CRS Report for Congress

The Chained Consumer Price Index:
How Is It Different?

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Summary

The Bureau of Labor Statistics (BLS) of the Department of Labor publishes two important measures of inflation: the consumer price index for all urban consumers (CPI-U), and the consumer price index for urban wage earners and clerical workers (CPI-W). The CPI-W is used to adjust Social Security benefit payments, and the CPI-U is used to adjust the personal income tax brackets to keep up with inflation. As is the case with most economic indicators, the two CPIs are not without their flaws.

One of the difficulties in estimating changes in the cost of living is that consumer spending patterns change continuously. Spending patterns change because of changing tastes and also because of changes in relative prices. Over time, as prices change, consumers will tend to buy more of those goods and services whose prices are rising slower than average and fewer of those goods and services whose prices are rising faster than average. This substitution is believed to result in a CPI that overstates the effect of inflation on consumer well-being.

As part of the continuing effort to improve measures of change in the cost of living, BLS introduced a supplemental measure known as the *chained consumer price index for all urban consumers* (C-CPI-U). The C-CPI-U does not replace either of the current CPIs, and has not affected any current indexing provisions of federal government programs. The aim of the C-CPI-U is to produce a measure of change in consumer prices that is free of substitution bias.

Actual data for the C-CPI-U are now available beginning with December 1999. With the exception of the year 2000, the difference between the "final" C-CPI-U and the CPI seems to range from 0.1 to 0.5 percentage point. In 2000, the increase in the C-CPI-U was 0.8 percentage point less than the CPI-U.

That the CPIs are not revised makes them attractive for use in making automatic cost-of-living adjustments. The C-CPI-U is subject to two revisions after its initial release. If the C-CPI-U were to be used instead, either the adjustment would have to wait until the final number was available, or the adjustment would have to rely on a number that could change after the fact. Depending on the month, the final C-CPI-U will not be available for as long as two years after the reference date.

This report will be updated as economic events warrant.

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Introduction

The consumer price index (CPI) is probably the most important measure of inflation published by the federal government. Published by the Bureau of Labor Statistics (BLS) of the Department of Labor, it is used to adjust Social Security benefit payments as well as personal income tax brackets to keep up with inflation.[1] Nonetheless, it has been subject to criticism. For example, in 1996, a group commissioned by the Senate Finance Committee issued a report that examined the CPI and identified a number of weaknesses and made specific recommendations.[2]

As part of its continuing efforts to construct a better measure of changes in the cost of living, BLS introduced the chained consumer price index for all urban consumers (C-CPI-U). In testimony before the House Budget Committee in 2004, then Federal Reserve Board chairman Alan Greenspan suggested that Congress might consider replacing the CPI with the C-CPI-U to make automatic cost-of-living adjustments to federal programs.[3] He pointed out that, at that time, if the C-CPI-U had been used instead of the CPI over the previous 10 years that the federal debt would have been about $200 billion less. This report explains how the C-CPI-U is calculated, and discusses how it differs from the existing CPI.

Ideally, a price index would measure changes in the cost of living. A true cost-of-living index would measure the change in income that would be required for consumers to maintain a constant level of satisfaction, or "utility." But there are a number of practical complications that make constructing such an index difficult.

The concept of utility is pervasive in economic theory. With a given level of income, which constrains their choices, consumers decide how to spend their money based on the utility, or satisfaction, yielded by the various available goods and

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[1] Actually, there are two CPIs. The consumer price index for all urban consumers (CPI-U) and the consumer price index for urban wage earners and clerical workers (CPI-W). Social Security benefits are indexed to the CPI-W, and income tax brackets are indexed to the CPI-U. See CRS Report RL34168, *Automatic Cost-of-Living Adjustments: Some Economic and Practical Considerations*, by Brian W. Cashell.

[2] See *Toward a More Accurate Measure of the Cost of Living*, Final Report to the Senate Finance Committee from the Advisory Commission to Study the Consumer Price Index, Michael Boskin, Chairman, December 4, 1996.

