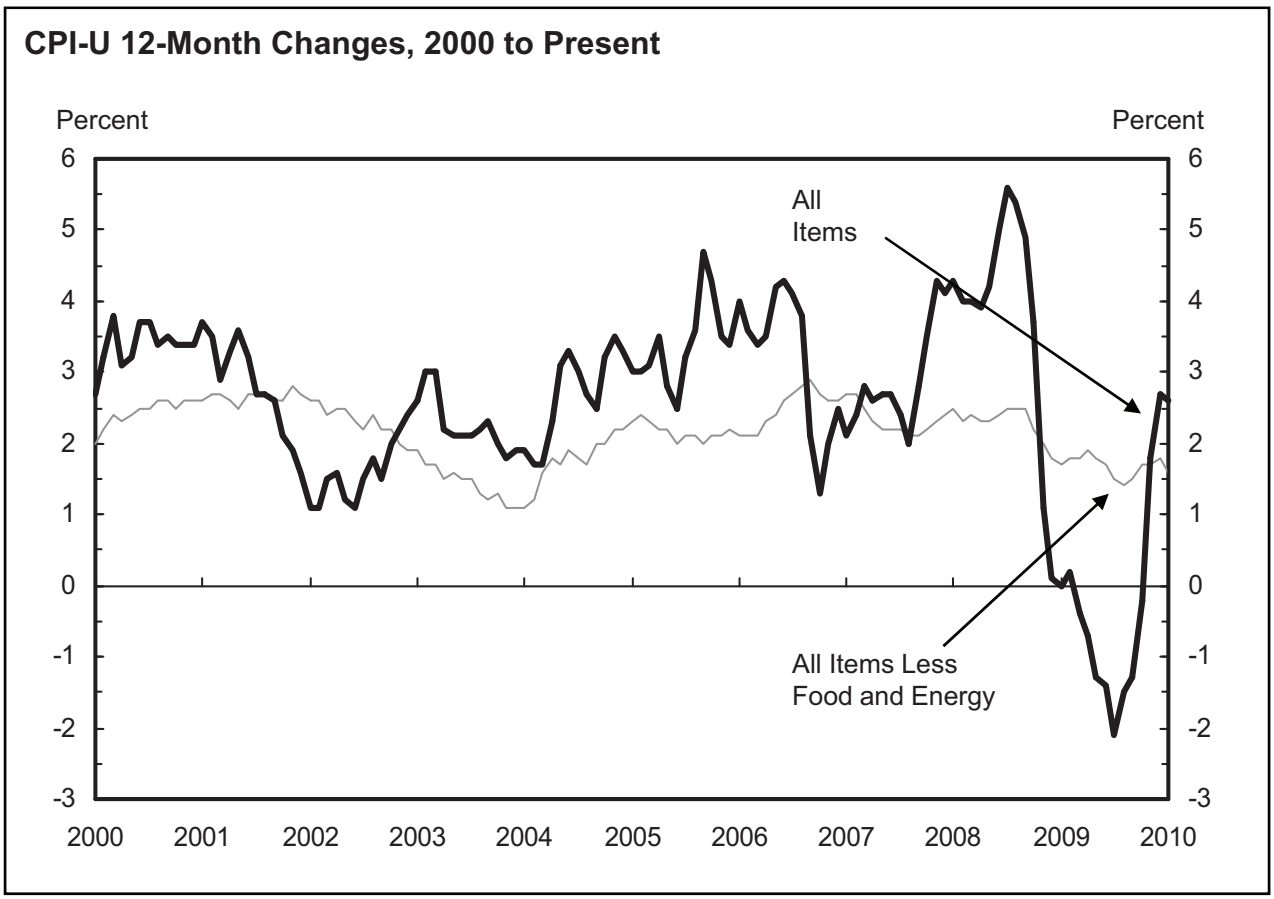

CPI-U 12-Month Changes, 2000 to Present
Percent
Percent
6
5
4
3
2
1
0
-1
-2
-3
All
Items
All Items Less
Food and Energy
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Revised Seasonally Adjusted Changes

Over-the-month percent changes in the U.S. City Average Consumer Price Index for All Urban Consumers (CPI-U) for All Items and for All Items less food and energy, seasonally adjusted, using former and recalculated seasonal factors for 2009.

All Items

2009	Former	Recalculated	Difference
January	.3	.3	.0
February	.4	.4	.0
March	-.1	-.1	.0
April	.0	.1	.1
May	.1	.1	.0
June	7	.7	.0
July	.0	.1	.1
August	.4	.4	.0
September	2	.2	.0
October	.3	.2	-.1
November	.4	.2	-.2
December	.1	.2	.1

All Items less food and energy

2009	Former	Recalculated	Difference
January	.2	.2	.0
February	.2	.2	.0
March	.2	.2	.0
April	.3	.2	-.1
May	.1	.1	.0
June	.2	.2	.0
July	.1	.1	.0
August	.1	.1	.0
September	.2	.2	.0
October	.2	.2	.0
November	.0	.0	.0
December	.1	.1	.0

A Note on Seasonally Adjusted and Unadjusted Data

Because price data are used for different purposes by different groups, the Bureau of Labor Statistics publishes seasonally adjusted as well as unadjusted changes each month.

For analyzing general price trends in the economy, seasonally adjusted changes are usually preferred since they eliminate the effect of changes that normally occur at the same time and in about the same magnitude every year--such as price movements resulting from changing climatic conditions, production cycles, model changeovers, holidays, and sales.

The unadjusted data are of primary interest to consumers concerned about the prices they actually pay. Unadjusted data also are used extensively for escalation purposes. Many collective bargaining contract agreements and pension plans, for example, tie compensation changes to the Consumer Price Index before adjustment for seasonal variation.

Seasonal factors used in computing the seasonally adjusted indexes are derived by the X-12-ARIMA Seasonal Adjustment Method. Seasonally adjusted indexes and seasonal factors are computed annually. Each year, the last 5 years of seasonally adjusted data are revised. Data from January 2005 through December 2009 were replaced in January 2010. Exceptions to the usual revision schedule were: the updated seasonal data at the end of 1977 replaced data from 1967 through 1977; and, in January 2002, dependently seasonally adjusted series were revised for January 1987-December 2001 as a result of a change in the aggregation weights for dependently adjusted series. For further information, please see "Aggregation of Dependently Adjusted Seasonally Adjusted Series," in the October 2001 issue of the CPI Detailed Report.

The seasonal movement of all items and 54 other aggregations is derived by combining the seasonal movement of 73 selected components. Each year the seasonal status of every series is reevaluated based upon certain statistical criteria. If any of the 73 components change their seasonal adjustment status from seasonally adjusted to not seasonally adjusted, not seasonally adjusted data will be used in the aggregation of the dependent series for the last 5 years, but the seasonally adjusted indexes will be used before that period. Note: 46 of the 73 components are seasonally adjusted for 2010.

Seasonally adjusted data, including the all items index levels, are subject to revision for up to five years after their original release. For this reason, BLS advises against the use of these data in escalation agreements.

Effective with the calculation of the seasonal factors for 1990, the Bureau of Labor Statistics has used an enhanced seasonal adjustment procedure called Intervention Analysis Seasonal Adjustment for some CPI series. Intervention Analysis Seasonal Adjustment allows for better estimates of seasonally adjusted data. Extreme values and/or sharp movements which might distort the seasonal pattern are estimated and removed from the data prior to calculation of seasonal factors. Beginning with the calculation of seasonal factors for 1996, X-12-ARIMA software was used for Intervention Analysis Seasonal Adjustment.

For the seasonal factors introduced in January 2010, BLS adjusted 30 series using Intervention Analysis Seasonal Adjustment, including selected food and beverage items, motor fuels, electricity and vehicles. For example, this procedure was used for the Motor fuel series to offset the effects of events such as damage to oil refineries from Hurricane Katrina.

For a complete list of Intervention Analysis Seasonal Adjustment series and explanations, please refer to the article "Intervention Analysis Seasonal Adjustment", located on our website at http://www.bls.gov/cpi/cpisapage.htm.

For additional information on seasonal adjustment in the CPI, please write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, Washington, DC 20212 or contact David Levin at (202) 691-6968, or by e-mail at Levin.David@bls.gov. If you have general questions about the CPI, please call our information staff at (202) 691-7000.

Intervention Analysis in Seasonal Adjustment

In some Consumer Price Index (CPI) series, a process known as seasonal adjustment is used to identify and factor out seasonal movements. The resulting seasonally adjusted data reflect an estimate of nonseasonal price movements. The CPI uses the Bureau of the Census X-12-ARIMA software to calculate factors for seasonal adjustment of both historical and current series.

Seasonal adjustment for some CPI series use a technique called intervention analysis that is included in the Census X-12 seasonal adjustment program. Intervention analysis seasonal adjustment allows economic phenomena that are not seasonal in nature, such as outliers and level shifts, to be factored out of indexes before calculation of seasonal adjustment factors. (An *outlier* is an extreme value for a particular month. A *level shift* is a change or shift in the price level of a CPI series caused by an event, such as a sales tax increase or oil embargo, occurring over one or several months.) The result is an adjustment based on a representation of the series with the seasonal pattern emphasized. Intervention analysis seasonal adjustment also makes it possible to account for seasonal shifts, resulting in a better seasonal adjustment in the periods before and after the shift occurred. For those CPI series adjusted using intervention analysis seasonal adjustment techniques, the resulting seasonal factors more accurately represent the underlying seasonal pattern. Seasonal factors are applied to the original unadjusted series without intervention. As a result, level shifts and outliers, removed for the calculation of seasonal factors, are present in the seasonally adjusted series.

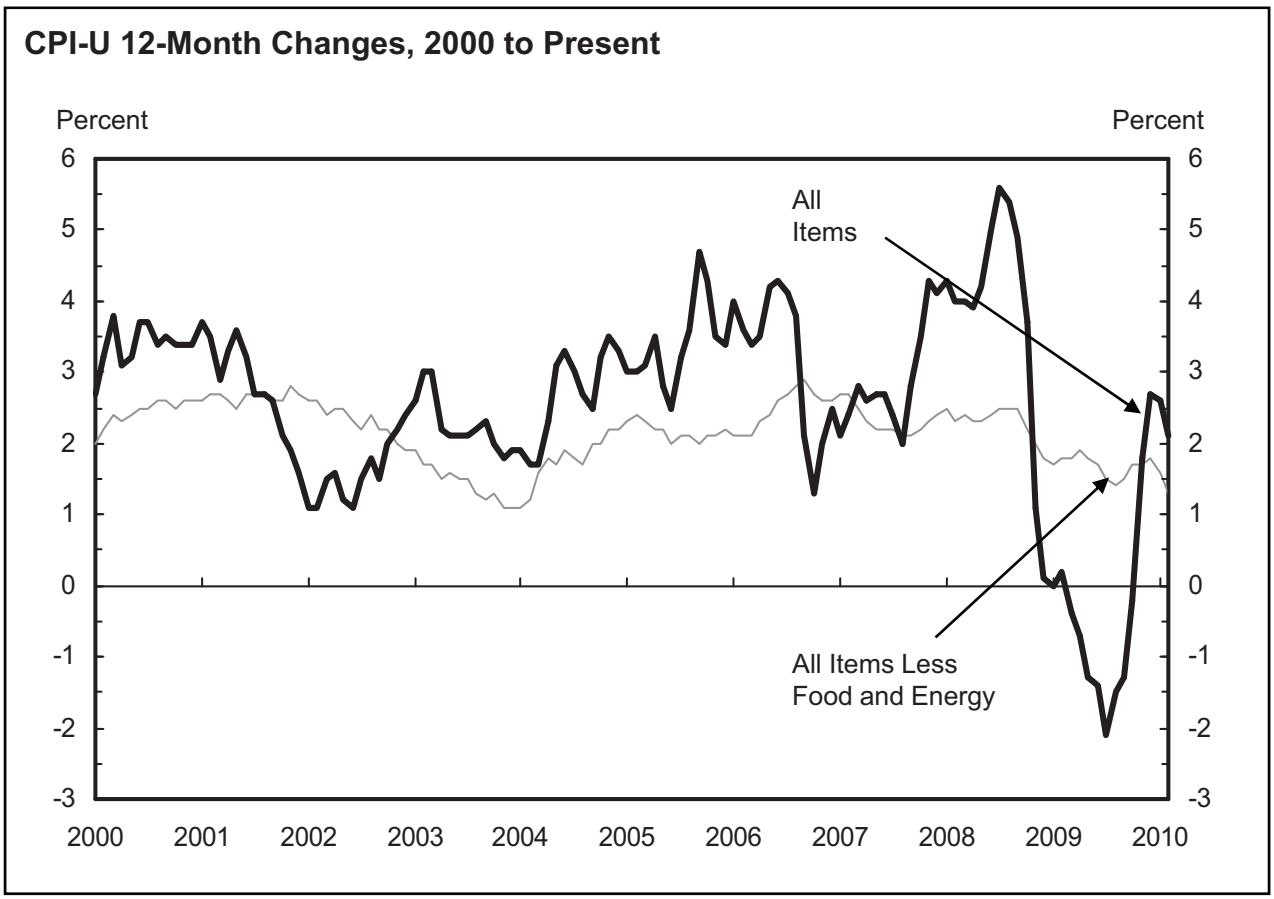
When X-12-ARIMA is used to perform intervention analysis seasonal adjustment, unusual events are modeled as part of the seasonal adjustment process. X-12-ARIMA's built-in regression variables are used for directly estimating the effects of sudden level changes and other disruptions and removing those effects before calculation of the seasonal factors. For a comprehensive discussion of X-12-ARIMA and intervention analysis seasonal adjustment, see "Improvements to CPI Procedures for Intervention Analysis Seasonal Adjustment" in the December 1996 issue of the *CPI Detailed Report*.

A CPI series may receive intervention analysis seasonal adjustment (IASA) if the series is directly adjusted and has a relative importance greater than 0.5% to the U.S. city average all items index. If IASA is used for a component of the seasonally adjusted U.S. city average all items index, series which are subsets of the component series are also eligible for IASA. In January 2010, BLS adjusted the series listed below using intervention analysis seasonal adjustment techniques. BLS examined these series using the 8-year span from January 2002 through December 2009.

