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## A Bureau of Labor Statistics Perspective on Bias in the Consumer Price Index

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I present the Bureau of Labor Statistics (BLS) perspective on bias in the Consumer Price Index (CPI). However, all the interesting measurement questions with which BLS is trying to deal, or even all the CPI issues that have been mentioned at this conference, cannot be covered in this discussion. Instead I'm just going to work my way through the main categories of potential bias in the CPI and mention some BLS activities that address those problems. No controversy exists over the types of measurement problems we face: The disagreements and controversy surround the problems' relative importance, size, and—in some cases—direction.

### FORMULA BIAS

The first measurement issue is what we have been referring to as formula bias, what Triplett (1996, 1997) refers to as basic component bias. This is a topic that, I am pleased to find, has not been discussed at this conference, but it is probably worth reviewing because of some ongoing confusion—both semantic and substantive—and because BLS has recently made some methodological changes to solve the problem.

BLS researchers discovered formula bias while trying to explain the empirical divergence between certain CPI food

indexes and the CPI average price series for the corresponding items. Because the CPI indexes hold outlet mix constant and the average price series do not, this divergence was first attributed to consumer substitution across outlet types. Only later was the true source of the divergence (i.e., CPI's inappropriate weighting of items when they are first introduced into the sample) correctly identified. Much of the early evidence on the potential size of the formula bias was obtained by BLS comparisons of CPI series with series constructed using a geometric mean formula for computing elementary aggregates. This history undoubtedly explains much of the confusion on what is meant by formula bias and its apparent magnitude.

Although the effect of going to a geometric mean formula at the substratum level from the pre-1995 version of the CPI formula appears to have reduced the rate of growth of the index by perhaps 0.5 percent per year, BLS research during the past year suggests that only about half of this difference is accounted for by formula bias (see McClelland, 1996, and unpublished estimates by Smedley and Gallagher, cited in Moulton, 1996). BLS made several changes to correct formula bias in January 1995 and made two more changes in June and July 1996 that should effectively have eliminated the problem. BLS estimates that the combined impact of these changes is to have reduced the rate of growth of the CPI by about 0.24 percent per year.

### LASPEYRES INDEX

The measurement issue that has been studied the most, and about which the most is probably known, concerns consumer substitution among CPI item strata in response to relative price change. A number of studies have analyzed substitution among the 200 or so item categories that make up the CPI. Most recently, BLS research by Aizcorbe, Cage and Jackman (1996) has compared an annual index

using the CPI's Laspeyres formula and 1982 expenditure weights to superlative indexes of both the fixed base and chained variety. Through most of the years from 1984 to 1994, the growth of the 1982-based Laspeyres index has exceeded that of the chained-superlative indexes by around 0.2 percent per year.

I'd like to note that these comparisons can be broken down into two subcomponents. The weight-updating subcomponent is the difference between the Laspeyres index using 1982 expenditure weights and a chained Laspeyres index (i.e., a Laspeyres index that uses expenditure weights corresponding to year  $t-1$  to compute price change in year  $t$ ). The formula subcomponent is the difference between the chained Laspeyres index and a chained superlative index. Aizcorbe, Cage, and Jackman (1996) have presented Laspeyres indexes using various expenditure base periods. Comparisons of these indexes shed some light on the potential effect of updating the CPI expenditure base period more frequently. Their results provide some evidence of a mild positive relationship between the estimated rate of inflation in a given year and the age of the expenditure base period of the Laspeyres index. A reasonable estimate would be that a decennial CPI revision, such as the change in January 1998 that will replace the 1982-84 expenditure base period with a 1993-95 base, would reduce the rate of growth in the CPI by roughly 0.1 percent per year. Going to a superlative formula, which would include information on expenditure patterns in year  $t$ , might then reduce index growth by another 0.1 percent or more on average.

I don't want to make too much of this evidence or my reading of it. In particular, the level and pattern of inflation during the recent period may not be representative of what we'll see in the future. Moreover, we know little or nothing about the statistical significance of the Aizcorbe, Cage, and Jackman index comparisons. I merely want to emphasize the distinction that is sometimes missed by non-economists—the distinction between updating the CPI

expenditure base period and going to a superlative formula.

Researchers also know little, I believe, about substitution effects below the stratum level. We do have the above-mentioned empirical comparisons between indexes constructed using a geometric mean formula to weight individual item prices and the CPI as now calculated. As I noted earlier, for the aggregate index, the divergence between these two measures is perhaps a quarter of a percent annually after the Laspeyres series is purged of formula bias. Because the Laspeyres and geometric mean formulas are consistent with cost-of-living indexes under Leontief and Cobb-Douglas preferences, respectively, the divergence suggests that reflecting substitution behavior below the stratum level could be quantitatively significant. Unfortunately, researchers do not as yet have any way of identifying the most accurate behavioral assumption overall. The CPI contains item strata like motor fuel, where we would expect the elasticity of substitution to be very high, but within which exists little relative price variation and consequently little divergence between the Laspeyres and geometric mean indexes. We have other strata, such as prescription drugs, that exhibit greater divergence but also greater heterogeneity. The presumed substitution elasticity may therefore be lower. However, numerous strata fit neither of these categories.

