a	2,079	21.8	34
Tea	a	1,856	22.0	23
Other noncarbonated drinks	a	2,374	22.0	58
Other prepared foods	1.046	31,997	26.9	506
Canned and packaged soup	0.096	6,504	25.5	90
Frozen prepared food	0.165	6,185	36.1	146
Frozen prepared meals	a	2,213	37.1	69
Frozen prepared foods other than meals	a	3,972	35.5	77
Snacks	0.205	6,321	24.7	124
Potato chips and other snacks	a	5,098	25.2	101
Nuts	a	1,223	22.7	23
Seasonings, condiments, sauces, and spices	0.282	6,539	22.6	77
Salt, other seasoning, and spices	a	1,447	15.6	16
Olives, pickles, and relishes	a	713	26.0	11

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
1.6	104	55.6	83	0	0	83
1.3	38	51.4	36	0	0	36
1.8	66	58.4	47	0	0	47
2.0	54	59.3	37	0	0	37
1.5	12	54.6	10	0	0	10
1.0	97	70.8	40	0	0	40
1.1	18	81.8	4	0	0	4
1.1	55	66.3	28	0	0	28
0.8	11	84.6	2	0	0	2
0.9	13	68.4	6	0	0	6
1.4	169	63.3	98	9	2	87
1.0	46	66.7	23	3	0	20
0.6	17	65.4	9	0	0	9
1.7	29	67.4	14	3	0	11
1.3	50	60.2	33	3	1	29
1.4	34	68.0	16	1	0	15
1.3	16	48.5	17	2	1	14
1.8	73	63.5	42	3	1	38
1.6	20	58.8	14	0	0	14
1.2	15	65.2	8	1	1	6
2.4	38	65.5	20	2	0	18
1.6	273	54.0	233	11	3	219
1.4	47	52.2	43	1	1	41
2.4	79	54.1	67	4	1	62
3.1	39	56.5	30	3	0	27
1.9	40	52.0	37	1	1	35
2.0	62	50.0	62	0	0	62
2.0	50	49.5	51	0	0	51
1.9	12	52.2	11	0	0	11
1.2	35	45.5	42	3	0	39
1.1	8	50.0	8	2	0	6
1.5	6	54.6	5	0	0	5

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Sauces and gravies	a	3,269	26.2	41
Other condiments, excluding olives, pickles, and relishes	a	1,110	19.2	9
Miscellaneous prepared food, including baby food	0.299	6,448	25.9	69
Canned or packaged salads and desserts	a	638	27.4	12
Baby food	a	1,389	22.0	10
Other canned or packaged prepared foods	a	4,421	26.8	47
Food away from home	5.923	60,536	13.9	1,336
Lunch	2.097	21,256	13.6	431
Dinner	2.512	27,850	14.0	665
Other meals and snacks	1.004	11,430	14.0	240
Snacks and nonalcoholic beverages	a	8,413	13.9	209
Breakfast or brunch	a	3,017	14.2	31
Unpriced board and catered affairs ^b	0.310	0	0.0	0
Alcoholic beverages	0.813	14,868	23.7	377
Beer, ale, and other alcoholic malt beverages at home	0.415	3,919	30.3	64
Distilled spirits	0.209	3,803	23.1	27
Whiskey at home	a	1,553	25.3	9
Distilled spirits at home, excluding whiskey	a	2,250	21.5	18
Wine at home	0.189	3,844	28.6	194
Alcoholic beverages away from home	0.765	3,302	10.8	92
Beer, ale, and other alcoholic malt beverages away from home	a	1,333	9.7	30
Wine away from home	a	834	10.4	42
Distilled spirits away from home	a	1,135	12.3	20
Housing component total	41.469	182,162	n/a	10,254
Renters' costs	8.169	70,792	n/a	6,524
Rent, residential	5.810	45,732	n/a	6,180
Lodging while out of town	2.089	22,889	39.0	297
Lodging while at school	0.236	390	47.4	24

**Appendix VIII
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
1.3	15	36.6	26	1	0	25
0.8	6	66.7	3	0	0	3
1.1	50	72.5	19	3	1	15
1.9	11	91.7	1	0	0	1
0.7	8	80.0	2	1	0	1
1.1	31	66.0	16	2	1	13
2.2	533	39.9	803	41	1	761
2.0	175	40.6	256	10	0	246
2.4	279	42.0	386	19	0	367
2.1	79	32.9	161	12	1	148
2.5	68	32.5	141	10	1	130
1.0	11	35.5	20	2	0	18
0.0	0	0.0	0	0	0	0
2.5	241	63.9	136	22	0	114
1.6	36	56.3	28	5	0	23
0.7	17	63.0	10	2	0	8
0.6	5	55.6	4	1	0	3
0.8	12	66.7	6	1	0	5
5.1	145	74.7	49	2	0	47
2.8	43	46.7	49	13	0	36
2.3	12	40.0	18	6	0	12
5.0	21	50.0	21	4	0	17
1.8	10	50.0	10	3	0	7
5.6	n/a	n/a	7,774	5,773	1,023	978
9.8	n/a	n/a	6,228	5,658	0	570
13.5	n/a	n/a	6,180	5,641 ^c	0	539
1.3	264	88.9	33	12	0	21
6.2	12	50.0	12	5	0	7

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Tenants' insurance	0.034	1,781	10.1	23
Rental equivalence and household insurance	20.269	d	d	d
Owners' equivalent rent	19.881	e	e	e
Household insurance	0.388	f	f	f
Maintenance and repair services	0.202	457	19.3	17
Property maintenance and repair services	0.126	457	19.3	17
Inside home maintenance and repair services	a	381	17.3	8
Repair and/or replacement of hard surface flooring	a	0	0.0	0
Replacement of installed wall-to-wall carpet	a	76	29.0	9
Repair of disposal, built-in dishwasher, and range hood	a	0	0.0	0
Maintenance and repair commodities	0.076	1,637	15.6	57
Materials, supplies, and equipment for home repairs	0.034	825	19.5	29
Paint, wallpaper, and supplies	a	408	20.1	13
Tools and equipment for painting	a	61	19.7	4
Lumber, paneling, wall and ceiling tile, awnings, and glass	a	179	25.1	4
Blacktop and masonry materials	a	23	17.4	0
Plumbing supplies and equipment	a	67	6.0	1
Electrical supplies and heating and cooling equipment	a	87	16.1	7
Other maintenance and repair commodities	0.042	812	11.7	28
Miscellaneous supplies and equipment	a	609	9.2	22
Hard surface floor covering	a	136	16.2	4
Landscaping items	a	67	25.4	2
Fuel oil and other fuels	0.368	5,297	43.0	23
Fuel oil	0.254	2,383	55.4	9