Airline fare
Beverage materials including coffee and tea
Cable and satellite television and radio service
Carbonated drinks
Coffee
Electricity
Gasoline, all types
Gasoline, unleaded midgrade
Gasoline, unleaded premium
Gasoline, unleaded regular
Ice cream and related products
Juices and nonalcoholic drinks
Leased cars and trucks
Motor fuel
New cars
New cars and trucks
New trucks
New vehicles
Nonalcoholic beverages and beverage materials
Nondurables
Nondurables less food
Nondurables less food and apparel
Nondurables less food and beverages
Nondurables less food, beverages, and apparel
Other lodging away from home including hotels and motels
Public transportation
Used cars and trucks
Utilities and public transportation
Utility (piped) gas service
Video and audio

For each series that was adjusted using X-12-ARIMA intervention analysis seasonal adjustment, a list of level shifts is provided in the table below, along with the identified causes (events). Outliers are also included in the list.

For further information, write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, 2 Massachusetts Avenue, NE, Room 3615, Washington, DC 20212-0001, or call David Levin at (202) 691-6968. Mr. Levin may also be reached at Levin.David@bls.gov by e-mail.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Percent
6
5
4
3
2
1
0
-1
-2
-3
All
Items
All Items Less
Food and Energy
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Variance Estimates for Price Changes in the Consumer Price Index January -December 2009

Owen J. Shoemaker

This article presents variance estimates for 1-month, 2-month, 6-month, and 12-month percent changes in the Consumer Price Index for All Urban Consumers (CPI-U). Variance is a measure of the uncertainty caused by the use of a sample of retail prices, instead of the complete universe of retail prices. The estimates cover the period January 2009 through December 2009.[1] Each month the U.S. Bureau of Labor Statistics collects prices from a sample of approximately 83,500 commodities and services (C&S) quotes in approximately 26,400 outlets[2] around the United States for the Consumer Price Index (CPI).

The most commonly used measure of sampling variability is the *standard error* of the estimate – the square root of the variance. The standard error of the CPI's change can be used to construct confidence intervals to determine whether the change for a particular CPI series is significantly different from zero. This information should help users determine which index changes are significant.

Presentation of findings

The percent changes in the CPI along with their standard errors were estimated for the 12 months from January through December 2009. In summary, tables 1V through 5V show the median values of those percent changes, as well as the median values of the standard errors. Table 1V shows this information for U.S. city average, and tables 2V through 5V show the same information for the Northeast, Midwest, South, and West regions of the country.

For example, from January through December 2009, the 1-month changes in the U.S. city average all items index had a median value of 0.23 percent. The standard errors of those 12 estimates had a median value of 0.04 percent. Margins of error are usually expressed as a statistic's point estimate plus or minus two standard errors, so the margin of error on this CPI's 1-month change is approximately 0.23 percent plus or minus 0.08 percent. Therefore, in a typical 1-month period, the true change in the CPI was probably somewhere between 0.15 percent and 0.31 percent. The tables also show median percent changes and standard errors for 2- and 6-month intervals and for the full year 2009. Margins of error can be calculated for these intervals in the same way as for a 1-month period.

Analysis of findings

Analyzing the data reveals three significant observations. First, standard errors increase as one moves from the U.S. city average to individual regions of the country and from *all items* to individual item categories. Second, standard errors differ between item categories. Third, the standard errors decrease on a relative basis (standard error divided by price change), as the price change interval gets longer.

The primary reason standard errors increase as one moves from the U.S. city average to individual regions of the country is that sample sizes differ. In general, smaller sample sizes lead to larger standard errors. For example, the U.S. city average all items index is computed each month from approximately 87,800 prices (including all Rent and REQ quotes) throughout the United States, and its median standard error for 1-month changes is 0.04 percent. By contrast, the Northeast region all items index is computed from approximately 19,400 prices, and its median standard error is 0.10 percent. Regional indexes have larger standard errors because their sample sizes are smaller.

One can observe this same effect moving from the all items index to individual item categories. Again, the U.S. city average all items index is computed each month from approximately 87,800 prices, and its median 1-month standard error is 0.04 percent. By contrast, the U.S. city average recreation index is computed from approximately 5,400 prices, and its median 1-month standard error is 0.14 percent, more than three times as large. Again, smaller sample sizes lead to larger standard errors.

The second significant observation is that standard errors differ between item categories. There are two reasons for this. First, item categories differ in sample size. For example, the U.S. city average food and beverages index is computed from approximately 34,800 prices each month, while the U.S. city average recreation index is computed from approximately 5,400 prices. Therefore, it is not surprising that the recreation index has larger standard errors. Second, there are real differences in item category price behaviors caused by different selling practices, seasonal influences, and consumer demand. This is especially true for the apparel category, in which it is common for the prices of individual items to fluctuate by 50 percent or more each month. As a result, standard errors for apparel indexes are large.

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[1] In 1998 significant changes were made to the CPI's structure and sample, and a new variance calculation system was implemented. For information on variances from 1978-1986, 1993-1997 and then 1998 and 1999, see the *CPI Detailed Report* for February 1991, May 1994, February 1998, December 1999, and November 2000, respectively.

[2] In addition, BLS collects approximately 4,300 shelter quotes, used for both Rent and Rental Equivalence (REQ), each month.

The third observation is that standard errors generally tend to decrease, on a relative basis (standard error divided by price change), as the price change interval gets longer. For the U.S. city average all items index, the median standard error divided by the median percent change is 0.04/0.23 = 0.174 for 1-month changes, 0.06/0.39 = 0.154 for 2-month changes, 0.08/0.92 = 0.087 for 6-month changes. This shows that the relative accuracy of percent changes in the CPI generally improves as the price change interval gets longer. On an absolute basis, standard errors tend to increase, but at a decreasing rate. (Note: Since the median 12-month change for 2009 was actually negative, the relative standard error for 12-month changes is more difficult to interpret).

Findings presented here indicate that users should exercise caution when using CPI estimates to make inferences about index changes for relatively short time periods, for individual goods and services, or for local areas. The standard errors of those estimates may be on the same order of magnitude as the estimates themselves; and, thus, few inferences about them are reliable.

Sources of error

One way of analyzing the error in a survey estimate is to divide the total error into two sources: *sampling error* and *non-sampling error*. Sampling error is the uncertainty in the CPI caused by the fact that a sample of retail prices is used to compute the CPI, instead of using the complete universe of retail prices. Non-sampling error is the rest of the error. Non-sampling error includes things such as incorrect information given by survey respondents, data processing errors, and so forth. Non-sampling error arises regardless of whether data are collected from a sample of retail prices or from the complete universe.

Another way of analyzing error is to divide it into *variance* and *bias*. The variance of the CPI is a measure of how close different estimates of the CPI would be to each other if it were possible to repeat the survey over and over using different samples. Of course, it is not feasible to repeat the survey multiple times, but statistical theory allows the CPI's variance to be estimated anyway. A small variance, for example, indicates that multiple independent samples would produce values that are consistently very close to each other. *Bias* is the difference between the CPI's *expected* value and its *true* value. A statistic may have a small variance but a large bias, or it may have a large variance but a small bias. For an index to be considered accurate, both its variance and bias need to be small.

The Bureau of Labor Statistics (BLS) is constantly trying to reduce the error in the CPI. Variance and sampling error are reduced by using a sample of retail prices that is as large as possible, given resource constraints. BLS has developed a model that optimizes the allocation of resources by indicating the number of prices that should be observed in each geographic area and each item category, in order to minimize the variance of the U.S. city average all items index. BLS reduces non-sampling error through a series of computerized and professional data reviews, as well as through continuous survey process improvements and theoretical research.

Replication and variance estimation

An important advantage of using sampling is that the CPI's variance can be estimated directly from the sample data. Starting in 1978, the CPI's sample design has accommodated variance estimation by using two or more independent samples of items and outlets in each geographic area. This allows two or more statistically independent estimates of the index to be made. The independent samples are called *replicates*, and the set of all observed prices is called the *full sample*.

BLS collects CPI data in 38 geographic areas across the United States. These areas consist of 31 *self-representing* areas and 7 *non-self-representing* areas. Self-representing areas are large metropolitan areas, such as the Boston, St. Louis, and San Francisco metropolitan areas. Non-self-representing areas are collections of smaller metropolitan areas. For example, one non-self-representing area is a collection of 32 small metropolitan areas in the Northeast region (Buffalo, Hartford, Providence, Bangor, and others), of which 8 were randomly selected to represent the entire set. Within each of the 38 areas, price data are collected for 211 item categories called *item strata*. Together the 211 item strata cover all consumer purchases. Examples of item strata are bananas, women's dresses, and electricity.

Multiplying the number of areas by the number of item strata gives 8,018 (= 38 × 211) different area and item combinations for which price indexes need to be calculated. Separate price indexes are calculated for each one of these 8,018 area and item combinations. After all 8,018 of these *basic-level* indexes are calculated, they are aggregated to form *higher-level* indexes, using expenditure estimates from the Consumer Expenditure Survey as their weights. Examples of higher-level geographic areas are the four regions (Northeast, Midwest, South, and West); and examples of higher-level item categories are the eight major groups (food & beverages, housing, apparel, transportation, medical care, education and communication, recreation, and other goods and services). The highest level of geographic aggregation is the U.S. city average, and the highest level of item aggregation is all items.

Variances are computed with a Stratified Random Groups Method, in which variances are computed separately for certain subsets of areas and items and are then combined to produce the variance of the entire area and item combination. Subsets of items are formed by the intersection of the item category with each of the eight major groups.

Let $CPI(A,I,f,t)$ denote the index value where A = area, I = item category, f indicates that it is the full-sample value, and t = month; and let $CPI(A,I,f,t-k)$ denote the value of the same index in month = $t-k$. In general, the upper-case letter A denotes a *set* of

areas, such as the Northeast or Midwest region of the country; and the upper-case letter *I* denotes a higher-level item category, such as all items or all items less food and energy. Also let *CPI(A,I,r,t)* and *CPI(A,I,r,t−k)* be the corresponding index values for replicate = *r*. Most areas have two replicates, but some have more. Then, the full-sample k-month percent change between months *t−k* and *t* is computed by dividing *CPI(A,I,f,t)* by *CPI(A,I,f,t−k)*, subtracting 1, and multiplying by 100:

$$PC(A,I,f,t,t-k) = \left(\frac{CPI(A,I,f,t)}{CPI(A,I,f,t-k)} - 1 \right) \times 100$$

Every index has a weight *W(A,I,f)* or *W(A,I,r)* associated with it, which is used to combine the index with other indexes to produce indexes for larger geographic areas and larger item categories. For example, the weights are used to combine all 8,018 basic-level indexes into higher-level indexes such as the U.S. city average all items index. The product of an index and its weight is called a *cost weight*, *CW(A,I,r,t) = CPI(A,I,r,t) × W(A,I,r)*, and is an estimate of the total cost in area = *A* for consumption of item category = *I* in month = *t*.

For the Stratified Random Groups method used here, replicate percent changes are defined as follows: full sample cost weights are used for every geographic area within area = *A* except for one of the areas. In the omitted area, the full sample cost weight is replaced by a replicate cost weight. Let the lower case letter *a* denote one of the 38 basic-level areas included in area = *A*, and let the lower case letter *i* denote the intersection of item category = *I* with one of the 8 major groups. Then, the replicate percent change, for area = *a*, item subset = *i*, replicate = *r*, between months *t−k* and *t*, is computed as:

$$PC_S(a,i,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,i,f,t) + CW(a,i,r,t)}{CW(A,I,f,t-k) - CW(a,i,f,t-k) + CW(a,i,r,t-k)} - 1 \right) \times 100$$

for self-representing areas. For non-self-representing areas, the replicate percent change, for area = *a*, item category = *I*, replicate = *r*, between months *t−k* and *t*, is computed as:

$$PC_N(a,I,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,I,f,t) + CW(a,I,r,t)}{CW(A,I,f,t-k) - CW(a,I,f,t-k) + CW(a,I,r,t-k)} - 1 \right) \times 100$$

where:

$$CW(A,I,f,t) = \sum_{a \subset A} \sum_{i \subset I} CW(a,i,f,t)$$
$$CW(A,I,f,t) = \sum_{a \subset A} CW(a,I,f,t)$$
$$CW(a,I,f,t) = \sum_{i \subset I} CW(a,i,f,t)$$

and likewise for replicates. The symbol "$a \subset A$" means that the sum is over all basic-level areas within area = *A*, and the symbol $i \subset I$ means that the sum is over all item categories that are intersections of item category = *I* with a major group.