[3] Testimony of Alan Greenspan before the Committee on the Budget, U.S. House of Representatives, February 25, 2004. Available on the Federal Reserve Board website at [http://www.federalreserve.gov/boarddocs/testimony/2004/20040225/default.htm].

services. They are assumed to spend that money in such a way as to get the most satisfaction possible within the limitations of their budget. But since there is no unit of measure for utility, any measure of change in the cost of living must be based on what consumers actually spend. Any numerical measure that attempts to approximate changes in the cost of a given standard of living depends on a number of assumptions and has numerous practical limitations.

One of the difficulties in estimating changes in the cost of living is that consumer spending patterns change continuously. Spending patterns change because of changing tastes and also because of changes in relative prices. Over time, as prices change, consumers will tend to buy more of those goods and services whose prices are rising slower than average and fewer of those goods and services whose prices are rising faster than average. This substitution is believed to cause the CPI to overstate the effect of inflation on consumer well-being.

Methodological Differences

Because the CPI is a fixed-weight index, it does not entirely reflect ongoing changes in buying habits.[4] As the overall level of prices rises, relative prices change as well. Some prices rise faster than average and some prices rise more slowly than average. When goods are reasonably close substitutes, consumers can change their spending patterns and buy relatively more of those goods whose prices are rising slowly, and fewer of those goods whose prices are rising rapidly.

If these changes in consumer spending patterns have no effect on overall consumer satisfaction, then a price index based on a fixed marketbasket of goods and services will overstate the increase in cost of a given standard of living. Because the CPI does not take into account consumers' ability to insulate themselves, albeit to a limited extent, from inflation by changing their spending patterns, it overestimates how much they would need to raise total spending to maintain a constant standard of living. This is referred to as "substitution bias."[5]

The Current CPI Is a Fixed-Weight Index

The current CPI is a fixed-weight, or "Laspeyres," price index. To see how a fixed-weight index is calculated, consider the simple case of two time periods and two goods. In the first period, the value of the index is one. The index value in the

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[4] The CPI is, strictly speaking, a modified fixed-weight price index, in that the marketbasket is periodically updated. Until recently, however, those updates occurred only about once every 10 years. With the release of CPI data for January 2002, the marketbasket was updated to reflect spending patterns in the 1999-2000 period, and BLS now plans to update the marketbasket every two years. With the release of the January 2008 CPI, the weights were updated to reflect spending patterns in the 2005-2006 period. While the marketbasket may not be allowed to get too far out of date, it is always somewhere between two and four years out of date.

[5] Ana M. Aizcorb and Patrick C. Jackman, "The Commodity Substitution Effect in CPI Data, 1982-91," *Monthly Labor Review*, December 1993, pp. 25-33.

second period is a function of the quantities in the first period and the prices in the two periods. It is a weighted sum. The first step is to calculate, for each good, the ratio of the price in the second period to the price in the first period. The ratios are then summed using expenditure shares in only the first period as weights. To see how a fixed-weight price index is calculated, see **Box 1**.

Box 1. Calculating a Fixed-Weight Price Index

To illustrate, consider the formula:

$$\textbf{Index}_{[1;t]}^{L} = \sum_{i} \mathbf{s}_i^1 \left(\frac{\mathbf{p}_i^t}{\mathbf{p}_i^1} \right)$$

where i refers to the good, t refers to the period, and s^1 refers to the expenditure share for each good in the first period, and the following hypothetical values for prices and quantities:

Period	Beer			Wine			Total Cost
	Quantity	Price	Cost	Quantity	Price	Cost	
1	10	4	40	6	10	60	100
2	12	2	24	4	19	76	100

the index for period 1 is 1.000, and the index value for period 2 is:

$$\textbf{Index}_2^{L} = \left[\mathbf{0.4} \times \left(\frac{\mathbf{2}}{\mathbf{4}} \right) \right] + \left[\mathbf{0.6} \times \left(\frac{\mathbf{19}}{\mathbf{10}} \right) \right]$$

$$\textbf{Index}_2^{L} = \mathbf{1.340}$$

Using expenditure weights from the first period (in the case of beer, the expenditure weight is $40 \div 100 = 0.40$, and for wine it is $60 \div 100 = 0.60$), yields an index value in the second period of 1.340 which indicates an overall increase in the price of this marketbasket of 34.0%. In this case, the measure of price change does not take into account the fact that the hypothetical consumer bought more beer and less wine because of the change in relative prices.