**Appendix VIII
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
1.3	20	87.0	3	0	0	3
d	d	d	d	d	d	d
e	e	e	e	e	e	e
f	f	f	f	f	f	f
3.7	2	11.8	15	1	0	14
3.7	2	11.8	15	1	0	14
2.1	2	25.0	6	0	0	6
0.0	0	0.0	0	0	0	0
11.8	0	0.0	9	1	0	8
0.0	0	0.0	0	0	0	0
3.5	37	64.9	20	2	0	18
3.5	20	69.0	9	1	0	8
3.2	8	61.5	5	0	0	5
6.6	3	75.0	1	0	0	1
2.2	3	75.0	1	1	0	0
0.0	0	0.0	0	0	0	0
1.5	1	100.0	0	0	0	0
8.1	5	71.4	2	0	0	2
3.4	17	60.7	11	1	0	10
3.6	15	68.2	7	1	0	6
2.9	1	25.0	3	0	0	3
3.0	1	50.0	1	0	0	1
0.4	12	52.2	11	6	0	5
0.4	4	44.4	5	2	0	3

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Other household fuel commodities	0.113	2,914	32.9	14
Bottled or tank gas	a	2,073	35.4	8
Coal	a	0	0.0	0
Other fuels	a	841	26.8	6
Gas (piped) and electricity	3.401	28,152	51.4	123
Electricity	2.265	15,586	40.6	78
Utility natural gas service	1.136	12,566	64.9	45
Other utilities and public services	3.246	28,653	13.4	260
Telephone services, local charges	1.115	6,450	12.7	26
Interstate toll calls	0.305	5,265	18.5	34
Intrastate toll calls	0.227	5,674	6.9	23
Water and sewerage maintenance	0.795	4,112	10.9	42
Community antenna and cable television	0.582	3,867	25.2	93
Garbage and trash collection	0.221	3,285	7.4	42
Textile house furnishings	0.313	3,898	34.7	289
Bathroom linens	a	679	35.2	55
Bedroom linens	a	1,638	39.1	130
Kitchen and dining room linens	a	220	23.2	22
Curtains and drapes	a	648	36.6	42
Slipcovers and decorative pillows	a	106	23.6	12
Sewing materials for household items	a	607	26.4	28
Furniture and bedding	1.089	7,469	32.9	566
Bedroom furniture	0.361	2,154	31.4	142
Mattress and springs	a	941	33.1	65
Bedroom furniture other than mattress and springs	a	1,213	30.2	77
Sofas	0.225	1,330	33.6	103
Living room chairs and tables	0.179	1,341	33.4	105
Living room chairs	a	871	36.6	84
Living room tables	a	470	27.5	21
Other furniture	0.324	2,644	33.6	216

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method				
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking	
0.5	8	57.1	6	4	0	2	
0.4	4	50.0	4	2	0	2	
0.0	0	0.0	0	0	0	0	
0.7	4	66.7	2	2	0	0	
0.4	98	79.7	25	14	0	11	
0.5	63	80.8	15	14	0	1	
0.4	35	77.8	10	0	0	10	
0.9	173	66.5	87	54	0	33	
0.4	17	65.4	9	0	0	9	
0.7	2	5.9	32	32	0	0	
0.4	16	69.6	7	0	0	7	
1.0	34	81.0	8	6	0	2	
2.4	85	91.4	8	2	0	6	
1.3	19	45.2	23	14	0	9	
7.4	187	64.7	102	0	99	3	
8.1	39	70.9	16	0	16 ⁹	0	
7.9	86	66.2	44	0	42 ⁹	2	
10 ^a 0	12	54.6	10	0	9 ⁹	1	
6.5	24	57.1	18	0	18 ⁹	0	
11.3	6	50.0	6	0	6 ⁹	0	
4.6	20	71.4	8	0	8 ⁹	0	
7.6	238	42.1	328	0	320	8	
6.6	60	42.3	82	0	80	2	
6.9	32	49.2	33	0	32 ⁹	1	
6.4	28	36.4	49	0	48 ⁹	1	
7.7	51	49.5	52	0	49 ⁹	3	
7.8	42	40.0	63	0	62	1	
9.6	35	41.7	49	0	49 ⁹	0	
4.5	7	33.3	14	0	13 ⁹	1	
8.2	85	39.4	131	0	129	2	

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Kitchen and dining room furniture	a	1,193	34.5	84
Infants' furniture	a	253	23.3	19
Outdoor furniture	a	201	43.8	39
Occasional furniture	a	997	33.0	74
Television and sound equipment	0.385	5,327	36.9	711
Television sets	0.128	2,170	43.3	306
Video products other than televisions	0.065	683	32.9	108
Video cassette recorders, disc players, cameras, and accessories	a	376	41.0	63
Video cassettes and discs, blank and prerecorded	a	236	18.2	28
Video game hardware, software, and accessories	a	71	39.4	17
Audio components, radios, recordings, and other audio equipment	0.192	2,474	32.3	297
Radios, phonographs, and tape recorders and players	a	293	39.9	43
Components and other sound equipment	a	961	32.3	148
Records and tapes, prerecorded and blank	a	1,220	17.8	106
Unpriced accessories for electronic equipment ^b	0.000	0	0.0	0
Household appliances	0.274	3,124	46.4	287
Refrigerators and home freezers	0.084	819	47.6	79
Laundry equipment	0.092	820	47.0	60
Washers	a	507	48.3	43
Dryers	a	313	44.7	17
Stoves, ovens, portable dishwashers, and window air conditioners	0.098	1,485	45.5	148
Stoves and ovens, excluding microwave ovens	a	576	47.2	55
Microwave ovens	a	658	45.7	80
Portable dishwashers	a	24	25.0	1
Window air conditioners	a	227	42.3	12

**Appendix VIII
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
7.0	27	32.1	57	0	56 ⁹	1
7.5	11	57.9	8	0	7 ⁹	1
19.4	24	61.5	15	0	15 ⁹	0
7.4	23	31.1	51	0	51 ⁹	0
13.4	438	61.6	273	5	264	4
14.1	191	62.4	115	1	113 ⁹	1
15.8	76	70.4	32	3	28	1
16.8	44	69.8	19	0	19 ⁹	0
11.9	22	78.6	6	3	3 ⁹	0
23.9	10	58.8	7	0	6 ⁹	1
12.0	171	57.6	126	1	123	2
14.7	18	41.9	25	0	25 ⁹	0
15.4	60	40.5	88	0	87 ⁹	1
8.7	93	87.7	13	1	11 ⁹	1
0.0	0	0.0	0	0	0	0
9.2	263	91.6	24	0	23	1
9.7	72	91.1	7	0	7 ⁹	0
7.3	59	98.3	1	0	1	0
8.5	43	100.0	0	0	0 ⁹	0
5.4	16	94.1	1	0	1 ⁹	0
10.0	132	89.2	16	0	15	1
9.6	49	89.1	6	0	6 ⁹	0
12.2	74	92.5	6	0	5 ⁹	1
4.2	0	0.0	1	0	1 ⁹	0
5.3	9	75.0	3	0	3 ⁹	0