Then, the variance is computed with the following Stratified Random Groups Variance Estimation Formula:

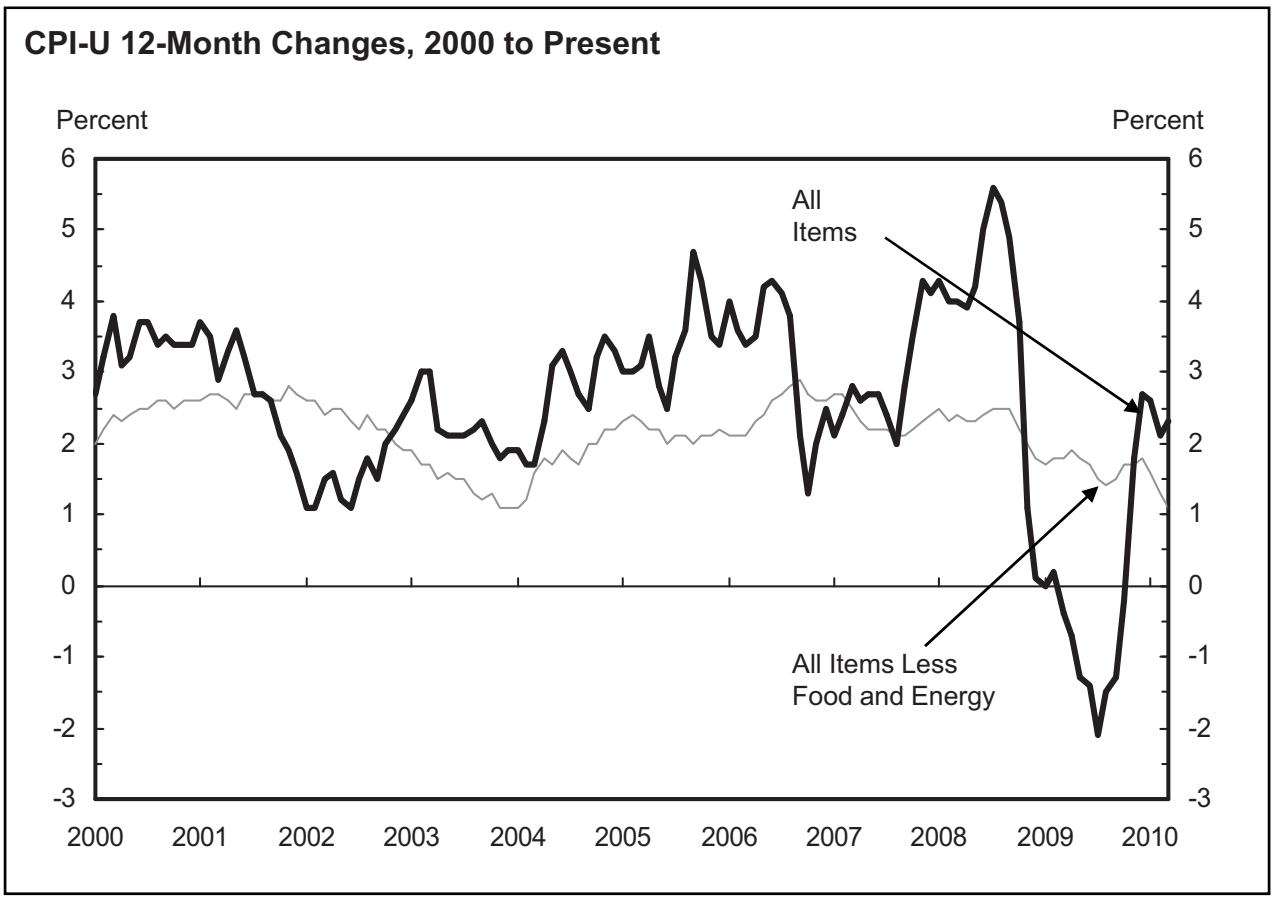
$$V[PC(A,I,f,t,t-k)] = \sum_{i \subset I} \sum_{a \subset A \cap S} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_S(a,i,r,t,t-k) - PC(A,I,t,t-k) \right)^2$$
$$+ \sum_{a \subset A \cap N} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_N(a,I,r,t,t-k) - PC(A,I,t,t-k) \right)^2$$

where S and N are the sets of all self-representing and non-self-representing areas in the CPI's geographic sample, respectively; and A∩S and A∩N are the sets of all self-representing and non-self-representing areas within area = *A*. The number R_a is the number of replicates in area = *a*.

Finally, the standard error of the percent change is computed by taking the square root of its variance:

$$SE[PC(A,I,f,t,t-k)] = \sqrt{V[PC(A,I,f,t,t-k)]}\ .$$

For more information, write to the CPI Information Office, BLS - Room 3130, 2 Massachusetts Avenue, N.E., Washington, DC 20212, or call Owen Shoemaker at 202-691-6918.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Experimental Consumer Price Index for Americans 62 Years of Age and Older, 1998-2009

Introduction

The Consumer Price Index (CPI) measures the average change over time in the prices paid by urban consumers for a representative market basket of consumer goods and services. The CPI for All Urban Consumers (CPI-U) represents the spending habits of about 87 percent of the population of the United States. The CPI for Urban Wage Earners and Clerical Workers (CPI-W), a subset of the CPI-U population, represents about 32 percent of the U.S. population. [1]

The Bureau of Labor Statistics (BLS) also calculates an experimental price index for Americans 62 years of age or older (often called the CPI-E). This article reviews price changes seen in the experimental CPI-E from December 1997 through December 2009 and reiterates the methods, sources of data, and limitations of the experimental index described in earlier articles[2]. Over the 12-year period from December 1997 through December 2009, the experimental CPI-E rose 36.1 percent. This compares to increases of 33.9 and 33.8 percent for the CPI-U and CPI-W, respectively.

Methodology, sources of data, and limitations

Although this study indicates a slightly higher overall inflation rate for older Americans compared to the official CPI population groups, any conclusions drawn from it should be used with caution because of the various limitations, summarized below, inherent in the methodology.

Expenditure weights. For purposes of index estimation, the CPI is divided into strata cross-classified by 38 areas and 211 item categories. For each CPI population group, these area/item strata are weighted according to their importance in the spending patterns of the respective population. The definition of the population of older Americans used for the experimental price index was all urban noninstitutionalized consumer units that met one of the following three conditions:

1) Unattached individuals who were at least 62 years of age;
2) Members of families whose reference person (as defined in the Consumer Expenditure Survey) or spouse was at least 62 years of age; or
3) Members of groups of unrelated individuals living together who pool their resources to meet their living expenses, whose reference person was at least 62 years of age.

In the 2007-2008 Consumer Expenditure Survey, which are used as the source of expenditure weights in the CPI for 2010-2011, 18 percent of the urban consumer units met the above definition for older Americans. Because the number of consumer units used for determining weights in the experimental index was relatively small, expenditure weights used in the construction of the experimental price index have a higher sampling error than those used for the larger populations.

For each population group, the base expenditure weight of any component represents the actual expenditure on that component in the base period. The "relative importance" of any component is its base expenditure weight updated for changes in relative prices expressed as a percent of the total updated expenditures for the population. The relative importance data for each of the three population groups for December 2009 are shown in Table 1.

Areas and outlets priced. The CPI-E is a weighted average of price changes for the same set of strata and collected from the same sample of urban areas used in calculating the CPI-U and CPI-W. Because the strata are defined by metropolitan area as well as item category, this means that the CPI-E reflects the general geographic distribution of the urban population.

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[1] The Chained CPI for All Urban Consumers (C-CPI-U), which BLS began publishing in August 2002 with data back to January 2000, also represents the urban population. The prices used in the C-CPI-U are the same as those used to produce the CPI-U and CPI-W, but the C-CPI-U uses a different formula and different weights to combine basic indexes.

[2] For example, the April 2008 *Monthly Labor Review* article by Kenneth J. Stewart, "The experimental consumer price index for elderly Americans (CPI-E), 1982-2007" provided estimates of the series for all items and major CPI expenditure components from December 1982 through December 2007.

Retail outlets are selected for pricing in the CPI based on data reported in a separate survey representing all urban households. The experimental index also uses the same retail outlet sample. The outlets thus selected may not be representative of the places of purchase (for example, the types of store or their locational distribution within metropolitan areas) of the elderly population.

Items priced. One major limitation of the experimental index is that the item samples priced within selected outlets are determined with probabilities proportionate to total urban (and not elderly) expenditures. As a result, the specific items selected for pricing in each outlet may not be representative of the experimental index population.

Prices collected. A final source of uncertainty about the appropriateness of using the CPI-U prices for the index of the older population concerns the availability of discount prices for older Americans. For example, senior-citizen discount rates are used in the CPI in proportion to their use by the urban population as a whole. To the extent that senior-citizen discounts take the form of a fixed percentage discount from the regular price, this may not be a problem. If, however, the discount is not expressed as a percentage of the price, or if that percentage is periodically adjusted, the scarcity of senior-citizen discount prices in the current CPI could lead to error in the experimental index.

Because of the above limitations, any conclusions drawn from these analyses should be treated as tentative.

Relative behavior of price indexes

Table 2 shows the behavior of the CPI-E, CPI-U, and CPI-W for selected expenditure categories for the period December 1997 through December 2009. Over this 12-year period, the reweighted experimental price index for older Americans (CPI-E) rose 36.1 percent. This compares with increases of 33.9 percent for the CPI-U and 33.8 percent for the CPI-W.

The relative importance data for the CPI-E and the CPI-U and CPI-W populations show that older Americans devote a substantially larger share of their total budgets to medical care (see Table 1). In addition, for each population group, medical care prices rose more rapidly than the overall (all items) index during each of the eight years studied. For this reason, the medical care component accounts for a significant portion of the difference between the higher rate of increase measured for the CPI-E relative to the two official population groups during the 1998-2009 period.

Price change for each major expenditure group varied by population because the distribution of expenditures on the products and services within the major groups varied among the three index populations. For example, within the housing major group, the weight for owner-occupied shelter is higher for the elderly than the CPI-U and CPI-W populations, as a higher proportion of elderly own homes than the other population groups. The weight for rent, on the other hand, is smaller for the CPI-E population.

The CPI and its relationship to Social Security benefits

Adjustments to Social Security benefits are currently based on the percent change in the CPI-W, measured from the average of the third quarter of one year to the third quarter of the succeeding year.

While the population covered for this study includes persons 62 years of age and older, it is important to note that it differs in many ways from the population receiving Social Security benefits.

First, many Social Security beneficiaries are younger than 62 years of age, and receive benefits because they are surviving spouses and/or minor children of covered workers or because of disability. The spending patterns of this younger group are excluded in the weights for the experimental index for older Americans. Second, a substantial number of persons 62 years of age and older do not receive Social Security benefits, especially those 62-64 years of age. Although these older consumers are included in the population covered by the experimental reweighted index, they would be excluded from an index specifically defined to reflect the experience of Social Security pensioners.

In short, an index designed specifically to measure price change for Social Security beneficiaries (i.e., one that excludes older people not receiving benefits, but includes younger persons receiving survival and disability benefits) might well show price movements that differ from those of the experimental index.

Conclusions

This report summarizes the change in the prices of three population groups: the CPI-U, the CPI-W, and the CPI-E, the experimental population of Americans older than 62 years of age, for the period December 1997 through December 2009. During this time period, the CPI-E increased at a slightly higher rate than either of the two official populations.

The CPI-E, reweighted to incorporate the spending patterns of older consumers, behaved more like the CPI-U than the CPI-W. This was expected, because the CPI-U includes the expenditures of all urban consumers, including those 62 years of age and over. The CPI-W, however, is limited to the spending patterns of wage-earner and clerical families and, therefore, specifically excludes the experience of families whose primary source of income is from retirement pensions.

Finally, the medical care component of the CPI has a substantially larger relative weight in the experimental population compared to the CPI-U or CPI-W. As a result, the medical care component tends to have a larger effect on the elderly population than it does on the other two indexes. Other differences also play an important role, however, such as the greater weight of homeownership in the CPI-E.

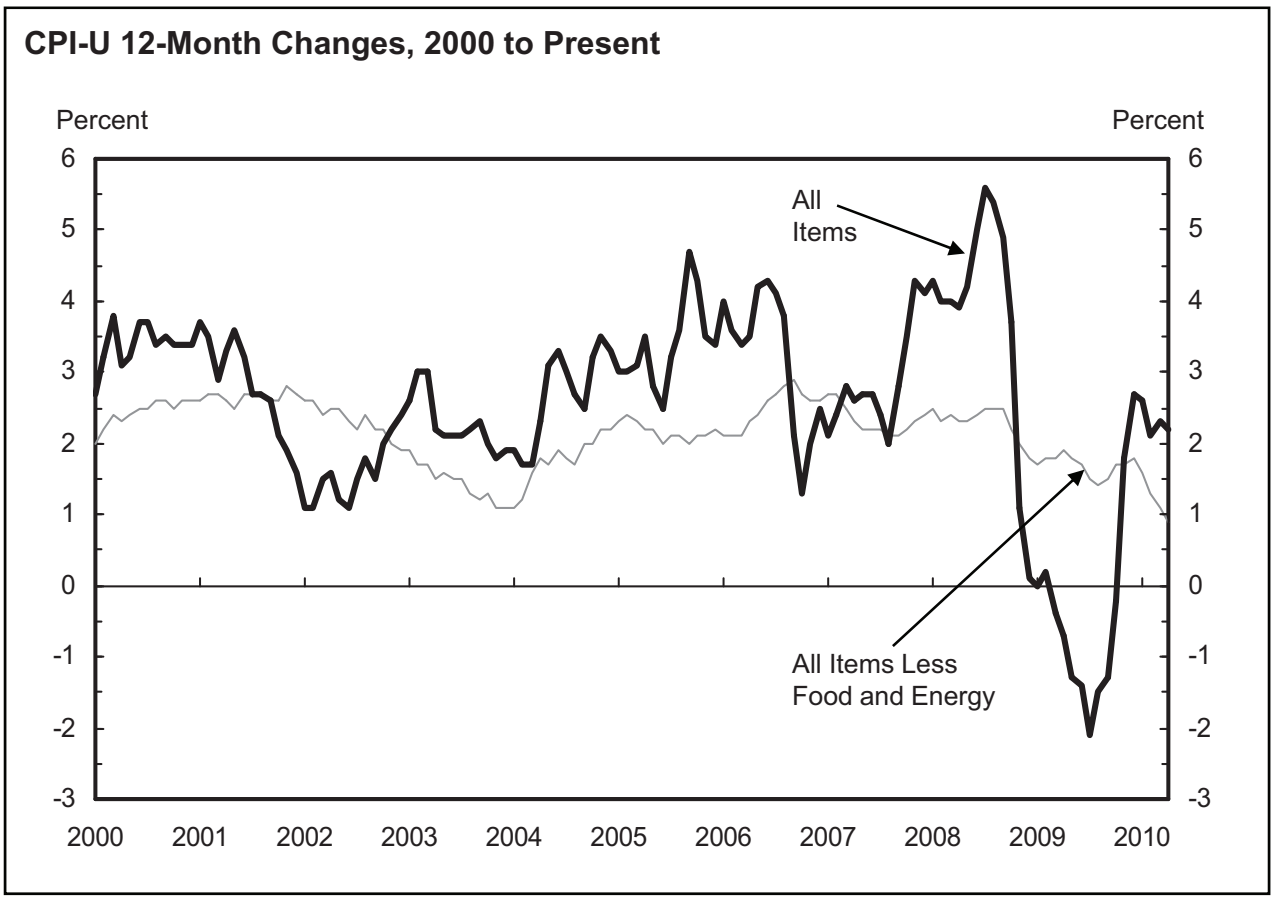
Finally, the experimental price index has limitations as an estimate of the inflation rate experienced by older Americans. Because of the various limitations inherent in the methodology, any conclusions drawn from these data should be made with caution.

Table 1. CPI relative importance for selected expenditure groups, December 2009 (based on 2007-2008 Consumer Expenditure Survey weights).