The Chain-Weighted CPI

As part of the continuing effort to improve measures of change in the cost of living, BLS introduced a supplemental measure known as the *chained consumer price index for all urban consumers* (C-CPI-U).[6] The C-CPI-U does not replace the current CPI, and has not affected any current indexing provisions of federal

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[6] Information about the C-CPI-U is available at [http://www.bls.gov/cpi/superlink.htm].

government programs. The aim of the C-CPI-U is to produce a measure of change in consumer prices that is free of substitution bias.

The "final" release of the C-CPI-U will be calculated using a "Törnqvist" index formula.[7] This formula uses expenditure weights in both periods, and thus it reflects both changes in prices *and* changes in the composition of the marketbasket. To see how a Törnqvist price index is calculated, see **Box 2**.

Box 2. Calculating a Törnqvist Price Index

The Törnqvist index formula looks like this:

$$\mathbf{Index}_{[1;t]}^{\mathbf{T}} = \prod_i \left(\frac{\mathbf{p}_i^t}{\mathbf{p}_i^1} \right)^{\left(\frac{s_i^1 + s_i^t}{2} \right)}$$

In this case, for each good (i), the price in the second period (in which case p^t is simply p^2) is divided by the price in the first period (p^1) and the exponent applied to that ratio is the average of the expenditure weights of that good in the two periods. In this formula, the $\prod$ symbol indicates that each of the weighted price ratios for the goods in the marketbasket are multiplied together. Continuing with the same hypothetical numbers from the previous example and using the Törnqvist formula gives:

$$\mathbf{Index}_2^{\mathbf{T}} = \left(\frac{2}{4} \right)^{\left(\frac{.40 + .24}{2} \right)} \times \left(\frac{19}{10} \right)^{\left(\frac{.60 + .76}{2} \right)}$$

$$\mathbf{Index}_2^{\mathbf{T}} = \mathbf{1.175}$$

Using the Törnqvist formula yields an index value for the second period of 1.175, indicating an increase in the price of this hypothetical marketbasket of 17.5%.

Because the Törnqvist index requires data on expenditures in both time periods, it cannot be published concurrently with existing CPIs. Expenditure data are not available in time. However, BLS publishes an "initial" estimate of the C-CPI-U based on an alternative formula. The release of this initial estimate will coincide with the release of other CPI data each month. Every February, the estimates for all of the months in the previous calendar year's C-CPI-U estimates are revised, again using an alternative formula. This first revision referred to as the "interim" release. In the following February, the "final" C-CPI-U estimates based on the Törnqvist formula are released for all of those same months.[8]

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[7] The Törnqvist price index formula was developed at the Bank of Finland in the 1930s.

[8] Neither the CPI-U nor the CPI-W is subject to revision. That the C-CPI-U will be subject

The "initial release" and the first revision, or "interim" release of the C-CPI-U, will be based on the same expenditure weights used for the CPI-U but these indexes will be based on a geometric mean formula.[9] In contrast with the Laspeyres index in which the quantities are held constant in both periods, the geometric mean index formula holds expenditure shares (price times quantity) constant. It assumes a particular consumer response to the change in relative prices. That means that if the price of a good rises the quantity consumed implicitly falls. Some research has suggested that the geometric mean based price index may have a negative substitution bias if consumers are assumed to respond to changes in relative prices more than they actually do. To see how a geometric mean index is calculated, see **Box 3**.[10]

Box 3. Calculating a Geometric Mean Price Index

The formula for a geometric mean price index looks like this:

$$\text{Index}_{[1;t]}^{G} = \prod_{i} \left(\frac{p_i^t}{p_i^1} \right)^{s_i^1}$$

Using the same prices and quantities as in the previous example with this formula gives:

$$\text{Index}_2^{G} = \left(\frac{2}{4} \right)^{.4} \times \left(\frac{19}{10} \right)^{.6}$$

$$\text{Index}_2^{G} = 1.114$$

Using the geometric mean approach to calculating the price index for period 2 yields an increase of 11.4% between the two periods, less than either of the other two measures.

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[8] (...continued)
to revision may make it less attractive for indexing purposes.