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Information processing equipment	0.064	649	42.4	119
Personal computers and peripheral equipment	a	375	57.6	103
Computer software and accessories	a	97	21.7	9
Telephone, peripheral equipment, and accessories	a	125	26.4	6
Calculators, adding machines, and typewriters	a	41	4.9	1
Other information processing equipment	a	11	27.3	0
Other household equipment and furnishings	1.107	9,383	26.8	784
Floor and window coverings, and outdoor, infants', laundry, and cleaning equipment	0.176	1,533	25.2	101
Floor coverings	a	544	21.7	38
Window coverings	a	519	29.7	13
Infants' equipment	a	111	23.4	10
Laundry and cleaning equipment	a	271	18.8	29
Outdoor equipment	a	88	42.1	11
Clocks, lamps, and decorator items	0.218	1,570	26.1	181
Clocks	a	80	21.3	9
Lamps and lighting fixtures	a	353	29.8	37
Household decorative items	a	1,137	25.2	135
Tableware, serving pieces, and nonelectric kitchenware	0.198	1,790	24.3	162
Plastic dinnerware	a	30	10.0	1
China and other dinnerware	a	389	31.6	42
Flatware	a	223	29.6	18
Glassware	a	228	24.1	17
Silver serving pieces	a	0	0.0	0
Serving pieces other than silver or glass	a	57	33.3	4
Nonelectric cookware	a	236	24.6	19
Tableware and nonelectric kitchenware	a	627	17.7	61

**Appendix VIII
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
18.3	67	56.3	52	0	0	52
27.5	59	57.3	44	0	0	44
9.3	5	55.6	4	0	0	4
4.8	2	33.3	4	0	0	4
2.4	1	100.0	0	0	0	0
0.0	0	0.0	0	0	0	0
8.4	443	56.5	341	5	317	19
6.6	56	55.5	45	1	43	1
7.0	22	57.9	16	1	14 ⁹	1
2.5	10	76.9	3	0	3 ⁹	0
9.0	7	70.0	3	0	3 ⁹	0
10.7	14	48.3	15	0	15 ⁹	0
12.5	3	27.3	8	0	8 ⁹	0
11.5	97	53.6	84	0	80	4
11.3	4	44.4	5	0	5 ⁹	0
10.5	23	62.2	14	0	13 ⁹	1
11.9	70	51.9	65	0	62 ⁹	3
9.1	74	45.7	88	1	83	4
3.3	1	100.0	0	0	0 ⁹	0
10.8	19	45.2	23	1	20 ⁹	2
8.1	10	55.6	8	0	8 ⁹	0
7.5	7	41.2	10	0	9 ⁹	1
0.0	0	0.0	0	0	0	0
7.0	1	25.0	3	0	3 ⁹	0
8.1	9	47.4	10	0	10 ⁹	0
9.7	27	44.3	34	0	33 ⁹	1

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Lawn and garden equipment, tools, and hardware	0.173	1,665	24.1	109
Lawn and garden equipment	a	819	33.7	80
Power tools	a	339	16.2	11
Other hardware	a	263	11.8	9
Nonpowered hand tools	a	244	16.0	9
Small kitchen appliances, sewing machines, and portable heating and cooling equipment	0.113	1,615	32.8	144
Floor cleaning equipment and sewing machines	a	597	38.5	63
Portable heating and cooling equipment, and small electric kitchen appliances	a	1,018	29.5	81
Indoor plants and fresh cut flowers	0.150	1,210	29.1	87
Unpriced household equipment parts and small furnishings ^b	0.079	0	0.0	0
Housekeeping supplies	1.090	10,013	23.8	446
Laundry and cleaning products	0.380	4,170	25.1	144
Soaps and detergents	a	2,512	26.6	97
Other laundry and cleaning products	a	1,658	23.0	47
Household paper products, including stationery	0.364	2,974	22.1	195
Cleansing and toilet tissue, paper towels, and napkins	a	1,531	27.3	53
Stationery, stationery supplies, and gift wrap	a	1,443	16.5	142
Other household products, lawn, and garden supplies	0.346	2,869	23.6	107
Miscellaneous household products	a	2,111	23.4	61
Lawn and garden supplies	a	758	24.0	46
Housekeeping services	1.492	7,311	6.6	48
Postage	0.254	1,578	0.0	0
Appliance and furniture repair	0.182	817	8.6	3
Repair of television, radio, and sound equipment	a	415	4.6	0
Repair of household appliances	a	229	18.8	1

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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method				
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking	
6.6	88	80.7	21	1	20	0	
9.8	69	86.3	11	1	10 ⁹	0	
3.2	7	63.6	4	0	4 ⁹	0	
3.4	7	77.8	2	0	2 ⁹	0	
3.7	5	55.6	4	0	4 ⁹	0	
8.9	93	64.6	51	1	45	5	
10.6	48	76.2	15	1	14 ⁹	0	
8.0	45	55.6	36	0	31 ⁹	5	
7.2	35	40.2	52	1	46 ⁹	5	
0.0	0	0.0	0	0	0	0	
4.5	206	46.2	240	19	0	221	
3.5	58	40.3	86	5	0	81	
3.9	35	36.1	62	3	0	59	
2.8	23	48.9	24	2	0	22	
6.6	95	48.7	100	12	0	88	
3.5	16	30.2	37	7	0	30	
9.8	79	55.6	63	5	0	58	
3.7	53	49.5	54	2	0	52	
2.9	31	50.8	30	2	0	28	
6.1	22	47.8	24	0	0	24	
0.7	20	41.7	28	9	0	19	
0.0	0	0.0	0	0	0	0	
0.4	1	33.3	2	1	0	1	
0.0	0	0.0	0	0	0	0	
0.4	0	0.0	1	1	0	0	

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Reupholstery of furniture	a	173	4.6	2
Gardening and other household services	0.378	3,765	8.6	32
Gardening and lawn care services	a	1,535	11.1	20
Water softening service	a	84	8.3	1
Moving, storage, and freight expense	a	1,033	10.1	10
Household laundry and drycleaning, excluding coin operated	a	946	4.0	1
Coin-operated household laundry and drycleaning	a	167	1.2	0
Babysitting	0.271	h	h	h
Domestic services	0.237	1,010	7.5	10
Care of invalids, elderly, and convalescents in the home	0.054	141	7.8	3
Unpriced rent and/or repair of household equipment, and sound equipment ^b	0.116	0	0.0	0
Apparel and upkeep component total	5.291	76,736	n/a	9,797
Men's apparel	1.061	17,016	40.6	1,391
Men's suits, coats, sportcoats, and jackets	0.312	6,221	40.6	466
Men's suits	a	3,841	38.4	181
Men's sportcoats and tailored jackets	a	619	47.0	40
Men's coats and jackets	a	1,761	43.3	245
Men's furnishings	0.257	3,335	37.2	336
Men's underwear and hosiery	a	968	29.1	43
Men's nightwear	a	287	24.0	17
Men's accessories	a	1,067	29.6	88
Men's sweaters	a	474	58.0	93
Men's active sportswear	a	539	55.5	95
Men's shirts	0.266	4,100	45.1	407
Men's pants and shorts	0.212	3,360	38.5	182
Unpriced men's uniforms and other clothing ^b	0.014	0	0.0	0
Boys' apparel	0.230	3,457	43.5	436