Expenditure group	Population	CPI-U	CPI-W	CPI-E
All items		100.00	100.00	100.00
Food and beverages		14.80	16.43	12.35
Food at home		7.80	8.90	7.16
Food away from home		5.94	6.43	4.37
Alcoholic beverages		1.06	1.09	0.82
Housing		41.96	39.75	47.08
Shelter		32.29	30.17	36.55
Rent		5.97	8.48	3.77
Owners' equivalent rent		25.21	20.96	31.52
Apparel		3.70	3.79	2.65
Transportation		16.69	18.65	14.22
Medical care		6.51	5.26	11.07
Medical care commodities		1.61	1.30	2.95
Medical care services		4.90	3.96	8.12
Recreation		6.44	6.03	5.53
Education and communication		6.43	6.18	3.91
College tuition		1.49	0.96	0.55
Other goods and services		3.48	3.92	3.19
Tobacco and smoking prod.		0.87	1.40	0.59

Table 2. Percentage changes in the CPI-U, CPI-W, and CPI-E by major expenditure group, December 1997 - December 2009

Expenditure Groups	CPI-U	CPI-W	CPI-E
All items	33.9	33.8	36.1
Food and beverages	37.1	37.0	36.3
Food at home	34.0	34.0	34.5
Food away from home	41.4	41.5	40.1
Alcoholic beverages	35.4	36.8	32.6
Housing	36.7	37.4	37.3
Shelter	39.2	39.8	38.0
Rent of primary residence	47.2	46.6	46.2
Owners' equivalent rent	39.0	38.2	39.2
Apparel	-9.3	-8.7	-9.3
Transportation	31.5	31.2	32.4
Medical care	60.1	60.8	60.0
Medical care commodities	42.2	40.0	45.7
Medical care services	66.0	67.1	65.9
Recreation	13.2	9.9	21.1
Education and communication	28.9	24.2	11.2
College tuition and fees	107.8	109.5	111.2
Other goods and services	64.0	78.0	57.5
Tobacco and smoking products	212.0	214.5	209.2


CPI-U 12-Month Changes, 2000 to Present
Percent
Percent
6
5
4
3
2
1
0
-1
-2
-3
All Items
All Items Less Food and Energy
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Consumer Price Index Research Series Using Current Methods, 1978-2009

Introduction

The Consumer Price Index (CPI) is the most widely used measure of inflation in the United States, and affects nearly all Americans. Annual cost-of-living adjustments (COLAs) for Social Security recipients and federal and military retirees are tied to changes in the CPI. The CPI also is used in the annual escalation of federal income tax brackets as well as personal exemption and standard deduction amounts. In addition, the CPI is used in the creation and analysis of many key economic indicators where real or constant-dollar measures are needed, including estimates of income, earnings, productivity, output, and poverty.

The Bureau of Labor Statistics (BLS) has made numerous improvements to the CPI over the past thirty-plus years. While these improvements make the present and future CPI more accurate, *historical* price index series are not adjusted for such improvements.[1] That said, the accuracy of the historical CPI is of great importance and interest to a variety of researchers. This paper presents an estimate of the CPI-U from 1978 to 2009 that incorporates most of the improvements made over that time span into the entire series. This measure, called the CPI research series using current methods (CPI-U-RS), attempts to answer the question, "What would have been the measured rate of inflation from 1978 forward had the methods currently used in calculating the CPI-U been in use since 1978?"

The CPI-U-RS is used by other statistical agencies that prefer a historically consistent CPI to deflate economic measures. The Bureau of Economic Analysis used the CPI-U-RS in its 1999 comprehensive revision of the National Income and Product Accounts.[2] The Bureau of Labor Statistics uses the CPI-U-RS in its measure of real hourly compensation for its quarterly measure of labor productivity and costs.[3] In addition, the Census Bureau uses the CPI-U-RS in estimates of historical real income. [4]

The CPI-U-RS was constructed by adjusting U.S.-level CPI-U index series for methodological improvements, usually at the level of the item stratum such as new vehicles or residential rent.[5] That is, the adjustments were not made to the aggregate all-items CPI-U directly, but rather to its component indexes. These adjusted series were then aggregated to form the all-items CPI-U-RS and other high-level aggregates. It is important to note in this regard that the component indexes were adjusted directly; individual prices were not used to recompute those indexes.

The CPI-U-RS provides an annual inflation series that adjusts only for specified changes in BLS methodology. No attempt has been made to incorporate research results, such as on the value of safer, but perhaps less comfortable, air travel, for which there is no corresponding methodological change in the CPI-U. Nevertheless, the CPI-U-RS is expected to be of use to forecasters and other researchers in analyzing the trends and other movements in consumer inflation over the last two decades. It should help to answer the question of the degree to which the measured rate of inflation has been affected by improvements BLS has made.

Over the 32-year period of the study (December 1977 – December 2009), the CPI-U-RS increased 217.1 percent, compared to 247.7 percent for the CPI-U over the same time period. This represents an average annual increase of 3.67 percent for the CPI-U-RS, compared to 3.97 percent for the CPI-U, for an average annualized difference between the two measures of 0.30 percent.

Methodological Improvements to the CPI, 1978-2009

There have been a number of significant methodological improvements made to the CPI since 1978. The CPI-U-RS differs from the CPI-U in that the CPI-U-RS is adjusted to incorporate estimates of what the measured rate of inflation would have been had those improvements to the CPI-U been made earlier. Table 1 lists all the improvements made to the CPI since 1978 for which estimates of historical effects were made and included in the CPI-U-RS.[6]

Unlike the CPI-U, the historical CPI-U-RS is revised annually to incorporate the estimated historical effect of new methods, and to improve adjustments previously made. In addition, there were several improvements made to the CPI since 1978 for which no adjustments to the CPI-U-RS were made.[7] Adjustments to the CPI-U-RS were not made if the impact of the improvement on the rate of growth of the index could not be estimated or was believed to be negligible.

Table 1. Improvements to the Consumer Price Index for all urban consumers (CPI-U) since 1978, and its effect on the CPI research series using current methods (CPI-U-RS).

Change	Description	Year implemented in CPI-U	CPI-U-RS incorporates estimate of change from:
Use of rental equivalence to measure changes in homeowner costs	Changed homeowners' component from cost of purchase to value of rental services	1983	1978-1982
Rental vacancy imputation	Employed new method for imputing price change for rental vacancies	1985	1978-1984
Quality adjustment of used car prices	Prices of used cars adjusted for differences in quality after model changeovers	1987	1978-1986
Quality adjustment of sampled housing units to reflect aging	Rental values in CPI sample were adjusted for aging	1988	1978-1987
Quality adjustment of apparel prices	Regression models used to adjust apparel prices for changes in quality when new clothing lines are introduced	1991	1978-1990
Treating shifts between brand name and generic drugs as price changes	Introduced new procedures that allow generic drugs to be priced when a brand drug loses its patent	1995	1978-1994
Change in shelter formula: elimination of composite estimator	Replaced composite estimator with a 6-month chain estimator. Under-reporting of 1-month rent changes had resulted in missing price change in residential rent and homeowners' equivalent rent	1995	1978-1994
Change in shelter formula: rental equivalence improved estimator	Modified imputation of homeowners' implicit rent to eliminate upward drift property of previous estimator	1995	1987-1994
Elimination of functional form bias for CPI food-at-home categories	Introduced "seasoning" procedures to eliminate upward bias derived from the setting of base period prices of newly initiated items	1995	1978-1994
Elimination of functional form bias for other CPI commodity and service categories	Extended food-at-home seasoning procedures to remainder of commodities and services. Base period prices left unchanged in most noncomparable substitutions	1996	1978-1996
Quality adjustment of personal computer prices	Regression models used to adjust personal computer prices for changes in quality	1998	1987-1997
Elimination of automobile finance charges	Deemed out of scope	1998	1978-1997
Quality adjustment of television prices	Regression models used to adjust television prices for changes in quality	1999	1978-1998
Accounting for consumer substitution within CPI item categories	The geometric formula now used assumes a modest degree of consumer substitution within most CPI item categories	1999	1978-1998
Treating mandated pollution control measures as price increases	Changes in pollution control regulations now viewed as price changes and not quality changes	1999	1978-1998
Quality adjustment of audio equipment prices	Regression models used to adjust audio equipment prices for changes in quality	2000	1978-1999
Quality adjustment of other video	Regression models used to adjust other video	2000	

equipment prices	equipment prices for changes in quality: - video cameras - video cassette recorders		 1987-1999 1987-03/2000
Quality adjustment of refrigerators/freezers	Regression models used to adjust refrigerators/freezers for changes in quality	2000	1978-06/2000
Quality adjustment of clothes washers	Regression models used to adjust prices of clothes washers for changes in quality	2000	1978-09/2000
Quality adjustment of clothes dryers	Regression models used to adjust prices of clothes dryers for changes in quality	2000	1978-09/2000
Quality adjustment of microwave ovens	Regression models used to adjust prices of microwave ovens for changes in quality	2000	1978-06/2000
Quality adjustment of college textbooks	Regression models used to adjust prices of college textbooks for changes in quality	2000	1978-06/2000
Revision of shelter indexes for 1999	To adjust for an error in the calculation of the rent and owners' equivalent rent indexes for 1999.	2000	1999
More frequent weight updates	Weights are now updated in the CPI every two years instead of approximately every ten years.	2002	1990-95

Limitations of the CPI-U-RS

There are two primary limitations of the CPI-U-RS. The first reflects uncertainty surrounding the magnitude of each adjustment made to the CPI-U-RS. The second reflects the fact that some improvements to the CPI-U, for which no adjustments were made to the CPI-U-RS, may nevertheless have affected the rate of inflation as measured by the CPI-U.

Most adjustments to the CPI-U-RS were based on BLS research that estimated the impact of methodological changes to the CPI over a relatively short period of time, and the effect of a given methodological change (outside the period of study) is assumed to be constant over time. For example, while the price changes for the experimental CPI using geometric means (CPI-U-XG) were used to adjust most CPI item categories from 1991-98, the CPI-U-RS was adjusted downward from 1978-90 by the *average* differences between the CPI-U and CPI-U-XG from 1991 to the mid-1990s. Similarly, apparel indexes for the CPI-U-RS from 1978-90 are adjusted based on study of the effect of the improvement during the last six months of 1991. While there is typically a great degree of confidence about the direction of the adjustment made to the CPI-U-RS, there must be less confidence about the precise size of adjustments made based on such extrapolation.

Similarly, as noted above, there have been a number of methodological improvements made to the CPI for which *no* estimate was made for the CPI-U-RS. Other organizations, such as the Congressional Budget Office and the Council of Economic Advisers, have estimated the impact of some of these CPI improvements on the projected rate of inflation for budget forecasts.

Results

Over the 32-year period of the study (December 1977 – December 2009), the CPI-U-RS increased 217.1 percent, compared to 247.7 percent for the CPI-U over the same time period; the annualized difference between the two measures is approximately 0.30 percent. Table 2 gives the December-to-December percent changes for 1978 through 2009 for the CPI-U and CPI-U-RS for the All Items index and for CPI major groups.

Table 2. CPI for all urban consumers (CPI-U) and CPI research series using current methods (CPI-U-RS), all items and major groups, December to December percent changes, 1978-2009.

