

Extending the Improvements in CPI Sample Rotation Procedures and Improving the Procedures for Substitute Items

Effective with the Consumer Price Index for June 1996, the Bureau of Labor Statistics will extend to all categories of items in the CPI the change in sample rotation procedures introduced in the January 1995 CPI for food-at-home categories. In addition, effective with the CPI for July 1996, BLS will change the way it determines the weight of replacement items that enter the sample during certain types of item substitutions. These changes will complete the process of correcting a technical problem that ties an item's weight to its expected price change. BLS researchers identified this problem, and determined that it can lead to an overstatement of inflation whenever new items are introduced into the CPI sample. The Senate Finance Committee's Advisory Commission To Study the CPI has referred to this problem as "formula bias."

Sample rotation improvements

The CPI samples items in proportion to consumer expenditures for them. However, as a fixed quantity weight index, the CPI assigns weights to items by their quantities. BLS estimates the base-period quantity of a sample item by dividing its base-period expenditure by an estimate of its price during the same period. BLS estimates the item's base-period price by projecting a recent price for the item back to the base period.

The CPI replaces its samples of items and retail outlets on a 5-year rotation to keep them from becoming out of date. As part of the sample rotation process, there is an initiation period during which BLS staff members find the new outlets and select the items in them. In the overlap period, which follows the initiation period, BLS prices both the new and old samples but uses only the old sample in the CPI.¹ The old practice was to estimate the base period prices of the items in the new sample using their overlap-period prices. Then BLS would also use the overlap-period prices to calculate their subsequent price changes. This double use of the overlap-period prices can set up a correlation between quantity weight and price change. Relatively high weights

were assigned to items with prices that were temporarily low and therefore more likely to rise in subsequent periods. Conversely, items with temporarily high prices received relatively low weights.

Many categories of food items exhibit short-term price fluctuations that make it especially likely that they will suffer from this problem. Effective with the index for January 1995, in a process called "seasoning," BLS lengthened the overlap period by 3 months for food-at-home items. The seasoning period is a time to obtain the data needed to properly assign a weight to each new sample observation before its use in the index. Seasoning breaks the link between the weights for food-at-home items and the prices eventually used in price index calculation. The October 1994 *CPI Detailed Report* article explained this change in the treatment of new samples of food-at-home categories.²

Starting with the index for June 1996, this treatment will be extended to all other nonshelter categories in the CPI. (Residential rent and owners' equivalent rent are not subject to "formula bias" and their treatment will not be changed.) Prices used in CPI price change calculations will no longer be used to determine item weights. Item weights for city outlet samples introduced into the index during 1996 will be based on prices collected during the samples' initiation periods. Subsequent city samples will be handled by an extension of the "seasoning" procedure from food-at-home categories to the remainder of the CPI. The overlap period for pricing of both old and new samples will be lengthened by a minimum of 3 months. Special seasoning or other procedures will be used in several minor sample rotation situations during 1996 and early 1997.

Item substitution procedure

When an outlet stops selling a CPI sample item, or other circumstances make it necessary or desirable for the CPI to replace an item it has been following, the CPI field agent finds a replacement item. The object of the substitution process is to find the item in the outlet that is most similar to

¹ See "Improving CPI Sample Rotation Procedures" in the October 1994 *CPI Detailed Report*. This article provides a mathematical description of how this procedure can lead to "formula bias."

² See "Improving CPI Sample Rotation Procedures" in the October 1994 *CPI Detailed Report*. This article explains this change in the treatment of new samples of food-at-home categories.

the one the CPI had been following. About 3.5 percent of all pricings result in substitutions. Whenever there is a substitution, a CPI analyst determines if the new item is comparable to (not significantly different from) the item it replaces. If the item is judged comparable, there is no break in the series or change in the item's weight. About 55 percent of substitutions are comparable. If the substitute is not comparable to the previous item, the analyst may be able to determine the value of the difference and make a quality adjustment to keep the series continuous. The weight will change according to the value of the quality adjustment, but, because the quality adjustment does not depend on the price of the new item, this will not cause "formula bias."

CPI analysts adjust for quality about 15 percent of the substitutions. However, about 30 percent of the substitutes are neither comparable nor adjustable. In this case, CPI starts the item's series anew and recalculates its base-period price using the price of the substitute item. As in the sample rotation case, this creates a situation in which the item's weight is not independent of its probability of price change.

Effective with the CPI for July 1996, the CPI will not—except in rare and extreme cases—recalculate the base-period price, and hence the implicit quantity weight, of a noncomparable substitute item. Instead, the CPI will use the originally calculated weight for the item throughout the life of that item series. This will prevent "formula bias" from entering the index through item substitution.

Research on alternative methods

Because the "formula bias" problem was first identified by BLS researchers, a number of theoretical and empirical research projects have been conducted to clearly define the problem and evaluate a number of proposed solutions. The evaluation included simulations of sample rotations using historical data, as well as mathematical derivations. The re-

search indicated that the method of seasoning, as described above, should effectively eliminate any upward bias associated with estimation of base prices following sample replacement.

Results of simulations

BLS analyzed simulations based on 2 years of historical CPI data to assess the effect of the improvements to the sample rotation and item substitution procedures. The results of the simulations suggest that the combined effect of the two changes will be to reduce the measured rate of price change of the all-items CPI index by about 0.10 percent per year. The methods used in the simulations are similar to those that were described in detail in BLS Working Paper No. 263, "Improvements to the Food at Home, Shelter, and Prescription Drug Indexes in the U.S. Consumer Price Index."

This estimated effect of 0.10 percent per year is in addition to the effects of the January 1995 change in rotation procedures for food at home. In combination with simultaneous improvements in the CPI shelter indexes, the 1995 food-at-home changes were estimated at that time to reduce the rate of growth in the all-items index by approximately 0.11 percent per year.

Because the exact magnitude of "formula bias" will vary from year to year, the effect of eliminating it from the index is impossible to calculate precisely in advance. Estimated percentage effects on the CPI must be based on historical simulations. As resources permit in the future, BLS will continue to prepare retrospective simulations of the effects of these and other methodological improvements.

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