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
1.2	1	50.0	1	0	0	1
0.9	17	53.1	15	3	0	12
1.3	10	50.0	10	2	0	8
1.2	0	0.0	1	1	0	0
1.0	7	70.0	3	0	0	3
0.1	0	0.0	1	0	0	1
0.0	0	0.0	0	0	0	0
^h	^h	^h	^h	^h	^h	^h
1.0	1	10.0	9	4	0	5
2.1	1	33.3	2	1	0	1
0.0	0	0.0	0	0	0	0
12.8	6,598	67.3	3,199	1,223	1,796	180
8.2	989	71.1	402	192	183	27
7.5	285	61.2	181	101	69	11
4.7	93	51.4	88	71	14 ⁹	3
6.5	24	60.0	16	7	7 ⁹	2
13.9	168	68.6	77	23	48 ⁹	6
10.1	254	75.6	82	18	57	7
4.4	39	90.7	4	0	3 ⁹	1
5.9	16	94.1	1	0	1 ⁹	0
8.3	71	80.7	17	0	15 ⁹	2
19.6	51	54.8	42	18	22 ⁹	2
17.6	77	81.1	18	0	16 ⁹	2
9.9	306	75.2	101	53	42 ⁹	6
5.4	144	79.1	38	20	15 ⁹	3
0.0	0	0.0	0	0	0	0
12.6	305	70.0	131	1	125	5

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Boys' coats and jackets	a	264	66.3	58
Boys' sweaters	a	96	62.5	22
Boys' shirts	a	1,008	48.5	159
Boys' underwear, nightwear, and hosiery	a	332	25.0	16
Boys' accessories	a	336	30.7	27
Boys' suits, sportcoats, and pants	a	1,200	37.7	89
Boys' active sportswear	a	221	64.7	65
Unpriced boys' uniforms and other clothing ^b	a	0	0.0	0
Women's apparel	1.765	23,328	52.1	5,040
Women's coats and jackets	0.181	1,960	55.6	503
Women's dresses	0.246	2,299	65.5	853
Women's separates and sportswear	0.821	12,452	55.3	2,653
Women's tops	a	5,472	61.7	1,514
Women's skirts	a	704	64.6	208
Women's pants and shorts	a	5,272	46.6	653
Women's active sportswear	a	1,004	60.2	278
Women's underwear, nightwear, and accessories	0.323	5,449	35.2	653
Women's nightwear	a	1,155	56.0	288
Women's underwear	a	1,510	33.3	91
Women's hosiery	a	1,631	19.2	79
Women's accessories	a	1,153	39.4	195
Women's suits	0.168	1,168	64.6	378
Unpriced women's uniforms and other clothing ^b	0.026	0	0.0	0
Girls' apparel	0.307	4,414	49.2	918
Girls' coats and jackets	a	160	60.6	55
Girls' dresses and suits	a	547	75.1	238
Girls' tops	a	804	60.5	212
Girls' skirts and pants	a	1,334	45.4	185
Girls' active sportswear	a	283	63.3	97
Girls' underwear and nightwear	a	599	33.4	55
Girls' hosiery and accessories	a	687	27.8	76

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
22.0	44	75.9	14	0	14 ⁹	0
22.9	11	50.0	11	0	9 ⁹	2
15.8	104	65.4	55	0	53 ⁹	2
4.8	12	75.0	4	1	3 ⁹	0
8.0	21	77.8	6	0	6 ⁹	0
7.4	67	75.3	22	0	21 ⁹	1
29.4	46	70.8	19	0	19 ⁹	0
0.0	0	0.0	0	0	0	0
21.6	3,199	63.5	1,841	844	897	100
25.7	275	54.7	228	95	117 ⁹	16
37.1	486	57.0	367	176	175 ⁹	16
21.3	1,689	63.7	964	484	425	55
27.7	922	60.9	592	299	256 ⁹	37
29.6	103	49.5	105	62	39 ⁹	4
12.4	442	67.7	211	120	79 ⁹	12
27.7	222	79.9	56	3	51 ⁹	2
12.0	535	81.9	118	2	110	6
24.9	237	82.3	51	0	50 ⁹	1
6.0	71	78.0	20	1	19 ⁹	0
4.8	63	79.8	16	1	13 ⁹	2
16.9	164	84.1	31	0	28 ⁹	3
32.4	214	56.6	164	87	70 ⁹	7
0.0	0	0.0	0	0	0	0
20.8	584	63.6	334	129	183	22
34.4	34	61.8	21	4	15 ⁹	2
43.5	130	54.6	108	51	55 ⁹	2
26.4	148	69.8	64	30	32 ⁹	2
13.9	116	62.7	69	19	44 ⁹	6
34.3	58	59.8	39	22	11 ⁹	6
9.2	40	72.7	15	1	13 ⁹	1
11.1	58	76.3	18	2	13 ⁹	3

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Unpriced girls' uniforms and other clothing ^b	a	0	0.0	0
Infants' and toddlers' apparel	0.182	1,819	28.5	167
Infants' and toddlers' outerwear	a	37	59.5	11
Infants' and toddlers' play and dresswear	a	358	50.0	82
Infants' and toddlers' underwear	a	1,268	20.4	52
Infants' and toddlers' sleepwear	a	156	38.5	22
Unpriced infants' accessories and other clothing ^b	a	0	0.0	0
Sewing materials, notions, and luggage	0.083	1,464	32.3	121
Fabric for making clothes	a	656	26.1	43
Sewing notions and patterns	a	185	22.7	10
Luggage	a	623	41.7	68
Jewelry	0.401	6,428	35.9	495
Watches	0.078	1,223	30.3	106
Jewelry	0.323	5,205	37.2	389
Footwear	0.719	11,159	39.7	1,193
Men's footwear	0.224	2,972	35.6	235
Boys' and girls' footwear	0.154	1,537	38.2	203
Boys' footwear	a	760	44.1	115
Girls' footwear	a	777	32.4	88
Women's footwear	0.341	6,650	41.8	755
Apparel services	0.543	7,651	7.1	36
Apparel laundry and dry cleaning, excluding coin operated	0.288	4,012	9.6	11
Other apparel services	0.255	3,639	4.4	25
Shoe repair and other shoe services	a	379	7.7	3
Coin-operated apparel laundry and dry cleaning	a	2,467	2.3	12
Alterations and repairs	a	444	4.7	1
Clothing rental	a	224	19.2	9
Watch and jewelry repair	a	125	8.0	0