Year	Index	All items	Food and beverages	Housing	Apparel	Transpor-tation	Medical care	Entertain-ment	Other g and ser	Recre-ation	Educ and Comm
1978	**CPI-U**	**9.0**	**11.6**	**10.0**	**3.1**	**7.7**	**8.8**	**5.7**	**6.4**	**-**	**-**
	CPI-U-RS	7.9	11.0	7.7	2.1	7.5	8.7	5.2	6.1	-	-
1979	**CPI-U**	**13.3**	**10.0**	**15.2**	**5.5**	**18.3**	**10.1**	**6.9**	**7.8**	**-**	**-**
	CPI-U-RS	10.8	9.5	9.7	4.5	18.3	9.8	6.3	7.5	-	-
1980	**CPI-U**	**12.5**	**10.1**	**13.7**	**6.8**	**14.6**	**9.9**	**9.7**	**10.1**	**-**	**-**
	CPI-U-RS	10.8	9.5	10.2	5.7	15.4	9.8	9.0	9.8	-	-
1981	**CPI-U**	**8.9**	**4.3**	**10.2**	**3.5**	**10.9**	**12.5**	**7.2**	**9.9**	**-**	**-**
	CPI-U-RS	8.3	3.8	10.1	2.7	10.4	12.3	6.6	9.4	-	-
1982	**CPI-U**	**3.8**	**3.2**	**3.6**	**1.6**	**1.8**	**11.0**	**5.6**	**12.1**	**-**	**-**
	CPI-U-RS	5.1	2.7	7.0	0.7	1.9	10.7	5.1	11.7	-	-
1983	**CPI-U**	**3.8**	**2.7**	**3.5**	**2.9**	**3.9**	**6.4**	**4.0**	**7.9**	**-**	**-**
	CPI-U-RS	3.8	2.1	3.9	2.0	4.2	6.2	3.2	7.6	-	-
1984	**CPI-U**	**3.9**	**3.8**	**4.3**	**2.0**	**3.1**	**6.1**	**4.2**	**6.0**	**-**	**-**
	CPI-U-RS	3.8	3.2	4.6	1.0	2.6	5.9	3.7	5.8	-	-
1985	**CPI-U**	**3.8**	**2.8**	**4.3**	**2.8**	**2.6**	**6.8**	**3.1**	**6.3**	**-**	**-**
	CPI-U-RS	3.6	2.3	4.4	1.9	2.7	6.4	2.6	5.9	-	-
1986	**CPI-U**	**1.1**	**3.7**	**1.7**	**0.9**	**-5.9**	**7.7**	**3.4**	**5.5**	**-**	**-**
	CPI-U-RS	1.0	3.2	2.0	0.0	-6.3	7.5	2.7	5.3	-	-
1987	**CPI-U**	**4.4**	**3.5**	**3.7**	**4.8**	**6.1**	**5.8**	**4.0**	**6.1**	**-**	**-**
	CPI-U-RS	4.1	3.0	3.4	3.8	5.9	5.5	3.4	5.8	-	-
1988	**CPI-U**	**4.4**	**5.1**	**4.0**	**4.7**	**3.0**	**6.9**	**4.6**	**7.0**	**-**	**-**
	CPI-U-RS	3.9	4.5	3.5	3.7	2.4	6.6	3.9	6.6	-	-
1989	**CPI-U**	**4.6**	**5.5**	**3.9**	**1.0**	**4.0**	**8.5**	**5.1**	**8.2**	**-**	**-**
	CPI-U-RS	4.2	4.9	3.6	-0.1	3.7	8.3	4.5	7.9	-	-
1990	**CPI-U**	**6.1**	**5.3**	**4.5**	**5.1**	**10.4**	**9.6**	**4.3**	**7.6**	**-**	**-**
	CPI-U-RS	5.7	4.6	4.0	4.1	10.7	9.2	3.3	7.1	-	-
1991	**CPI-U**	**3.1**	**2.5**	**3.4**	**3.4**	**-1.5**	**7.9**	**3.9**	**8.0**	**-**	**-**
	CPI-U-RS	2.4	2.0	2.5	2.1	-1.5	7.5	3.1	7.4	-	-
1992	**CPI-U**	**2.9**	**1.6**	**2.6**	**1.4**	**3.0**	**6.6**	**2.8**	**6.5**	**-**	**-**
	CPI-U-RS	2.5	1.1	2.0	-0.1	3.4	6.3	2.0	6.0	-	-
1993	**CPI-U**	**2.7**	**2.7**	**2.7**	**0.9**	**2.4**	**5.4**	**2.8**	**2.7**	**-**	**-**
	CPI-U-RS	2.3	2.1	2.3	-0.7	2.4	5.0	2.2	2.0	-	-
1994	**CPI-U**	**2.7**	**2.7**	**2.2**	**-1.6**	**3.8**	**4.9**	**2.3**	**4.2**	**-**	**-**
	CPI-U-RS	2.2	2.1	1.8	-2.3	3.3	4.6	1.0	3.6	-	-
1995	**CPI-U**	**2.5**	**2.1**	**3.0**	**0.1**	**1.5**	**3.9**	**3.3**	**4.3**	**-**	**-**
	CPI-U-RS	2.3	1.9	2.7	-1.3	1.4	3.6	2.5	3.9	-	-
1996	**CPI-U**	**3.3**	**4.2**	**2.9**	**-0.2**	**4.4**	**3.0**	**2.9**	**3.6**	**-**	**-**
	CPI-U-RS	3.1	3.8	2.8	-1.1	4.4	2.9	2.0	3.4	-	-
1997	**CPI-U**	**1.7**	**1.6**	**2.3**	**1.0**	**-1.4**	**2.8**	**1.4**	**5.2**	**-**	**-**
	CPI-U-RS	1.5	1.5	2.3	0.0	-1.4	2.7	0.8	5.0	-	-
1998	**CPI-U**	**1.6**	**2.3**	**2.3**	**-0.7**	**-1.7**	**3.4**	**-**	**8.8**	**1.2**	**0.7**
	CPI-U-RS	1.4	1.9	2.3	-2.4	-1.5	3.2	-	8.1	0.8	0.2
1999	**CPI-U**	**2.7**	**2.0**	**2.2**	**-0.5**	**5.4**	**3.7**	**-**	**5.1**	**0.8**	**1.6**
	CPI-U-RS	2.7	2.0	2.3	-0.4	5.3	3.7	-	5.1	0.8	1.6
2000	CPI-U	**3.4**	**2.8**	**4.3**	**-1.8**	**4.1**	**4.2**	**-**	**4.2**	**1.7**	**1.3**
	CPI-U-RS	3.3	2.7	4.1	-1.7	4.1	4.2	-	4.2	1.7	1.3
2001	CPI-U	**1.6**	**2.8**	**2.9**	**-3.2**	-3.8	**4.7**		**4.5**	**1.5**	**3.2**
	CPI-U-RS	1.5	2.8	2.9	-3.3	-3.9	4.7		4.5	1.5	3.2
2002	CPI-U	**2.4**	**1.5**	**2.4**	**-1.8**	**3.8**	**5.0**		**3.3**	**1.1**	**2.2**
	CPI-U-RS	2.4	1.5	2.3	-1.7	3.8	5.0		3.3	1.1	2.1
2003	CPI-U	**1.9**	**3.5**	**2.2**	**-2.1**	**0.3**	**3.7**		**1.5**	**1.1**	**1.6**
	CPI-U-RS	1.8	3.5	2.2	-2.1	0.4	3.7		1.5	1.0	1.6
2004	CPI-U	**3.3**	**2.6**	**3.0**	**-0.2**	**6.5**	**4.2**		**2.5**	**0.7**	**1.5**
	CPI-U-RS	3.3	2.6	3.0	-0.2	6.5	4.3		2.6	0.8	1.5
2005	CPI-U	**3.4**	**2.3**	**4.0**	**-1.1**	**4.8**	**4.3**		**1.1**	**3.1**	**2.4**
	CPI-U-RS	3.4	2.3	4.0	-1.0	4.8	4.3		1.1	3.1	2.4
2006	CPI-U	**2.5**	**2.2**	**3.3**	**0.9**	**1.6**	**3.6**		**1.0**	**2.3**	**3.0**
	CPI-U-RS	2.6	2.2	3.3	0.9	1.6	3.6		1.0	2.4	3.0
2007	CPI-U	4.1	4.8	3.0	-0.3	8.3	5.2		3.3	0.8	3.0
	CPI-U-RS	4.1	4.8	3.0	-0.3	8.3	5.2		3.3	0.8	3.0
2008	CPI-U	0.1	5.8	2.4	-1.0	-13.3	2.6		3.4	1.8	3.6
	CPI-U-RS	0.1	5.8	2.4	-1.0	-13.3	2.6		3.4	1.7	3.6
2009	CPI-U	2.7	-0.4	-0.3	1.9	14.4	3.4		8.0	-0.4	2.4
	CPI-U-RS	2.7	-0.4	-0.2	2.0	14.4	3.4		8.1	-0.4	2.3

Dec. 1977-Dec. 2009	**CPI-U**	**247.7**	**225.0**	**264.1**	**47.9**	**216.5**	**544.3**	**134.3****	**505.7**	**13.2***	**28.9***
	CPI-U-RS	217.1	194.2	228.8	18.0	212.8	512.6	104.4**	460.7	12.8*	28.2*
	Avg annual difference	0.30	0.32	0.33	0.71	0.04	0.17	0.71	0.25	0.03*	0.05*

Note: From 1978-1997, there were seven major groups in the CPI. In 1998, entertainment was dropped as a major group, and two major groups were added: recreation, and education and communication.

*These represent changes from December 1997-December 2009

**Entertainment was dropped as a major group in December 1997; these numbers represent percent changes from December 1977 through December 1997.

Conclusion and Future Research

Since the CPI-U does not incorporate methodological changes retroactively, the BLS developed the CPI-U-RS for researchers interested in a measure of inflation that attempts to use current and consistent methods of estimating consumer inflation over the 1978-2009 time period.

The CPI-U-RS provides a somewhat different picture of inflation from 1978-2009 by including an estimate of most improvements made over time in the CPI back to 1978. This can provide users of CPI data a new perspective on inflation, and on the performance of the American economy, over the 1978-2009 time period.

Researchers should be aware of the limitations of the CPI-U-RS, including the fact that adjustments made to the CPI-U-RS from 1978 forward typically reflect extrapolations of estimates made over later, and much shorter, periods. In addition, the CPI-U-RS is not adjusted for many improvements made to the CPI over the past 32 years. Nonetheless, for some purposes, the CPI-U-RS can serve as a valuable proxy for what the CPI-U would have been had current methods been in place from 1978 forward.

The CPI-U-RS is subject to revision. When an improvement is made to the CPI, and an estimate of the effect of that change can be made, the CPI-U-RS will be revised to reflect that improvement. In addition, if a superior method of adjusting the CPI-U-RS for past improvements is made available, the adjustments reported here will be refined.

To assist users, the All items CPI-U-RS indexes are available on request by calling 202-691-7000.

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[1] Historical CPI indexes are occasionally revised when data collection or processing errors are discovered. Methodological improvements, however, do not result in data revisions.

[2] See the U.S. Bureau of Economic Analysis, *Survey of Current Business*, October 1999.

[3] See the U.S. Bureau of Labor Statistics, "Productivity and costs, second-quarter measures, 1999", August 1999.

[4] See the U.S. Bureau of the Census, *Money Income in the U.S., 1998,* September 1999.

[5] Because of limitations of available data, adjustments for periods prior to the 1987 CPI Revision often had to be made at a slightly higher level of aggregation, roughly corresponding to the level of a CPI expenditure class.

[6] A more detailed description of most of these methodological changes is available in Kenneth J. Stewart and Stephen B. Reed, "Consumer Price Index research series using current methods, 1978-98," *Monthly Labor Review*, June 1999, pp. 29-38.

[7] These are more fully described in Stewart and Reed.

Current Price Topics: The Use of CPI in Poverty Measurement

The Consumer Price Index (CPI) plays a critical role in adjusting the Nation's measurement of poverty every year. Poverty thresholds are used by the Census Bureau to determine which families are poor. Poverty guidelines are used by the Department of Health and Human Services to determine eligibility for Federal assistance. The poverty figures are adjusted by the changes in the CPI to keep the real income levels associated with these thresholds and guidelines constant.[1] Specifically, these annual poverty measures are tied to changes in the annual average all items Consumer Price Index for All Urban Consumers (CPI-U).

To illustrate an annual adjustment, the poverty guideline for a family of four in the 48 contiguous States in 2008 was $21,200. Since the annual average CPI-U rose 3.8 percent in 2008, the poverty guideline for a family of four in 2009 was then adjusted upward to $22,050. Similar adjustments were made to the poverty thresholds.[2]

Although the annual average CPI-U typically increases from year to year, as in the previous example, this measure of inflation actually *fell* 0.4 percent in 2009. This represented the first decline in the annual average CPI-U since 1955, and the first decline since these poverty measures were tied to the all items CPI-U. This meant that, unless there was a change in the law underlying the adjustment rules, the poverty guidelines would have been adjusted downward. Said another way, without Congressional action, if the poverty guidelines would be adjusted downward for 2010, some families making the same amount of income would no longer be eligible for financial assistance, and others would have had their level of aid reduced. As a result, Congress took action to keep the 2010 poverty guidelines at 2009 levels until at least May 31, 2010.[3]

The poverty thresholds, on the other hand, were adjusted lower in 2010, in line with the small decrease in the annual average CPI-U. For example, the weighted average poverty threshold for a family of four in 2008 was $22,025. In 2009, reflecting the slight drop in the CPI-U, the preliminary average poverty threshold was adjusted downward to $21,947.[4]

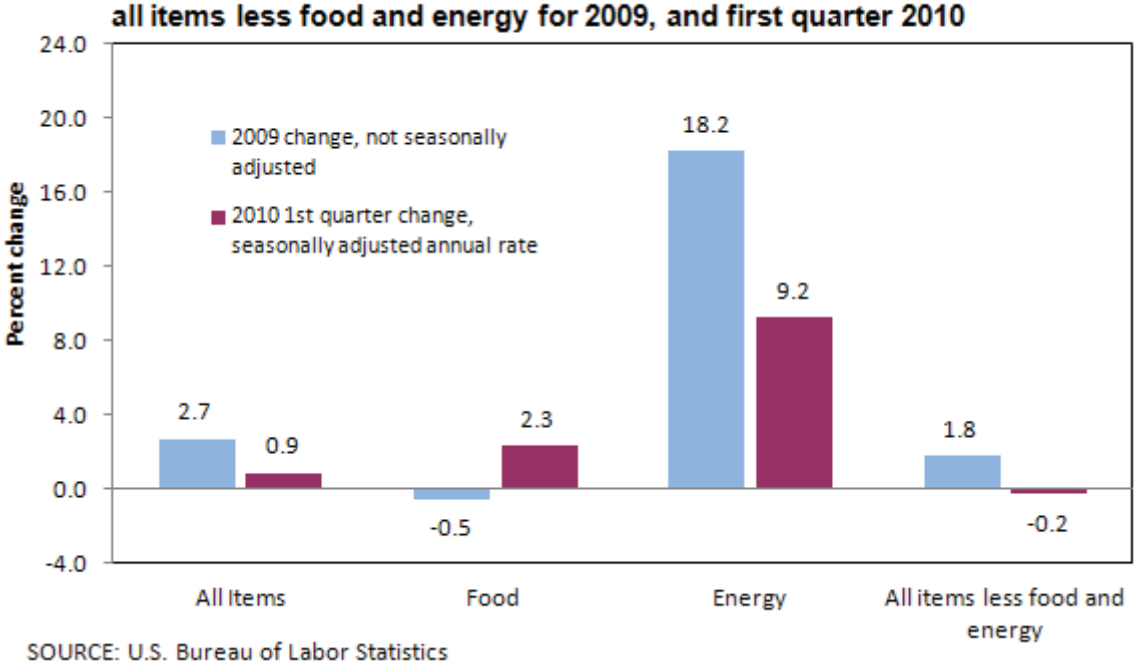
The use of the CPI in adjusting poverty values is mandated by law. This is only one example of myriad programmatic and contractual uses for this prominent statistic. Its influence extends far beyond simply being a measure of price changes paid by consumers. Future editions of this *Focus* series for the CPI will examine some of these other applications.

Current Price Trends: Recent Modest Inflation Caused Primarily by Higher Gasoline Prices

All items

The all items Consumer Price Index for All Urban Consumers (CPI-U) rose at a 0.9-percent seasonally adjusted annual rate during the first quarter of 2010. (See chart 1.)[5] In 2009, this index had increased 2.7 percent, not seasonally adjusted.

Chart 1. CPI-U percent changes for all items, food, energy, and all items less food and energy for 2009, and first quarter 2010



SOURCE: U.S. Bureau of Labor Statistics

Energy

The modest increase in the all items index for the first quarter of 2010 was due primarily to a 9.2-percent annual rate of growth in the index for energy. Within energy, gasoline prices continued to increase in the first quarter of 2010, up at an 8.6-percent annual rate after increasing 53.5 percent in 2009. Natural gas prices were up at a 29.8-percent annual rate in the first quarter of 2010 after falling 18.1 percent in 2009, and fuel oil prices rose at an annual rate of 18.2 percent.

