

# FRBSF ECONOMIC LETTER

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## Improving the Way We Measure Consumer Prices

Paying attention to consumer prices is a key aspect of central banks' efforts to maintain low and stable inflation. However, measuring consumer prices is not a straightforward or unambiguous procedure. Indeed, the consumer price index (CPI), which is produced by the Bureau of Labor Statistics (BLS), has undergone a series of refinements in recent years. Furthermore, in August 2002, the BLS began publishing a new aggregate price index called the Chained Consumer Price Index for All Urban Consumers (C-CPI-U). This new chained index is designed to be a better measure of consumer prices and the "cost-of-living" than the traditional CPI. This *Economic Letter* examines the details and recent behavior of this new index and compares it with other consumer price measures.

### **Solving the problem of "substitution bias"**

Coming up with a single measure that tracks changes in the prices of all the commodities consumed in the U.S. over time is difficult for several reasons. For instance, new items are constantly being introduced, existing items are constantly being improved, and consumer preferences may be changing as well. These changes complicate the task of constructing a price index because they lead to changes in the prices of these commodities and the quantities consumers purchase.

One particular complication is called "substitution bias." For example, when the price of computers falls while the price of books stays the same, consumers might well buy more computers than books. If the price index uses weights based on the relative expenditures on these two items before the price change, the cost of living would be overstated because consumers are spending relatively less on books than before. This problem is known as "substitution bias" because the price index does not reflect consumers' substitution between computers and books. Substitution bias is a significant flaw in the traditional CPI, which uses expenditures in the base period as fixed weights.

Before 1999, substitution bias affected both the "lower level" and the "upper level" tiers of the index. At the "lower level," the CPI aggregates the price quotes within an item category in each of the CPI sampling areas, for example, the prices of merlot and chardonnay within the category of "wine" in Minneapolis. At the "upper level," the CPI aggregates over 8,000 category-area strata (composed of all possible combinations of 211 item categories and 38 areas), for example, the price of "breakfast cereal" in Pittsburgh and the price of "hospital services" in St. Louis. According to the Advisory Commission to Study the Consumer Price Index, "lower level" bias caused annual inflation to be overestimated by about 0.25 percentage point while "upper level" bias led to an additional overestimation of about 0.15 percentage point (for a complete range of estimates of these biases, see Table 1 in Lebow and Rudd 2003).

In 1999 the BLS introduced into the traditional CPI a geometric mean aggregator for averaging prices within most item categories (that is, at the "lower level"). This new procedure is designed to reflect consumers' responses to relative price changes within these item categories and to mitigate "lower level" substitution bias. With the C-CPI-U, the BLS has taken another step forward. This index uses expenditure data in both the base and the current period in computing the weights, and that helps mitigate the "upper level" substitution bias.

Since the composition of C-CPI-U requires using expenditure data in the current period, and since these data are available only with a lag, the initial release of the C-CPI-U is termed preliminary and is followed by two revisions, the first labeled "interim" and the second labeled "final." For instance, in January 2003, the BLS published the preliminary index for that month, the interim index for all of 2002, and the final index for all of 2001. The C-CPI-U is issued only at the national level and is not seasonally adjusted. (Note that the traditional CPI is not revised, so its values are "final" upon release.)

### Some surprises with the new index

A recent BLS announcement indicated that the differences between the inflation measures implied by the C-CPI-U and the CPI-U (that is, the traditional CPI for All Urban Consumers) are notably larger than expected. In particular, the BLS expected the annual C-CPI-U for 2000 to be about 0.1–0.2 percentage point lower than the CPI-U; instead, the final release was 0.8 percentage point lower.