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method				
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking	
0.0	0	0.0	0	0	0	0	0
9.2	126	75.5	41	0	39	2	
29.7	8	72.7	3	0	3 ⁹	0	
22.9	65	79.3	17	0	17 ⁹	0	
4.1	35	67.3	17	0	15 ⁹	2	
14.1	18	81.8	4	0	4 ⁹	0	
0.0	0	0.0	0	0	0	0	
8.3	79	65.3	42	0	41	1	
6.6	31	72.1	12	0	11 ⁹	1	
5.4	7	70.0	3	0	3 ⁹	0	
10.9	41	60.3	27	0	27 ⁹	0	
7.7	338	68.3	157	12	139	6	
8.7	82	77.4	24	0	23 ⁹	1	
7.5	256	65.8	133	12	116 ⁹	5	
10.7	962	80.6	231	30	189	12	
7.9	193	82.1	42	10	27 ⁹	5	
13.2	169	83.3	34	0	31	3	
15.1	96	83.5	19	0	17 ⁹	2	
11.3	73	83.0	15	0	14 ⁹	1	
11.4	600	79.5	155	20	131 ⁹	4	
0.5	16	44.4	20	15	0	5	
0.3	3	27.3	8	7	0	1	
0.7	13	52.0	12	8	0	4	
0.8	1	33.3	2	2	0	0	
0.5	10	83.3	2	2	0	0	
0.2	0	0.0	1	1	0	0	
4.0	2	22.2	7	3	0	4	
0.0	0	0.0	0	0	0	0	

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Transportation component total	16.620	94,366	n/a	5,660
New vehicles	4.829	15,176	53.9	2,420
New cars	3.842	11,617	56.4	1,917
New trucks	0.894	2,192	52.2	341
New motorcycles	0.093	1,367	34.6	162
Used vehicles	1.195	5,067	100.0	1,097
Unpriced used cars ^b	a	0	0.0	0
Motor fuel	2.925	29,524	75.0	172
Regular unleaded gasoline	a	9,509	79.3	50
Mid-grade unleaded gasoline	a	8,370	77.5	47
Premium unleaded gasoline	a	9,186	76.3	64
Diesel	a	2,285	45.4	9
Other motor fuel	a	174	63.8	2
Automobile maintenance and repair	1.546	8,401	25.6	1,303
Automotive body work	0.167	2,073	28.1	334
Automobile drive train and front end repair	0.453	1,990	27.5	306
Automotive drive-train repair	a	803	28.1	129
Automotive brake work	a	545	25.3	81
Repair to steering, front end, cooling system, and air conditioning	a	642	28.7	96
Automotive maintenance and servicing	0.490	2,376	17.6	352
Power plant repair	0.412	1,962	30.5	311
Unpriced automotive repair service policy ^b	0.023	0	0.0	0
Motor oil, coolant, and other fluids	0.058	3,745	11.7	36
Motor oil	a	2,676	11.2	18
Coolant brake fluid, transmission fluid, and additives	a	1,069	12.9	18
Automobile parts and equipment	0.516	7,964	20.9	255
Tires	0.256	4,037	26.8	102
Vehicle parts and equipment other than tires	0.260	3,927	14.9	153
Automobile insurance	2.647	5,111	25.0	147

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
6.2	2,699	47.6	2,961	1,837	823	301
16.0	805	33.3	1,615	838	670	107
16.5	584	30.5	1,333	667	580 ⁹	86
15.6	80	23.5	261	171	75 ⁹	15
11.9	141	87.0	21	0	15 ⁹	6
21.7	0	0.0	1,097	990	0	107
0.0	0	0.0	0	0	0	0
0.6	159	92.4	13	2	0	11
0.5	47	94	3	0	0	3
0.6	45	95.7	2	0	0	2
0.7	59	92.2	5	2	0	3
0.4	7	77.8	2	0	0	2
1.2	1	50.0	1	0	0	1
15.5	1,169	89.7	134	3	117	14
16.1	287	85.9	47	1	38 ⁹	8
15.4	273	89.2	33	1	31	1
16.1	114	88.4	15	0	15 ⁹	0
14.9	73	90.1	8	1	6 ⁹	1
15.0	86	89.6	10	0	10 ⁹	0
14.8	339	96.3	13	1	10 ⁹	2
15.9	270	86.8	41	0	38 ⁹	3
0.0	0	0.0	0	0	0	0
1.0	27	75.0	9	0	0	9
0.7	12	66.7	6	0	0	6
1.7	15	83.3	3	0	0	3
3.2	211	82.8	44	2	36	6
2.5	85	83.3	17	0	17 ⁹	0
3.9	126	82.4	27	2	19 ⁹	6
2.9	133	90.5	14	0	0	14

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Vehicle finance charges	0.571	2,373	36.1	68
Unpriced other vehicle finance charges ^b	a	0	0.0	0
Vehicle rental, registration, and inspection	0.768	5,757	25.1	89
State and local automobile registration, license, and inspection	0.368	1,874	4.5	15
State automobile registration	a	1,354	5.5	10
Local automobile registration	a	249	2.4	5
Driver's license	a	227	1.8	0
Vehicle inspection	a	44	0.0	0
Other automobile-related fees	0.372	3,883	35.1	74
Automobile rental	a	2,141	54.3	62
Truck rental	a	521	29.8	6
Parking fees	a	697	4.5	4
Vehicle tolls	a	464	2.6	1
Automobile towing charges	a	60	0.0	1
Other vehicle rental	a	0	0.0	0
Unpriced docking and landing fees ^b	0.027	0	0.0	0
Public transportation	1.566	11,248	45.5	73
Airline fare	1.037	6,366	69.5	0
Other intercity transportation	0.139	2,318	26.2	59
Intercity bus fare	a	407	35.9	4
Intercity train fare	a	1,154	12.0	1
Ship fares	a	757	42.7	54
Intracity transportation	0.378	2,564	3.6	14
Intracity mass transit	a	2,040	2.2	13
Taxi fare	a	524	9.2	1
Car and van pools	a	0	0.0	0
Unpriced school bus ^b	0.012	0	0.0	0
Medical care component total	7.426	50,237	n/a	1,116
Prescription drugs and medical supplies	0.897	4,471	26.0	108
Nonprescription drugs and medical	0.383	4,488	19.3	173

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method				
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking	
2.9	66	97.1	2	0	0	2	
0.0	0	0.0	0	0	0	0	
1.6	77	86.5	12	2	0	10	
0.8	12	80.0	3	2	0	1	
0.7	8	80.0	2	1	0	1	
2.0	4	80.0	1	1	0	0	
0.0	0	0.0	0	0	0	0	
0.0	0	0.0	0	0	0	0	
1.9	65	87.8	9	0	0	9	
2.9	57	91.9	5	0	0	5	
1.2	4	66.7	2	0	0	2	
0.6	2	50.0	2	0	0	2	
0.2	1	100.0	0	0	0	0	
1.7	1	100.0	0	0	0	0	
0.0	0	0.0	0	0	0	0	
0.0	0	0.0	0	0	0	0	
0.7	52	71.2	21	0	0	21	
0.0	0	0.0	0	0	0	0	
2.6	40	67.8	19	0	0	19	
1.0	2	50.0	2	0	0	2	
0.1	0	0.0	1	0	0	1	
7.1	38	70.4	16	0	0	16	
0.6	12	85.7	2	0	0	2	
0.6	12	92.3	1	0	0	1	
0.2	0	0	1	0	0	1	
0.0	0	0.0	0	0	0	0	
0.0	0	0.0	0	0	0	0	
2.2	355	31.8	761	336	3	422	
2.4	49	45.4	59	11	0	48	
3.9	41	23.7	132	43	0	89	