Over the past few years, crude oil prices—and subsequently retail gasoline prices—have been quite volatile. From July 2007 to July 2008, gasoline prices rose sharply, increasing 37.9 percent (not seasonally adjusted); crude oil prices peaked in July 2008 at more than $134 a barrel. During the last 5 months of 2008, as crude oil prices collapsed to under $32 a barrel, retail gasoline prices fell by more than 50 percent. In 2009, pump prices turned sharply higher again, increasing more than 50 percent, with crude oil prices increasing to around $70 a barrel by the end of 2009.[6]

Food

Food prices rose at a 2.3-percent annual rate in the first quarter of 2010, with grocery store prices increasing 3.7 percent. Significant increases were seen in 3 of the 6 major grocery store food groups. The index for fruits and vegetables was up at a 19.7-percent rate, with fresh vegetable prices up at a 32.5-percent rate. Unusually cold weather early in the year in Florida significantly affected tomato prices, which rose at a 40.5-percent annual rate in the first quarter of 2010. Dairy products rose at an 8.5-percent rate in the first quarter, with milk at 9.9 percent. Meats, poultry, fish, and eggs increased at an annual rate of 4.1 percent in the first quarter of 2010 after falling 3.8 percent in 2009. Within this group, egg prices have risen at a 12.7-percent annual rate so far in 2010.

Small or modest price declines were noted for the other three grocery store food groups. The index for cereal and bakery products fell 2.8 percent. Nonalcoholic beverages fell 0.7 percent, and other food at home declined 1.0 percent.

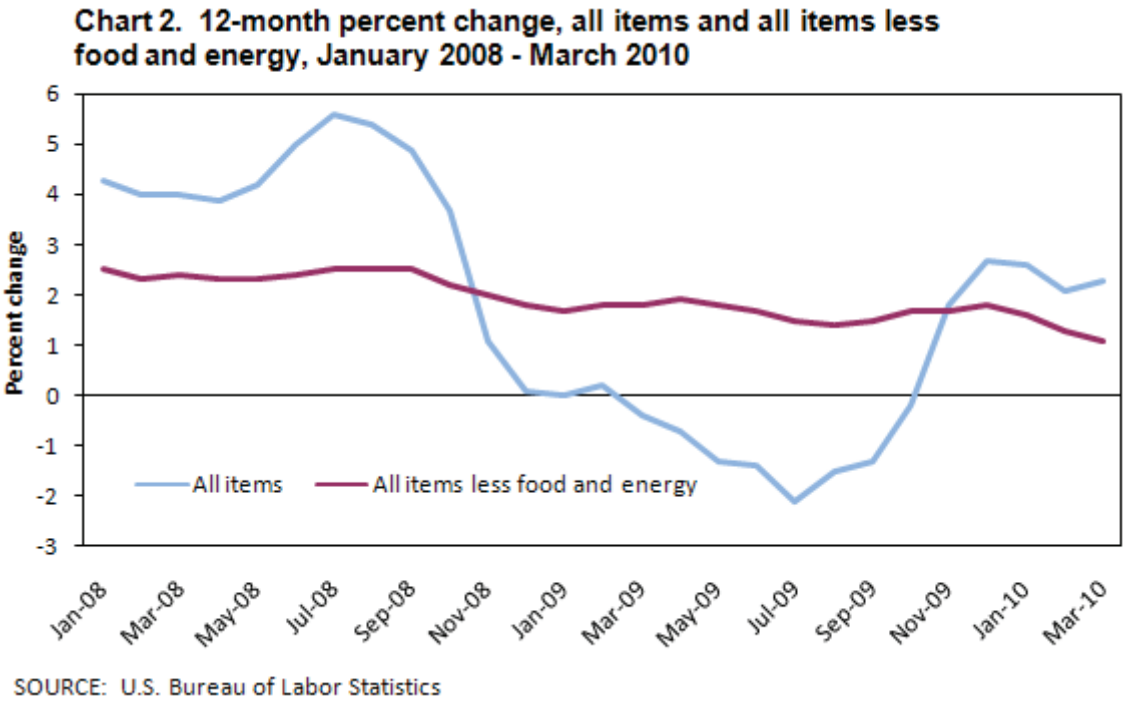
Grocery store price changes in the first quarter of 2010 were more modest than in recent years. Grocery store inflation was relatively high during most of 2008; for example, these prices rose 7.0 percent from November 2007 to November 2008. In the next 12 months, however, grocery store food prices turned down, falling 2.9 percent, its sharpest annual drop since June 1959.

All items less food and energy

The index for all items less food and energy fell at a 0.2-percent annual rate in the first quarter of 2010, the first quarterly decrease since September 1960. The decrease in the first quarter of 2010 was due primarily to a 2.2-percent annual rate of decline in shelter costs. Within shelter, owners' equivalent rent fell at a 0.8-percent rate, and lodging away from home declined at a rate of 6.7 percent. In addition, some transportation components fell in the first quarter of 2010 after increasing in 2009. Airline fares fell at a 10.9 percent rate in the first quarter of 2010 after rising 4.3 percent in 2009. The index for new vehicles also fell in the first quarter of 2010, dropping at a 1.2-percent annual rate after increasing 4.9 percent in 2009.

The first quarter 2010 decreases within all items less food and energy were partially offset by increases in other items. Medical care prices were up at a rate of 5.7 percent in the first quarter, with medical care commodities increasing at a 7.7-percent pace. Prices for used cars and trucks continued to increase in the first quarter of 2010, up at an 11.4-percent rate after increasing 9.2 percent in 2009. Tobacco prices, which had increased 30.1 percent in 2009 due in part to Federal and State tax increases, were up at an annual rate of 1.8 percent in the first quarter of 2010.

The rate of inflation for all items less food and energy has slowed somewhat in recent years, and has increased only 1.1 percent over the past 12 months. (See chart 2.) This is the lowest 12-month change in this broad expenditure category since an equivalent increase in January 2004, and the annual rate of inflation for this index has not been lower since a 0.9 percent increase in January 1966. The recent deceleration in this so-called "core" rate of inflation can largely be attributed to a similar deceleration in shelter inflation. Shelter prices, which had increased at a 3.1-percent average annual rate from 1992 to 2007, rose only 1.9 percent in 2008, and increased only 0.3 percent in 2009. This deceleration for shelter continued into 2010, with shelter prices down 2.2 percent in the first quarter.



Further information is available from the CPI Information and Analysis section, at cpi_info@bls.gov or (202) 691-7000.

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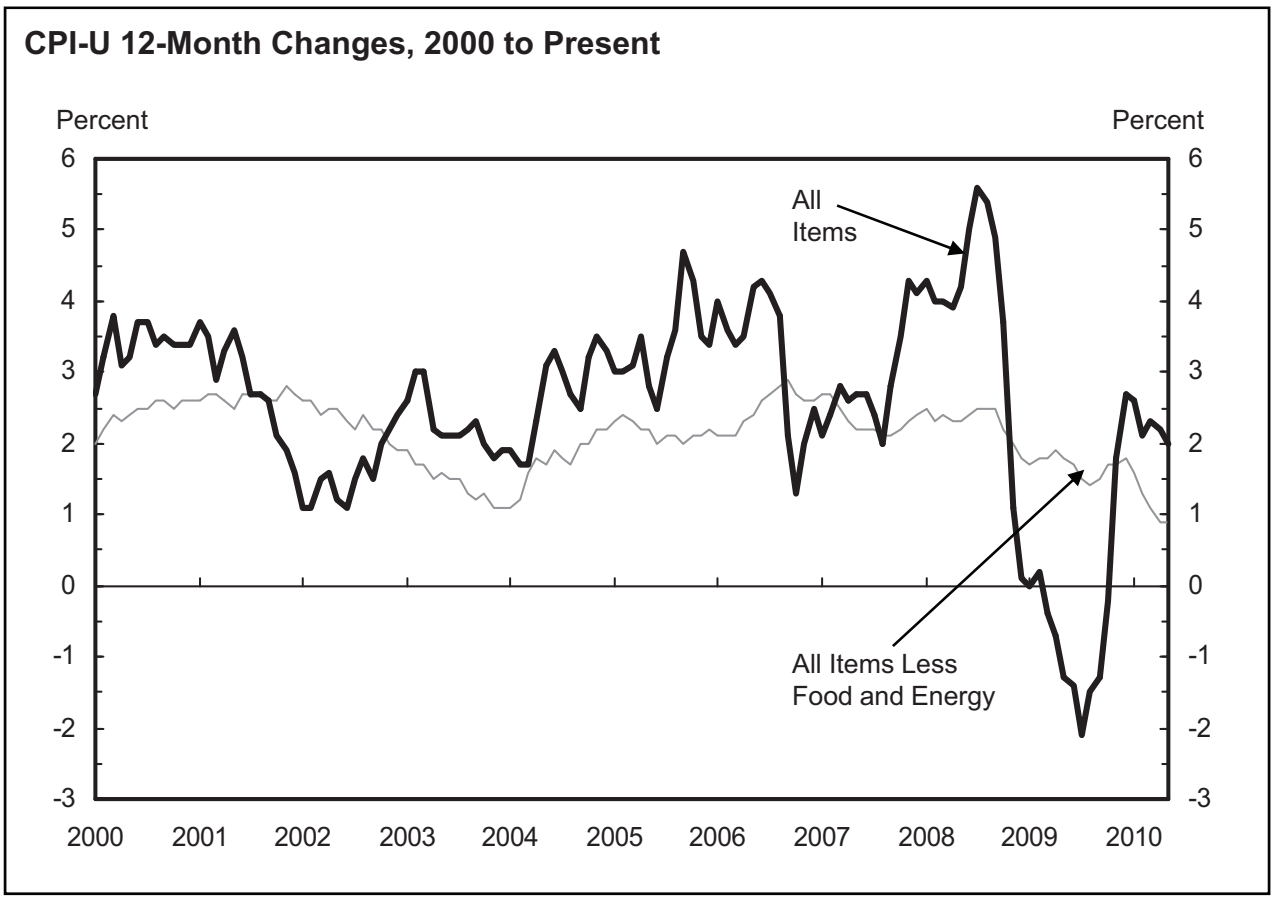
[1] A more detailed list of differences between poverty thresholds and poverty guidelines can be found at http://aspe.hhs.gov/POVERTY/faq.shtml (visited May 6, 2010).
[2] The figure resulting from this adjustment is rounded upward to the next multiple of $50; see http://aspe.hhs.gov/poverty/09computations.shtml (visited May 6, 2010).
[3] See http://aspe.hhs.gov/POVERTY/09extension.shtml for more details (visited May 6, 2010).
[4] See http://www.census.gov/hhes/www/poverty/threshld/09prelim.html (visited May 6, 2010). These threshold numbers are also subject to rounding.
[5] Price movements described in this text reflect data as released on April 14, 2010. All 12-month and longer percent changes reflect not seasonally adjusted data, and all hyperlinks show 12-month unadjusted changes for the last 10 years. Percent changes covering less than a year are based on seasonally adjusted annual rates, unless otherwise noted. CPI seasonally adjusted indexes and percent changes are subject to annual revision.
[6] Energy Information Administration; see http://tonto.eia.doe.gov/dnav/pet/pet_pri_wco_k_w.htm (visited May 6, 2010).