[9] A geometric mean is the root of a product of a set of numbers. The geometric mean of two numbers is the square root of their product. The current CPI already makes use of geometric means in calculating some of the component indexes. Geometric means were adopted for the CPI-U in January 1999 for use in aggregating some of the component indexes, where goods in a given category were relatively close substitutes. At the time, it was estimated that the change would result in a 0.2 percentage point drop per year in measured consumer price inflation. Kenneth V. Dalton, John S. Greenlees, and Kenneth J. Stewart, "Incorporating a Geometric Mean Formula into the CPI," *Monthly Labor Review*, October 1998, pp. 3-7.

[10] See Matthew D. Shapiro and David W. Wilcox, "Alternative Strategies for Aggregating Prices in the CPI," Federal Reserve Bank of St. Louis *Review*, May/June 1997, pp.113-125.

In estimating the initial and interim releases of the C-CPI-U, which will be calculated using the geometric mean formula, an adjustment is made to the numbers based on the historical differences between the geometric mean index and the Törnqvist index, so that the initial and interim release will be closer to the final index number.

Although the C-CPI-U may be superior to the CPI in some respects, final data are far from timely. For example, in the case of the release of C-CPI-U data for the month of January 2008, the initial release occurred in February 2008, the interim release will occur in February 2009, and final data will not be released until February 2010. Final data for all of the months in calendar 2008 will be released in February 2010. Thus the wait for the final release of any January C-CPI-U is 25 months. But, because all of the months in a given calendar year are revised at the same time, the wait for the final release of any December C-CPI-U is only 14 months. **Table 1** shows how many months after the reference month (the month for which the data are reported) that the various releases are published.

Table1. Number of Months After Reference Month That Data Are Released

Reference Month	CPI-U/W	C-CPI-U		
		Initial Release	Interim Release	Final Release
January	1	1	13	25
February	1	1	12	24
March	1	1	11	23
April	1	1	10	22
May	1	1	9	21
June	1	1	8	20
July	1	1	7	19
August	1	1	6	18
September	1	1	5	17
October	1	1	4	16
November	1	1	3	15
December	1	1	2	14

Source: Department of Labor, Bureau of Labor Statistics.

Statistical Differences

Data for the C-CPI-U are now available beginning with December 1999. That is the base period for the C-CPI-U, for which it is set equal to 100. Final data are available through the end of 2006, and interim data are available through the end of 2007. **Table 2** compares the various C-CPI-U releases as well as those for the CPI-U, and the consumer price index for urban wage earners and clerical workers (CPI-W), which is the index used to calculate Social Security cost-of-living adjustments.[11]

Table 2. The C-CPI-U, the CPI-U, and the CPI-W

| 12-Month Period Ending in December of: | Percentage Change | | | | |
| | C-CPI-U | | | CPI-U | CPI-W |
	Initial	Interim	Final		
2000	N.A.	N.A.	2.6	3.4	3.4
2001	N.A.	N.A.	1.3	1.6	1.3
2002	N.A.	2.3	2.0	2.4	2.4
2003	1.6	1.5	1.7	1.9	1.6
2004	3.0	3.1	3.2	3.3	3.4
2005	3.0	3.2	2.9	3.4	3.5
2006	2.7	2.4	2.3	2.5	2.4
2007	3.4	3.6	N.A.	4.1	4.3

Source: Department of Labor, Bureau of Labor Statistics.

With the exception of the year 2000, the differences between the actual C-CPI-U and the CPI-U have ranged from 0.1 to 0.5 percentage point. In 2000, the increase in the C-CPI-U was 0.8 percentage point less than the CPI-U. BLS examined the underlying data and found that increased variability in the component indexes may have led to the larger than usual difference. The difference between the two indexes is determined, in part, by the extent to which component indexes rise at varying rates and the degree to which consumers shift their spending habits as a result of changes in relative prices.

The short history of the C-CPI-U makes it difficult to say with any confidence how large future revisions are likely to be. In 2002, the change between the interim and final release amounted to 0.3 percentage point, a significant change. The initial estimate for 2006 actually indicated a larger increase in the cost of living than either the CPI-U or CPI-W. The final estimate was revised downwards by 0.4 percentage point, and the increase in it was smaller than either the CPI-U or CPI-W. Most of

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[11] The CPI-W differs from the C-CPI-U not only because the C-CPI-U corrects for substitution bias, but also because the CPI-W represents a different marketbasket of goods and services.

the other revisions to the C-CPI-U have been small. **Figure 1** plots the monthly index numbers for the CPI-U and all three versions of the C-CPI-U.