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Internal and respiratory over-the-counter drugs	0.245	2,392	19.9	73
Nonprescription medical equipment and supplies	0.138	2,096	18.5	100
Topicals and dressings	a	1,282	21.8	62
Medical equipment for general use	a	181	17.7	16
Supportive and convalescent medical equipment	a	195	14.9	11
Hearing aids	a	438	10.7	11
Unpriced drugs ^b	a	0	0.0	0
Professional services	3.518	18,430	9.4	210
Physicians services	1.904	8,664	8.7	106
Dental services	1.107	5,973	9.6	18
Eyeglasses and eye care	0.335	2,081	13.7	60
Services by other medical professionals	0.172	1,712	7.2	26
Hospital and related services	2.310	22,848	18.9	625
Hospital services	2.159	19,913	19.5	581
Nursing home services	0.145	2,935	14.9	44
Unpriced items ^b	0.006	0	0.0	0
Health insuranceⁱ	0.318	0	n/a	n/a
Entertainment component total	4.339	32,985	n/a	1,327
Reading materials	0.730	8,891	5.6	195
Newspapers	0.376	4,964	1.8	11
Magazines, periodicals, and books	0.354	3,927	10.4	184
Magazines	a	1,840	7.6	23
Books purchased through book clubs	a	362	14.4	34
Books not purchased through book clubs	a	1,725	12.5	127
Unpriced newsletters ^b	0.000	0	0.0	0
Sporting goods and equipment	0.391	4,303	26.3	384
Sport vehicles, including bicycles	0.181	1,658	30.6	170
Outboard motors and powered sports vehicles	a	1,173	31.6	123
Unpowered boats and trailers	a	136	19.1	11

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
3.1	18	24.7	55	25	0	30
4.8	23	23.0	77	18	0	59
4.8	19	30.7	43	13	0	30
8.8	0	0.0	16	1	0	15
5.6	4	36.4	7	0	0	7
2.5	0	0.0	11	4	0	7
0.0	0	0.0	0	0	0	0
1.1	68	32.4	142	49	0	93
1.2	22	20.8	84	28	0	56
0.3	7	38.9	11	7	0	4
2.9	30	50.0	30	8	0	22
1.5	9	34.6	17	6	0	11
2.7	197	31.5	428	233	3	192
2.9	175	30.1	406	218	3	185
1.5	22	50.0	22	15	0	7
0.0	0	0.0	0	0	0	0
n/a	n/a	n/a	n/a	n/a	n/a	n/a
4.0	763	57.5	564	95	321	148
2.2	126	64.6	69	9	55	5
0.2	6	54.6	5	2	2 ⁹	1
4.7	120	65.2	64	7	53	4
1.3	13	56.5	10	3	7 ⁹	0
9.4	17	50.0	17	0	16 ⁹	1
7.4	90	70.9	37	4	30 ⁹	3
0.0	0	0.0	0	0	0	0
8.9	247	64.3	137	7	114	16
10.3	146	85.9	24	3	15	6
10.5	108	87.8	15	3	8 ⁹	4
8.1	10	90.9	1	0	1 ⁹	0

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Bicycles	a	349	31.8	36
Sports equipment	0.210	2,645	23.6	214
Indoor, warm weather, and winter sports equipment	a	2,057	23.0	170
Hunting, fishing, and camping equipment	a	588	25.5	44
Toys, hobbies, and other entertainment commodities	0.803	6,793	22.1	436
Toys, hobbies, and music equipment	0.360	2,997	21.6	269
Toys, games, and hobbies	a	2,477	20.4	239
Playground equipment	a	8	75.0	3
Music instruments and accessories	a	512	26.6	27
Photographic supplies and equipment	0.111	1,162	20.0	62
Film	a	636	20.4	27
Photographic and darkroom supplies	a	24	8.3	0
Photographic equipment	a	502	19.9	35
Pets and pet products	0.323	2,634	23.7	105
Pet food	a	1,726	26.7	56
Purchase of pets, pet supplies, and accessories	a	908	18.1	49
Unpriced souvenirs, fireworks, and optic goods ^b	0.010	0	0.0	0
Entertainment services	2.415	12,998	14.4	312
Club memberships dues and fees	0.346	2,363	12.1	35
Fees for participant sports	0.400	2,211	17.2	38
Admissions	0.726	4,014	17.9	149
Admission to movies, theaters, and concerts	a	3,323	14.1	98
Admission to sporting events	a	691	36.5	51
Fees for lessons or instructions	0.256	888	11.5	38
Photographers, film procession, and pet services	0.665	3,522	10.9	52
Photographer fees	a	197	18.8	8
Film processing	a	710	10.6	9
Pet services	a	291	8.6	0

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
10.3	28	77.8	8	0	6 ⁹	2
8.1	101	47.2	113	4	99	10
8.3	77	45.3	93	3	83 ⁹	7
7.5	24	54.6	20	1	16 ⁹	3
6.4	265	60.8	171	8	152	11
9.0	160	59.5	109	4	99	6
9.7	145	60.7	94	3	86 ⁹	5
37.5	0	0.0	3	0	3 ⁹	0
5.3	15	55.6	12	1	10 ⁹	1
5.3	46	74.2	16	1	13	2
4.3	20	74.1	7	1	5 ⁹	1
0.0	0	0.0	0	0	0 ⁹	0
7.0	26	74.3	9	0	8 ⁹	1
4.0	59	56.2	46	3	40	3
3.2	29	51.8	27	2	22 ⁹	3
5.4	30	61.2	19	1	18 ⁹	0
0.0	0	0.0	0	0	0	0
2.4	125	40.1	187	71	0	116
1.5	10	28.6	25	6	0	19
1.7	19	50.0	19	4	0	15
3.7	79	53.0	70	28	0	42
3.0	68	69.4	30	6	0	24
7.4	11	21.6	40	22	0	18
4.3	3	7.9	35	22	0	13
1.5	14	26.9	38	11	0	27
4.1	2	25.0	6	0	0	6
1.3	1	11.1	8	2	0	6
0.0	0	0.0	0	0	0	0