CPI-U 12-Month Changes, 2000 to Present
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All Items
All Items Less Food and Energy
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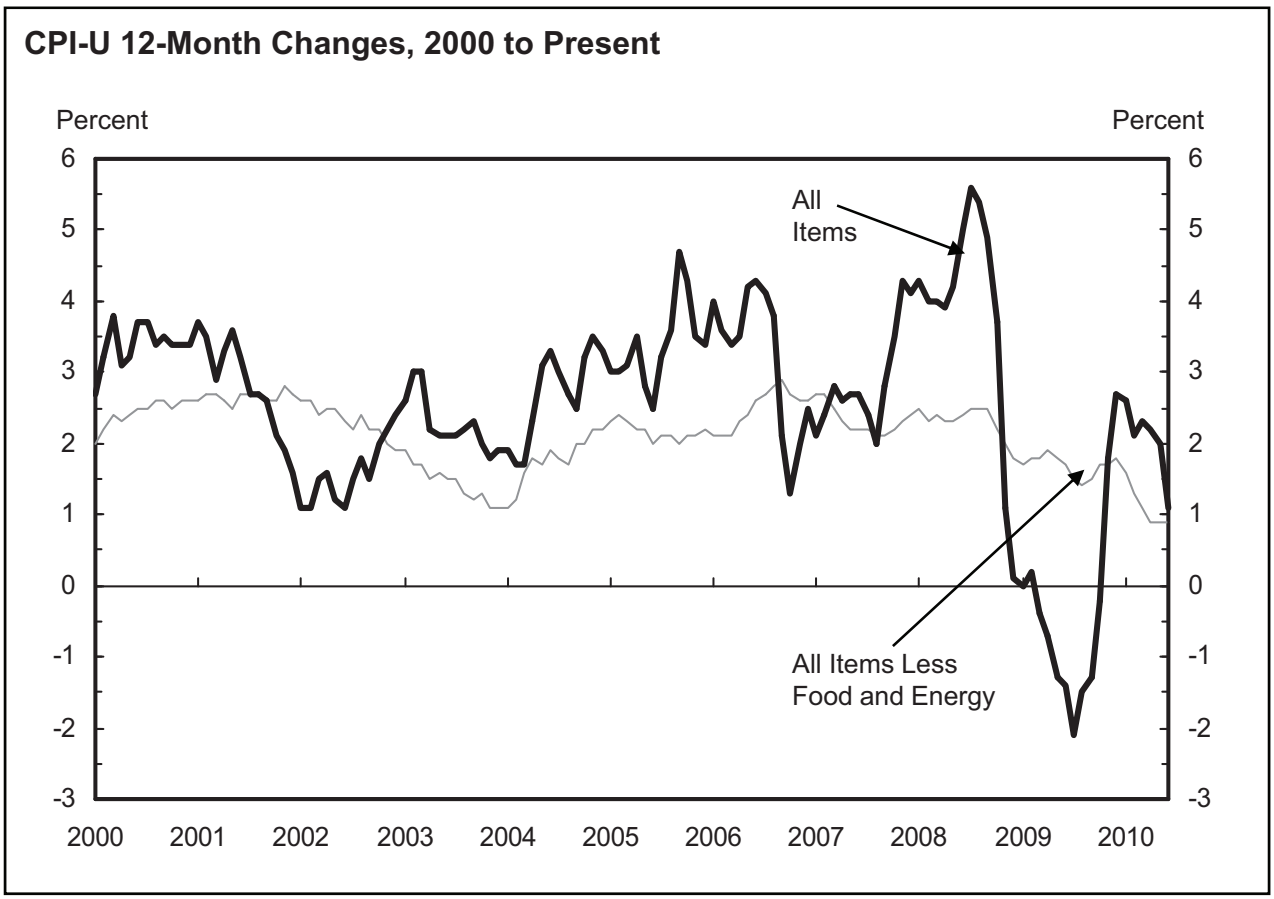
CPI-U 12-Month Changes, 2000 to Present
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All Items
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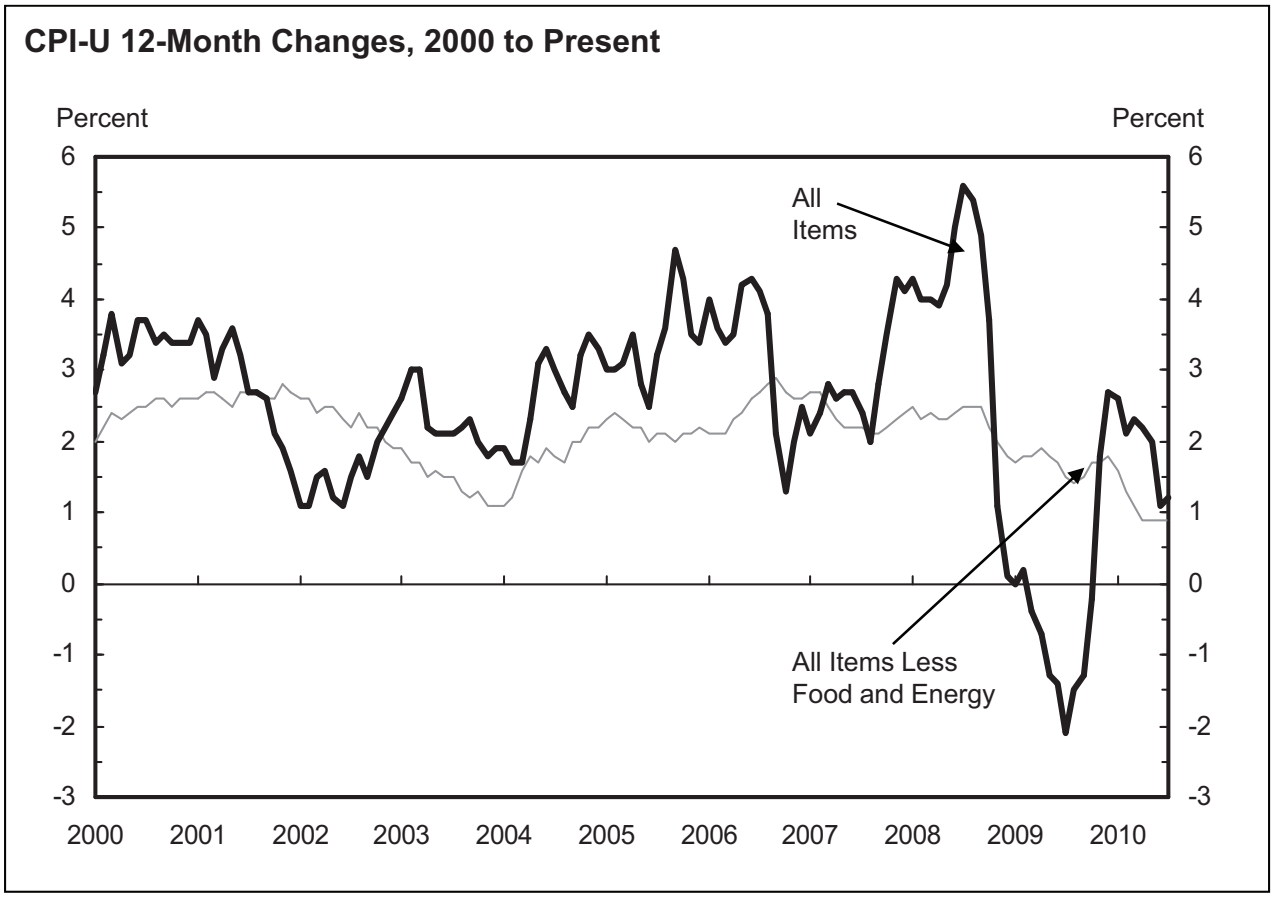
CPI-U 12-Month Changes, 2000 to Present
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The Use of the CPI in Adjusting Federal Income Tax Brackets and other Federal Tax Parameters

More than 140 million individual federal tax returns are filed each year.[1] Federal income tax brackets, as well as personal exemption amounts, standard deduction amounts, and other tax parameters, are adjusted each year by changes in the Consumer Price Index (CPI).

Before 1985, federal income tax brackets were not indexed to changes in the cost of living. As such, inflation eroded a family's purchasing power in multiple ways. First, families whose income did not keep up with inflation saw their real incomes fall. Second, even families whose pre-tax income kept pace with inflation were subject to reductions in real disposable income, as nominal increases in income forced taxpayers into higher tax brackets. For example, suppose a family's cost of living rose 5 percent in a year, as did its income. At first glance, the real income of this family has not changed, as its income has kept up with inflation. However, before 1985, the increase in the nominal income of this family would have resulted in higher federal income taxes, as more of the family's income would have been subject to the highest applicable tax bracket. This type of subtle tax increase is known as bracket creep. The Economic Recovery Tax Act (ERTA) of 1981 was passed, in part, to prevent bracket creep from adversely affecting American taxpayers.

Because of ERTA, and modifications made to that act in 1986, federal income tax brackets, as well as personal exemptions and standard deductions, are now tied to changes in the average CPI for All Urban Consumers (CPI-U) for the U.S. City Average for All items for the 12-month period ending in August of each year.

How the CPI-U affects federal income tax brackets

To see how the all items CPI-U affects federal income tax brackets, first take a look at the federal income tax brackets for 2008 for a married couple filing jointly. (See table 1.)

Table 1. Federal income tax brackets, married filing jointly, 2008 tax year

Marginal tax rate (in percent)	Tax brackets
10	Under $16,050
15	$16,051–$65,100
25	$65,101–$131,450
28	$131,451–$200,300
33	$200,301–$357,700
35	Over $357,700

To determine the 2009 federal income tax brackets, the Internal Revenue Service (IRS) looked at the average CPI-U from September 2007 through August 2008, and compared that average with the one for the preceding 12 months. For the 12 months ending in August 2007, the average CPI-U was 204.873. For the 12 months ending August 2008, the average CPI-U was 213.605, an increase of 4.26 percent. Therefore, each of the individual federal income tax brackets for 2009 was adjusted upwards by approximately 4.26 percent.[2] (See table 2.)

Table 2. Federal income tax brackets, married filing jointly, 2009 tax year

Marginal tax rate (in percent)	Tax brackets
10	Under $16,700
15	$16,701–$67,900
25	$67,901–$137,050
28	$137,051–$208,850
33	$208,851– $372,950
35	Over $372,950

CPI data were used in the same way to estimate the federal income tax brackets for 2010. The CPI-U for the 12 months ending in August 2009 was 214.002, which was only 0.19 percent higher than the previous annual average of 213.605. This resulted in only very slight increases in these tax brackets for 2010. (See table 3.)

Table 3. Federal income tax brackets, married filing jointly, 2010 tax year

Marginal tax rate (in percent)	Tax brackets
10	Under $16,750
15	$16,751–$68,000
25	$68,001–$137,300
28	$137,301–$209,250
33	$209,251–$373,650
35	Over $373,650

Again, tying changes in the tax brackets to the CPI has the effect of preventing taxpayers from being moved into higher marginal tax brackets for increases in income that do not exceed inflation. Similarly, this legislation has the effect of reducing taxes over time for families on a fixed income. For example, if a family made a constant $67,000 in 2008, 2009, and 2010, their real income has fallen because their income has not kept pace with inflation. Since tax brackets are tied to the CPI, the federal tax burden for this family actually fell from 2008 to 2010, and its marginal tax rates dropped from 25 percent in 2008 to 15 percent in 2010.

How the CPI-U affects standard deduction amounts and personal exemption amounts

Taxpayers who do not itemize can instead use a "standard deduction" amount to reduce the amount of income subject to federal tax. Similarly, "personal exemption" amounts can be deducted for each eligible member of the taxpayer's family. Similarly to the federal tax brackets, these federal tax parameters are also tied to annual changes in the CPI-U for each 12-month period ending in August. (See table 4.)

Table 4. Standard deduction and personal exemption amounts

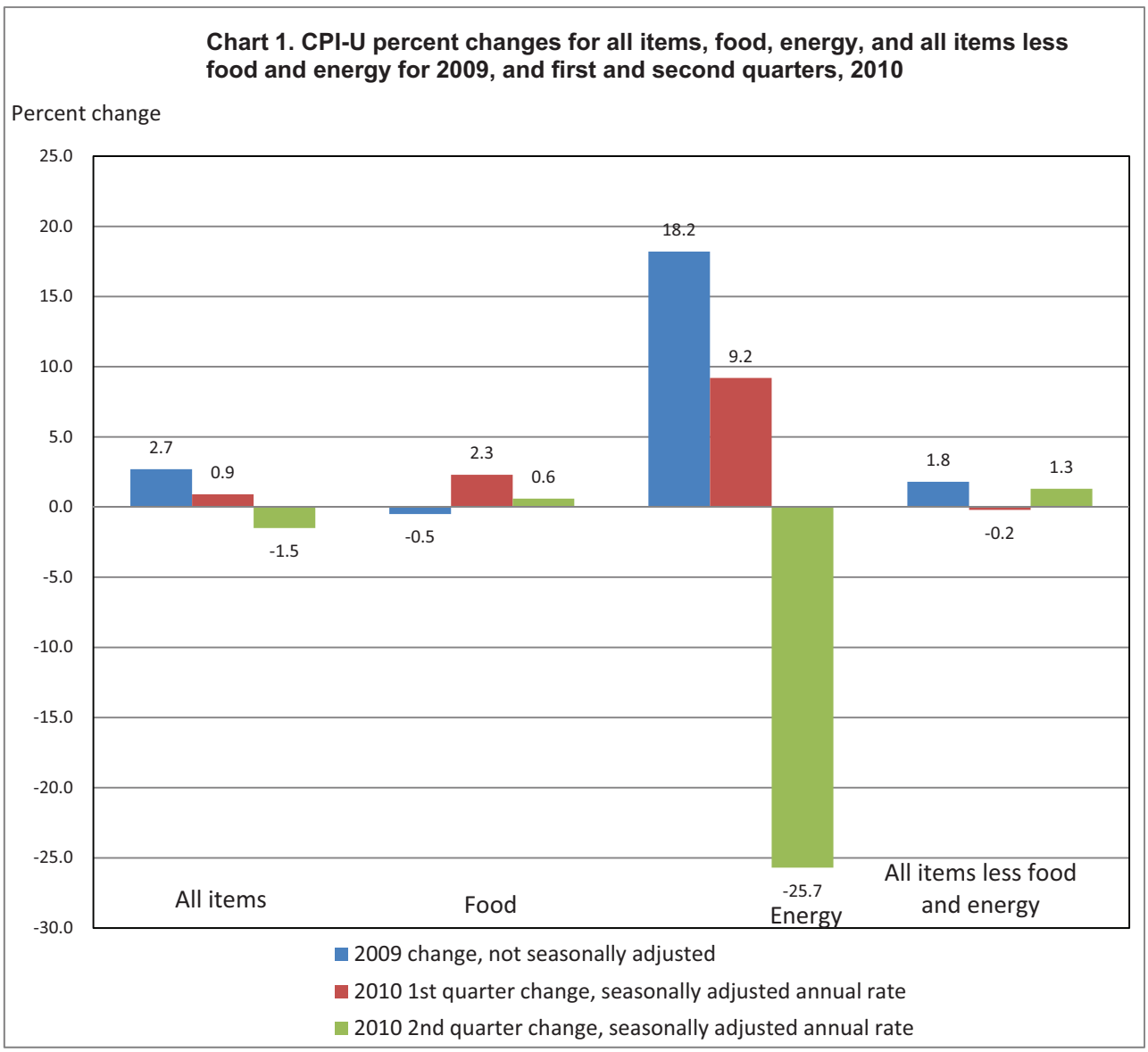
Tax year	Standard deduction amount	Personal exemption amount
2008	$10,900	$3,500
2009	11,400	3,650
2010	11,400	3,650

Note that, as with the tax brackets, the increase in standard deduction and personal exemption amounts rose more than four percent from 2008 to 2009. However, since the annual average CPI-U rose less than 0.2 percent for the next 12-month period, the standard deduction and personal exemption amounts (after rounding down to the next $50 amount), remained unchanged from 2009 to 2010.\

Current Price Trends: Decline in Energy Prices Dominates Second Quarter Retail Inflation Picture

All items

The all items Consumer Price Index for All Urban Consumers (CPI-U) declined at a 1.5-percent seasonally adjusted annual rate (SAAR) during the second quarter of 2010.[3] For the first 6 months of 2010, the index has declined at a 0.3-percent SAAR. This compares with an increase of 2.7 percent in 2009. (See chart 1.)



A downturn in the energy index is the main cause of the decline in the all items index thus far in 2010, but a deceleration in the index for all items less food and energy in the first quarter of the year is notable as well. The energy index rose significantly in 2009 but has declined so far in 2010. The index for all items less food and energy has risen so far in 2010, but at a rate lower than recent historical norms. In contrast, the food index has risen modestly in 2010 after declining in 2009.

Energy

Energy, typically, has been the most volatile of the major CPI components. It declined at a 25.7-percent SAAR in the second quarter of 2010 after rising at a 9.2-percent rate in the first quarter. (The monthly index has actually been declining since January.) For the first 6 months of 2010, the energy index has declined at a 9.9-percent SAAR after increasing 18.2 percent in 2009.