Figure 1. The CPI-U and the C-CPI-U
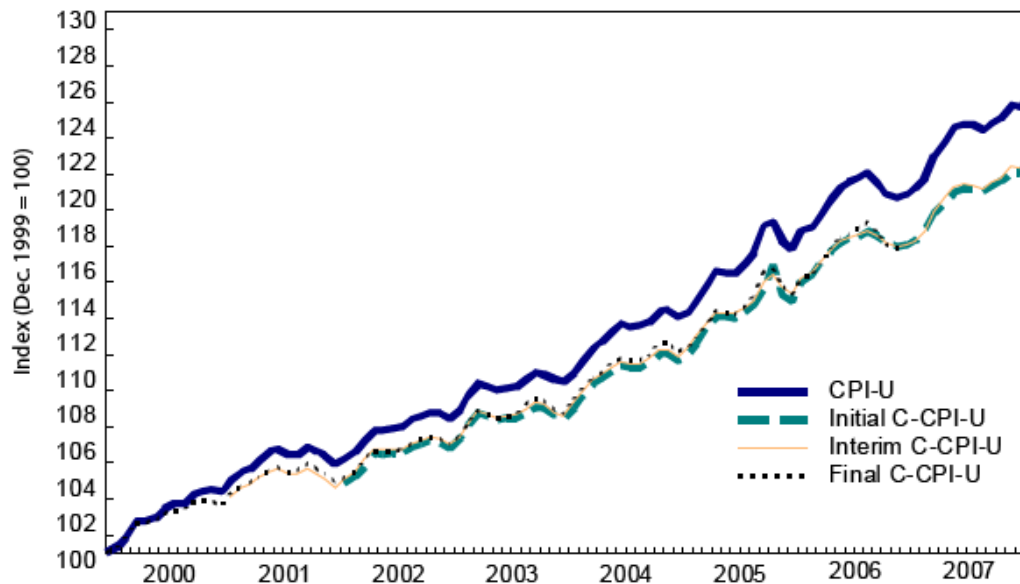
Source: Department of Labor, Bureau of Labor Statistics.

Policy Considerations

The publication of the C-CPI-U is part of a continuing effort by BLS to produce a more accurate measure of inflation.[12] If it is widely seen as superior to the CPI it will at least provide policymakers with a better measure of inflation.

The CPI is important, not only as an economic indicator, but also because it has significant implications for the budget through the indexing of the tax brackets and Social Security benefits. If the CPI overstates the effect of inflation on consumers, then Social Security benefits are rising more rapidly than necessary to preserve the living standards of beneficiaries. Similarly, the income tax brackets are rising faster than necessary to avoid "bracket creep," whereby, with progressive tax rates, income is taxed at a higher rate even though it is simply keeping up with rising prices.

If the C-CPI-U is a better measure of changes in the true cost of living, and the goal of indexing is strictly to reflect changes in the cost of living, then the C-CPI-U might be considered as a measure on which to base those adjustments. A major

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[12] As part of that effort, BLS sponsored a panel of experts to examine the CPI and make specific recommendations. The Panel on Conceptual, Measurement, and Other Statistical Issues in Developing Cost-of-Living Indexes was chaired by Charles L. Schultze. Their report was published in 2002 by the National Academy Press under the title *At What Price? Conceptualizing and Measuring Cost-of-Living and Price Indexes*.

complication, however is the release schedule. Final C-CPI-U data are not available for up to two years after the reference period. The January 2008 Social Security cost-of-living adjustment was based on the third quarter 2007 CPI data. Final C-CPI-U data for the third quarter of 2007 will not be available until February 2009. Such a long time lag might make the final C-CPI-U number a poor candidate as an index for automatic adjustments. Whether the initial or interim estimates might be attractive alternatives may depend on whether they are biased relative to the final number, or if the revisions tend to be significant. If there is a tendency for the final index to rise faster than the initial or interim indexes that might make the preliminary indexes unpopular with those who would be affected.

The C-CPI-U is likely to continue rising more slowly than either the CPI-U or the CPI-W as they are now calculated. That could generate opposition to changing current indexing provisions, and basing future cost-of-living adjustments on the C-CPI-U, from some Social Security beneficiaries and taxpayers