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Veterinarian services	a	1,106	11.8	15
Other entertainment services	a	1,218	9.7	20
Unpriced rental of recreational vehicles ^b	0.023	0	0.0	0
Other goods and services component total	7.390	22,440	n/a	422
Tobacco products	1.688	4,120	27.3	15
Cigarettes	a	3,710	28.8	10
Tobacco products other than cigarettes	a	356	14.3	3
Smoking accessories	a	54	11.1	2
Unpriced smoking products ^b	a	0	0.0	0
Toilet goods and personal care appliances	0.589	3,653	19.9	129
Cosmetics, bath, and nail preparations and implements	0.263	1,214	16.8	50
Hair, dental, shaving, and miscellaneous personal care products	0.325	2,439	21.4	79
Products for the hair	a	1,022	21.8	29
Nonelectric articles for the hair	a	72	12.5	5
Women's hair pieces and wigs	a	0	0.0	0
Dental products and nonelectric dental articles	a	528	23.5	17
Shaving products and nonelectric shaving articles	a	158	24.1	6
Deodorant and suntan preparations and sanitary and footcare products	a	580	19.1	15
Electric personal care appliances	a	79	22.8	7
Personal care services	0.564	5,576	4.1	16
Beauty parlor services for females	0.447	3,679	4.2	15
Haircuts and other barber shop services for men	0.116	1,897	4.0	1
Unpriced repair of personal care appliances ^b	0.000	0	0.0	0
School books and supplies	0.273	1,176	25.7	93
School books and supplies for college	0.194	637	37.1	69

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
1.4	2	13.3	13	4	0	9
1.6	9	45.0	11	5	0	6
0.0	0	0.0	0	0	0	0
1.9	215	50.9	207	40	52	115
0.4	5	33.3	10	2	0	8
0.3	2	20.0	8	2	0	6
0.8	1	33.3	2	0	0	2
3.7	2	100.0	0	0	0	0
0.0	0	0.0	0	0	0	0
3.5	63	48.8	66	5	0	61
4.1	26	52.0	24	2	0	22
3.2	37	46.8	42	3	0	39
2.8	11	37.9	18	0	0	18
6.9	2	40.0	3	0	0	3
0.0	0	0.0	0	0	0	0
3.2	9	52.9	8	2	0	6
3.8	1	16.7	5	1	0	4
2.6	9	60.0	6	0	0	6
8.9	5	71.4	2	0	0	2
0.3	8	50.0	8	0	0	8
0.4	7	46.7	8	0	0	8
0.1	1	100	0	0	0	0
0.0	0	0.0	0	0	0	0
7.9	35	37.6	58	2	52	4
10.8	19	27.5	50	2	45 ^a	3

(continued)

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Categories (name of component, expenditure class, item stratum, and ELI)	Relative importance for December	Number of price quotations	Percent of quotations with price changes	Number of substitutions
Reference books and elementary and high school books	0.064	539	12.2	24
Elementary and high school books and supplies	a	124	32.3	10
Encyclopedias and other sets of reference books	a	415	6.3	14
Unpriced miscellaneous school purchases ^b	0.014	0	0.0	0
Daycare, tuition, and other school fees	2.863	4,685	23.7	104
College tuition and fees	1.685	1,334	48.8	69
Elementary and high school tuition and fees	0.519	356	48.0	7
Child daycare and nursery school	0.388	1,665	9.1	10
Other tuition and fees	0.155	1,330	10.3	18
Unpriced miscellaneous school items, rentals, and other services ^b	0.116	0	0.0	0
Legal, financial, and funeral services	1.415	3,230	12.4	65
Legal fees	0.496	943	4.9	7
Personal financial services	0.407	1,047	12.2	23
Safe deposit box rental	a	113	6.2	0
Checking accounts and special check services	a	390	12.3	15
Tax return preparation and other accounting fees	a	544	13.4	8
Cemetery lots and funeral expenses	0.403	1,240	18.3	35
Funeral expenses	a	905	20.8	29
Cemetery lots and crypts	a	335	11.6	6
Unpriced miscellaneous personal services ^b	0.109	0	0.0	0

**Appendix VIII
CPI Price Quotations, Substitutions, and
Methods of Adjustment for 1997**

Percent of price quotations that were substitutions	Substitutions not adjusted (comparable)		Adjusted substitutions by method			
	Number not adjusted	Percent of substitutions	Number of adjustments	Direct	Class mean and/or overlap	Linking
4.5	16	66.7	8	0	7	1
8.1	2	20.0	8	0	7 ⁹	1
3.4	14	100.0	0	0	0 ⁹	0
0.0	0	0.0	0	0	0	0
2.2	70	67.3	34	16	0	18
5.2	57	82.6	12	6	0	6
2.0	5	71.4	2	1	0	1
0.6	6	60.0	4	2	0	2
1.4	2	11.1	16	7	0	9
0.0	0	0.0	0	0	0	0
2	34	52.3	31	15	0	16
0.7	2	28.6	5	1	0	4
2.2	11	47.8	12	6	0	6
0	0	0.0	0	0	0	0
3.9	9	60.0	6	2	0	4
1.5	2	25.0	6	4	0	2
2.8	21	60.0	14	8	0	6
3.2	18	62.1	11	5	0	6
1.8	3	50.0	3	3	0	0
0.0	0	0.0	0	0	0	0

**Appendix VIII
CPI Price Quotations, Substitutions, and
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Legend: n/a = Not applicable

^aELIs do not have relative importance assigned to them.

^bThe weight for this unpriced ELI is moved by changes in its expenditure class.

^cThis represents the lower bound of the number of direct adjustments. The upper bound of direct adjustments of 6,042 represents the number of adjustments made to residential rent units. A unit could have as many as three types of direct adjustments per collection period. The lower bound of 5,641 excludes multiple adjustments made to one unit in a collection period.

^dNone of these are directly priced and therefore do not experience substitution.

^eThe residential rent units are also used for owners' equivalent rent.

^fThe price quotations collected under tenants' insurance are also used for household insurance.

^gThe class-mean method of adjustment can be used for this ELI.

^hThe price quotations collected under child daycare and nursery school are used to determine babysitting.

ⁱThis expenditure class is moved by a combination of medical care price quotations and insurance companies' retained earnings, which BLS collects separately.

Source: BLS.

Comments From the Bureau of Labor Statistics

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

U. S. Department of Labor

Commissioner for
Bureau of Labor Statistics
Washington, D.C. 20212



APR 7 1999

Ms. Laurie E. Ekstrand
Associate Director
Federal Management and
Workforce Issues
General Accounting Office
Washington, D.C. 20548

Dear Ms. Ekstrand:

Thank you for the opportunity to comment on your draft report, "Consumer Price Index: Impact of Commodity Analysts' Decisionmaking Needs to be Assessed." We appreciate the effort that you and your staff put into the study of the decisionmaking procedures that Consumer Price Index (CPI) commodity analysts use to handle item substitutions, and the potential effects that their decisions may have on the index. The descriptions of the procedures in the appendices to the report will be useful to us and to many CPI users as well.