BLS is doing research using scanner data for some grocery store items. This is interesting and important work, suggesting that low-level substitution effects may be important. BLS does not know, however, how the results for any one item category apply elsewhere.

## QUALITY CHANGE AND NEW GOODS

Beyond substitution bias and formula bias, evidence on magnitudes is, as everyone recognizes, very limited. The issues of quality change and new goods are closely woven together. Shapiro and Wilcox (1996) have referred to quality change as

the “house-to-house combat” of price measurement—a very apt characterization. Each component of the index seems to present its own set of idiosyncratic problems. As Jack Triplett emphasizes, the CPI employs a variety of techniques to handle quality change, including the use of producer estimates of resource cost for vehicles and the use of hedonic regression estimation in shelter and apparel (see, for example, Triplett, 1996, 1997). The predominant method, however, is the linking process by which the quality-adjusted price difference between an item and its substitute in the CPI sample is assumed to equal the observed average price change among other similar items.

BLS has made several improvements to these procedures during the past several years, largely in response to the weaknesses of the assumptions underlying the linking approach in specific areas. More generally, however, once we reject the assumption that a common trend generating price movements within a stratum exists, a new conceptual paradigm is needed to justify methods other than linking for dealing with the 2,000 or so substitutions we observe in the CPI sample each month.

Brent Moulton has further pointed out how the introduction of new goods or new types of outlets at systematically lower (or higher) quality-adjusted prices extends the issue of quality change from situations of item substitution to sample rotation as well (Moulton, 1996). That is, at present, BLS makes quality adjustments when an item disappears from its CPI sample and is replaced by another good with different characteristics. When BLS replaces entire samples it implicitly assumes that quality differences are unimportant because the incoming and outgoing samples are following similar price trends. The CPI currently has no way of adjusting for the possibility that an incoming sample contains a greater proportion of new goods, or new outlets, at lower quality-adjusted prices on average. A hedonic or other new approach would be needed to incorporate the possibility that the trend of average quality-adjusted prices

in the market as a whole is different from the price trend within either sample.

## CPI CHANGES

In the meantime, BLS will continue to push forward with improvements in particular areas of concern. This will probably include greater use of hedonic regressions, despite the theoretical and empirical limitations of such an approach. Currently, all our hedonic adjustments are based on analysis of data in the CPI sample itself, but BLS may have to be more open to the use of secondary data as well, to facilitate more timely and accurate adjustments.

Also, in January 1997 BLS will implement a set of improvements to the CPI hospital services expenditure class, moving closer to the approach used in the Producer Price Index. One key improvement will involve selecting patient bills and pricing bundles of services rather than pricing individual items like room charges or units of blood. This and other associated changes are designed to keep the sample more representative of today's hospital services market. These changes should also position BLS at least to consider more aggressive quality adjustments in the future than it has been able to make up to now.

New goods present particularly difficult measurement problems for the CPI. The new goods issue per se results from the assumption that consumers benefit merely from the introduction of goods into the market (i.e., from the enhanced set of choices available). Although in principle a cost-of-living index would reflect this benefit, presumably through the estimation of reservation prices, I do not see any way BLS would accomplish that in the foreseeable future.

On the other hand, the problem of getting new goods more quickly into the CPI sample is primarily one of operational constraints. First, BLS must ensure that its item classification structure and CPI data collector instructions do not act as unintended roadblocks to the introduction of new items at times of substitution and sample rotation. Beyond that, BLS would

like to improve the effectiveness of its sample rotation process. As part of the ongoing CPI Revision program, BLS is building sample rotation procedures that it hopes will be more efficient in keeping the sample representative. Currently, BLS replaces the item samples in about 20 percent of CPI cities each year. Beginning around the year 2000, BLS will begin replacing samples on an item rather than an area basis. This will enable BLS to accelerate the rotation of samples in item categories where the introduction of new goods and outlet types is most frequent or important.

## OUTSIDE ASSISTANCE WELCOME

It has become traditional for BLS officials to conclude their remarks by emphasizing that those of us involved in the CPI would welcome any help we can get from outside researchers. As I have mentioned, BLS has numerous projects under way in connection with the 1998 Revision, in the production of experimental indexes, and in the evaluation of the potential uses of scanner data. In addition, BLS wants to expand its use of hedonic regression for explicit quality adjustment. But BLS would love to see additional research breakthroughs, such as practical ways to reflect new goods in published indexes. The need for continuing input from the research community is one reason why conferences like this are so important.

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