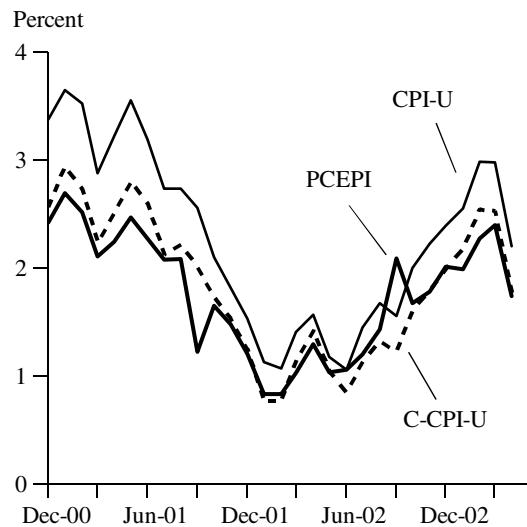
Several factors may help to explain the large divergence. One factor could be changes in the structure of consumers' expenditures. In 2000, the CPI-U's underlying expenditure weights were about six years old. Analysis by the BLS shows that, if 1997–1998 weights were adopted in the calculation, the CPI-U index would have increased by 3.3% instead of 3.4%, and the gap between the C-CPI-U and CPI-U inflation measure would diminish by 0.1 percentage point. It should be noted that the BLS plans to update the CPI-U expenditure weights more frequently and will make the average weights three years old.

Second, and more important, relative prices diverged more than usual during the late 1990s; consequently the substitution bias was larger than average. For instance, in 2000, the December-to-December CPI-U index for personal computers and peripheral equipment dropped by 22.7%, while the index for utility natural gas rose by 36.7%. A simulation study reported in *The BLS News* (2002) shows that, if these two component series were excluded from the calculations, the 2000 C-CPI-U inflation measure would remain at 2.6% since the price increase for natural gas and the decrease for the information-processing category cancel each other out. By contrast, the estimates for the 2000 CPI-U inflation measure (based on 1997–1998 weights) would be lowered from 3.3% to 3.0%; therefore the divergence between the CPI-U and C-CPI-U inflation measures would be only 0.4 percentage point.

### Comparing the PCEPI and the C-CPI-U

The Bureau of Economic Analysis (BEA) of the Department of Commerce produces another major chain-weighted price index, the personal consumption expenditures price index (PCEPI). Much of the price data used in constructing this index comes from the CPI. Figure 1 shows that the C-CPI-U is closer to the PCEPI than it is to the CPI-U. For instance, between December 1999 and December 2000, the published PCEPI rose 2.5%, only 0.1 percentage point less than the C-CPI-U increases.

**Figure 1**  
12-month moving average inflation



Nonetheless, there are important differences between the C-CPI-U and the PCEPI, so the two indexes should not be expected to move closely together over time. First, the PCEPI is considerably broader in scope than the C-CPI-U. The PCEPI covers expenditures by nonprofit institutions, such as churches and religious groups, as well as items like employer-paid insurance and Medicare expenditures, which are excluded from the CPI because they are not out-of-pocket expenditures for consumers.

Second, some of the indexes' underlying measures of prices are different, often reflecting their differences in scope. For instance, the PCEPI tracks the costs of doctors' services with a producer price index measure that reflects all payments to doctors rather than just consumer expenditures. Moreover, in cases where the actual transactions are hard to observe, the BEA formulates its own estimates of the "imputed" prices to approximate the nonmarket prices. Some imputed prices are extremely volatile and can have a substantial effect on movements in the overall PCEPI.

Third, their weights are different. Because the PCEPI and the CPI differ quite substantially in scope, one would expect the price of the same commodity to be weighted differently in the two series. For instance, the category of medical care accounts for a larger share of the PCEPI simply because the CPI covers only out-of-pocket medical expenditures. More fundamentally, the two sets of weights are derived from very different sources. The CPI weights

are derived from expenditures reported by households in the consumer expenditure survey, while the PCEPI weights are the expenditures as reported by businesses.

These differences are substantial and suggest that the C-CPI-U should provide a valuable, independent measurement of consumer prices.

**Tao Wu**  
**Economist**

## References

[URL accessed August 2003.]

*BLS News*. 2002. "Consumer Price Indexes." Department of Labor, Bureau of Labor Statistics (August 16). <http://www.bls.gov/cpi/home.htm>

Lebow, David, and Jeremy Rudd. 2003. "Measurement Error in the Consumer Price Index: Where Do We Stand?" *Journal of Economic Literature* (March) pp. 159–201.

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