The report contains a single recommendation: that the Bureau of Labor Statistics (BLS) evaluate, on a periodic basis, the degree of consistency and accuracy in analysts' substitution determinations and the resulting effects on the CPI. This is certainly a desirable thing to do and, as noted further below, my staff and I will explore ways that we can enhance the rigor of our existing review processes in this area. While agreeing with this recommendation, however, I feel it is important to emphasize the report's observation that there is no evidence that errors or inconsistencies in commodity analyst decisions have had a material effect on the CPI.

I also would like to emphasize the measures that BLS has taken in recent years to improve the substitution and quality adjustment processes in the CPI. Although, as your report states, the BLS has not fully acted upon the recommendations that came from its internal studies, significant progress certainly has been made. First, we have expended great effort to institutionalize a structured

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Ms. Laurie E. Ekstrand--2

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approach within which the commodity analysts' decision-making process operates, and we have achieved great success. This is the case, for example, in the apparel component of the index, which historically had been the sector in which substitution handling was the most problematic. New processes for apparel, including the use of tiered checklists and hedonic modeling, have served to improve and standardize the handling of apparel substitutions, thereby reducing the opportunity for inconsistent decisionmaking in the collection and evaluation of data. These processes also have reduced the number of noncomparable substitutions and the associated reliance on the linking process for indirect price adjustment. We have had similar, if less dramatic, success in other components of the CPI. Second, we have made extensive improvements to the CPI system, completely eliminating the problematic return-from-sale procedure and improving the handling of component prices. Third, we have instituted a formal checklist revision procedure that includes steps for field review of draft checklists and, in cases of major change, for field testing of the draft checklists. Finally, we have worked to improve collection materials and field representative training to reduce the number of problems with reported prices and price adjuncts (i.e., quantity, unit of size, and other data elements associated with price). All these technical steps work to improve the accuracy of substitution handling.

I also should note that the BLS has developed valuable tools for the monitoring of data handling in the CPI program. These include the monthly substitution monitor, which provided results used in your report on the number and treatment of substitutions in each CPI component index. Currently, we are in the process of institutionalizing the calculation of impacts on the aggregate index of each type of substitution method. Such calculations were reported for calendar year 1995 in a recent BLS paper, and will be prepared on a monthly basis in the future. Additionally, for several years, we produced a monthly monitor of commodity analyst decisions about individual items and their prices, broken down by item and analyst.

See comment 1.

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Finally, the Atkins *et al* study referred to briefly in your report deserves some mention here. It describes work done by a team of BLS staffers, who worked with specialists from the Oak Ridge National Laboratories, to investigate whether expert systems software could be used to assist the commodity analyst decision process. The study showed some promise. We did not follow through with implementation of the expert system, however, in part because of its limitations. Given the tight CPI production deadlines and the demands placed on the index's computer processing system, the expert system could have been used only for *ex post* evaluation of commodity analyst decisions, not in real time to assist decisionmaking during monthly production. It also would have been quite costly to develop the rules to be applied for each item category. Moreover, at the time the study was completed in 1993, competing demands on program resources, notably those associated with planning for the 1998 CPI Revision, were very great. It was not possible to undertake bringing in a new method for commodity analyst decisionmaking in those circumstances. Subsequent events have led to further deferral of the expert systems project in favor of other program priorities, including the calculation of substitution impacts as mentioned above. Nevertheless, the development work reported by Atkins *et al* does demonstrate that the BLS has long been committed to studying ways in which it could improve the handling of price data in the CPI.

Again, I commend the GAO for the seriousness and care with which it carried out this review project. We will consider several ways in which we could implement your recommendation. For example, we will continue to review our monitors of substitutions and substitution handling in the CPI, and we will evaluate enhancements to those monitors. We will review the documentation of commodity analyst procedures to see if that documentation can be made more complete. Finally, we will revisit the possible use of

See comment 2.

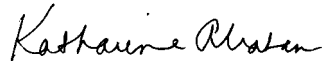
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expert systems software on the expectation that technological improvements in the last 5 years may have made this approach a viable means of assisting commodity analysts and enhancing the consistency of their decisions.

Sincerely yours,



KATHARINE G. ABRAHAM
Commissioner

See comment 2.

The following are GAO's comments on the Bureau of Labor Statistics' letter dated April 7, 1999.

GAO Comments

1. The Commissioner listed several measures BLS had taken to improve the substitution and quality adjustment processes in the CPI, and stated that these measures worked to improve the accuracy of substitution handling. However, because no data has been collected in periodic evaluations, neither BLS nor we can assess what effects these measures have had on the accuracy of commodity analysts' substitution handling.
2. The Commissioner reported that the expert system software BLS investigated in 1993 was limited because it only allowed for ex post evaluations of commodity analysts' decisions. Our recommendation, however, allows for the ex post evaluation of decisions and is therefore not affected by this limitation.

Major Contributors to This Report

**General Government
Division, Washington,
D.C.**

Martin de Alteriis, Evaluator-in-Charge
Kathleen Scholl, Supervisory Economist
Tony Assia, Senior Evaluator
Amber Roos, Student Intern

**Office of the Chief
Economist**

Loren Yager, Acting Chief Economist
Richard Krashevski, Supervisory Economist

Dallas Office

James Turkett, Senior Evaluator

Appendix X
Major Contributors to This Report

Related GAO Products

Bureau of Labor Statistics: Making the CPI More Reflective of Current Consumer Spending ([GAO/T-GGD-98-115](#), Apr. 29, 1998).

Consumer Price Index: More Frequent Updating of Market Basket Expenditure Weights Is Needed ([GAO/GGD/OCE-98-2](#), Oct. 9, 1997).

Consumer Price Index: Cost-of-Living Concepts and the Housing and Medical Care Components ([GAO/GGD-96-166](#), Aug. 26, 1996).

Economic Statistics: Status Report on the Initiative to Improve Economic Statistics ([GAO/GGD-95-98](#), July 7, 1995).

Economic Statistics: Measurement Problems Can Affect the Budget and Economic Policymaking ([GAO/GGD-95-99](#), May 2, 1995).

Prescription Drug Prices: Official Index Overstates Producer Price Inflation ([GAO/HEHS-95-90](#), Apr. 28, 1995).

Developing a Consumer Price Index for the Elderly ([GAO/T-GGD-87-22](#), June 29, 1987).

Stabilizing Social Security—Which Wage Measure Would Best Align Benefit Increases With Revenue Increases? ([GAO/IMTEC-85-13](#), Aug. 27, 1985).

Funds Needed to Develop CPI Quality Control System ([GAO/GGD-83-32](#), Apr. 1, 1983).

A CPI for Retirees Is Not Needed Now but Could Be in the Future ([GAO/GGD-82-41](#), June 1, 1982).

A Consumer Price Index for Retirees and Alternatives for Controlling Indexing (Testimony, Apr. 20, 1982).

Measurement of Homeownership Costs in the Consumer Price Index Should Be Changed ([GAO/PAD-81-12](#), Apr. 16, 1981).

Alternatives for Modifying the Indexation of Federal Programs (Testimony, Mar. 10, 1981).

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