Within the energy component, the gasoline index fell at a 38.9-percent SAAR in the second quarter of 2010. This decline followed an increase at an 8.6-percent rate in the first quarter and a 53.5-percent rise over all of 2009. Sharp changes in gasoline prices are often a major factor in short-term CPI movements. Over the past few years, crude oil prices–and subsequently retail gasoline prices—have been quite volatile. From July 2007 to July 2008, gasoline prices rose sharply, increasing 37.9 percent; crude oil prices peaked in July 2008 at more than $134 a barrel. During the last 5 months of 2008, as crude oil prices collapsed to under $32 a barrel,

retail gasoline prices fell by more than 50 percent. In 2009, pump prices turned sharply higher again, increasing more than 50 percent, with crude oil prices increasing to around $70 by the end of 2009.[4]

The household energy index also turned down in the second quarter of 2010, falling at a 10.1-percent rate after rising at an 8.9-percent rate in the first quarter. All the major components of household energy declined in the second quarter after rising in the first. The sharpest downturn was in the natural gas index, which declined at a 17.7-percent SAAR in the second quarter after rising at a 29.8-percent annual rate in the first quarter. The electricity index turned down as well, falling at a 7.1-percent SAAR in the second quarter of 2010 after rising at a 2.0-percent rate in the first quarter. For 2010 so far, the natural gas index has risen at a 3.4-percent annual rate after falling 18.1 percent in 2009, while the electricity index has fallen at a 2.7-percent rate after falling 0.5 percent in 2009. The fuel oil index fell at an 8.9–percent rate in the second quarter after rising at an 18.2-percent rate in the first.

Food

Food prices rose at a 0.6-percent SAAR in the second quarter of 2010 after rising at a 2.3-percent rate in the first quarter. The food index had declined 0.5 percent in 2009. Grocery store food prices, which rose at a 3.7-percent rate in the first quarter, were flat in the second quarter.[5] Of the six major grocery store food groups, only the meats, poultry, fish, and eggs group increased in second quarter. It rose at a 12.0-percent rate after rising at a 4.1-percent rate in the first quarter. Within this group, the beef and veal index (22.2 percent SAAR) and the pork index (16.6 percent SAAR) increased most rapidly. The other food at home groups posted declines, with fruits and vegetables falling the sharpest, at a 9.9-percent rate. The indexes for fresh fruits (at −16.9 percent SAAR) and fresh vegetables (at −9.0 percent SAAR) both declined sharply in the second quarter. Part of the decrease in the fresh vegetables index can be attributed to tomato prices, which dropped sharply in the second quarter after rising sharply in the first.

The other grocery store food groups decreased more modestly in the second quarter. Cereals and bakery products fell at the same 2.8-percent SAAR in the second quarter as it did in the first. Dairy and related products fell at a 1.7-percent rate after rising in each of the previous two quarters. The Nonalcoholic beverages index declined at a 2.6-percent rate, its fifth consecutive quarterly decline. Other food at home fell at a 0.5-percent SAAR in the second quarter.

Food away from home rose at 1.4-percent rate in the second quarter after rising at a 0.4-percent rate in the first. It has risen just 1.2 percent over the past year after rising at an average 3.6-percent rate over the previous 5 years.

Grocery store prices have risen in 2010 after falling through much of 2009, but the current rate of increase is still below the recent historical average. From November 2002 to November 2007, grocery store food prices rose at a 3.1-percent average annual rate. They then accelerated, increasing 7.0 percent from November 2007 to November 2008. In the next 12 months, however, the index turned down, falling 2.9 percent, the sharpest annual drop since June 1959. Since then, the food at home index has risen at a 2.0-percent rate (seasonally adjusted). Currently none of the six major grocery store food groups have increased or decreased more than 2.0 percent over the last 12 months.

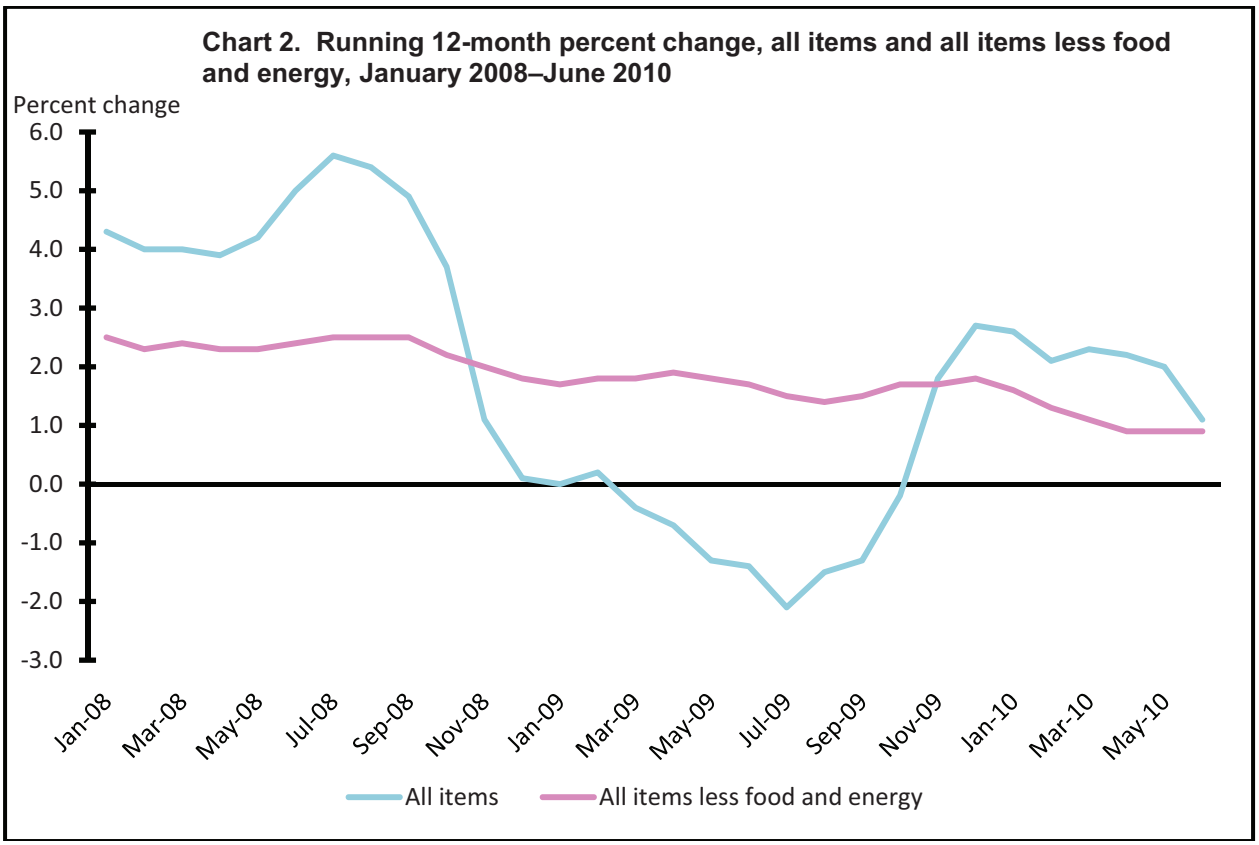
All items less food and energy

The index for all items less food and energy rose at a 1.3-percent rate in the second quarter of 2010 after falling at a 0.2-percent annual rate in the first quarter. Much of the reversal can be attributed to the shelter index, which rose at a 0.9-percent rate in the second quarter after falling at a 2.2-percent rate in the first. Within shelter, rent rose at a 0.4-percent SAAR in the second quarter and owners' equivalent rent rose at a 0.3-percent rate. Lodging away from home rose at a 23.1-percent rate after falling in the first quarter.

Several other indexes turned up in the second quarter as well. The sharpest upturn was the airline fare index, which rose at a 14.3-percent rate in the second quarter after declining at a 10.9-percent rate in the first. Similarly, the new vehicles index turned up in the second quarter, rising at a 0.4-percent rate after declining at a 1.2-percent rate in the first. Apparel, down at a 4.5-percent rate in the first quarter, rose at a 1.3-percent rate in the second, and Recreation rose at a 1.4-percent rate in the second quarter after falling at a 1.0-percent rate in the first.

Household furnishings and operations continued to decline in the second quarter of 2010, falling at the same 3.7-percent rate as it did in the first quarter, and the index for communication turned down, falling at a 1.3-percent rate after rising slightly in the first quarter. Used cars and trucks, which rose at an 11.4-percent SAAR in the first quarter, continued to advance in the second quarter but decelerated, rising at a 6.6-percent rate. The medical care index also decelerated in the second quarter, rising at a 2.3-percent rate after increasing at a 5.7-percent rate in the first. In contrast, the tobacco index accelerated in the second quarter, rising at a 9.9-percent rate after increasing at 1.8-percent rate in the first.

The rate of inflation for all items less food and energy has slowed recently. For the 5-year period from August 2003 to August 2008, the index for all items less food and energy increased at a 2.3-percent annual rate. (A very similar result holds if the period is extended back 10 or 15 years.) Since August 2008, however, the average annualized increase has fallen by nearly half, to 1.2 percent. (See chart 2.)



Much of this slower rate of inflation for the all items less food and energy index is attributable to the slowdown in the index for shelter, which is heavily weighted in the CPI. After increasing at a 3.0-percent average rate for the August 2003–08 period, the shelter index has risen at only a 0.2-percent annual rate since. Other indexes have decelerated as well, however, including airline fares and household furnishings and operations, which both turned down, as well as recreation, education, and medical care.

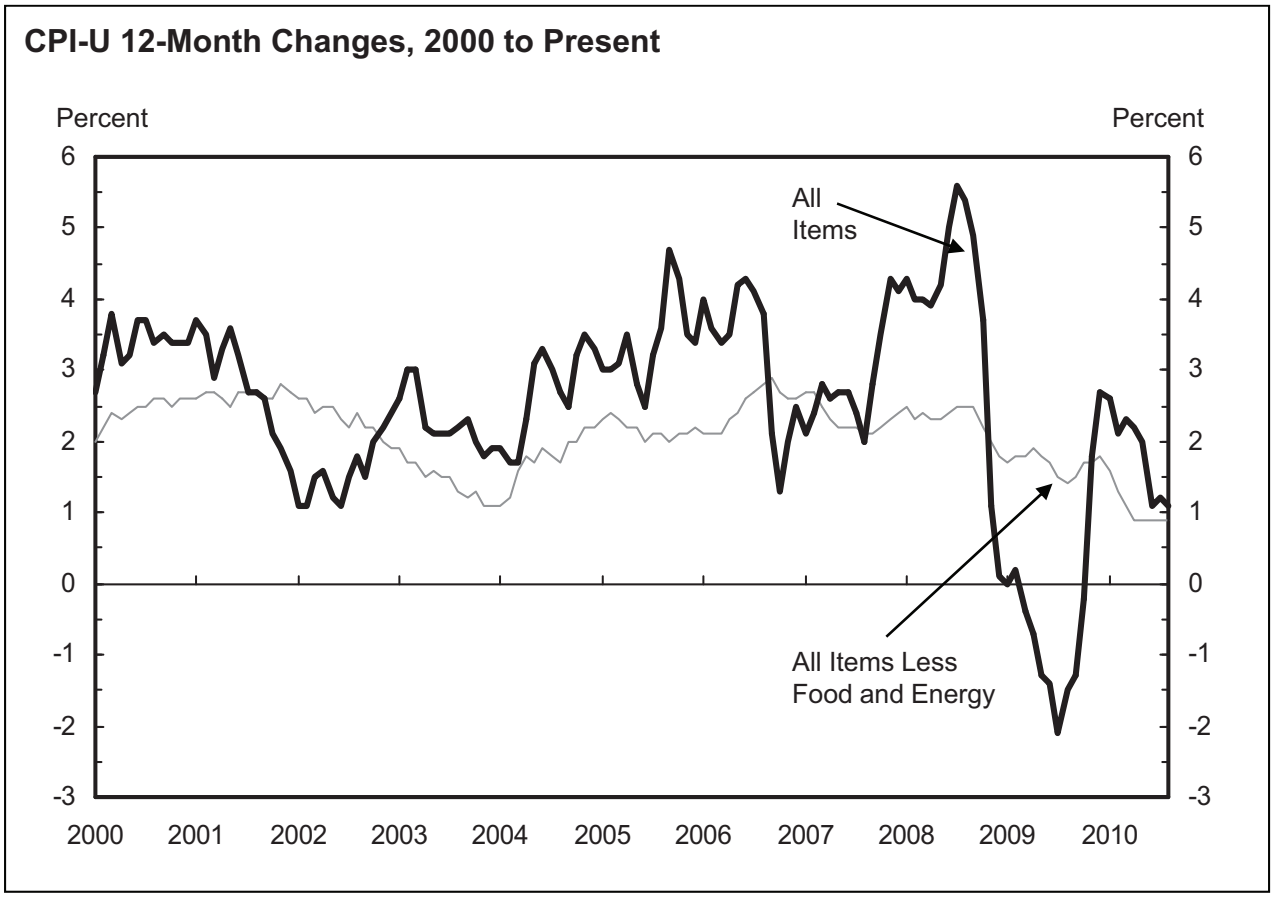
In contrast, some indexes within all items less food and energy actually accelerated recently. These include the tobacco index, which has risen sharply of late, in part due to excise tax increases, and the indexes for new vehicles and for used cars, which have both turned up after declining in the earlier period. Table 5 compares the changes of selected categories within all items less food and energy for the August 2003–August 2008 and August 2008–June 2010 periods.

Price movements described in this text reflect data as released on July 16, 2010. All 12-month and longer percent changes reflect not seasonally adjusted data except as noted. Percent changes covering less than a year are based on seasonally adjusted annual rates, unless otherwise noted. CPI seasonally adjusted indexes and percent changes are subject to annual revision.

Further information is available from the CPI Information and Analysis section, at cpi_info@bls.gov or (202) 691-7000.

Notes

[1] See http://www.irs.gov/pub/irs-soi/10winbulindincretpre.pdf (visited July 28, 2010).
[2] More precisely, each annual average is compared to an earlier initial base period, and the resulting numbers are rounded down to the next $50.
[3] Energy Information Administration; see http://tonto.eia.doe.gov/dnav/pet/pet_pri_wco_k_w.htm (visited July 28, 2010).
[4] The six major grocery store food groups are: Cereals and bakery products; Meats, poultry, fish and eggs; Dairy and related products; Fruits and vegetables-Nonalcoholic beverages and beverage materials; Other food at home.


CPI-U 12-Month Changes, 2000 to Present
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All Items Less Food and Energy
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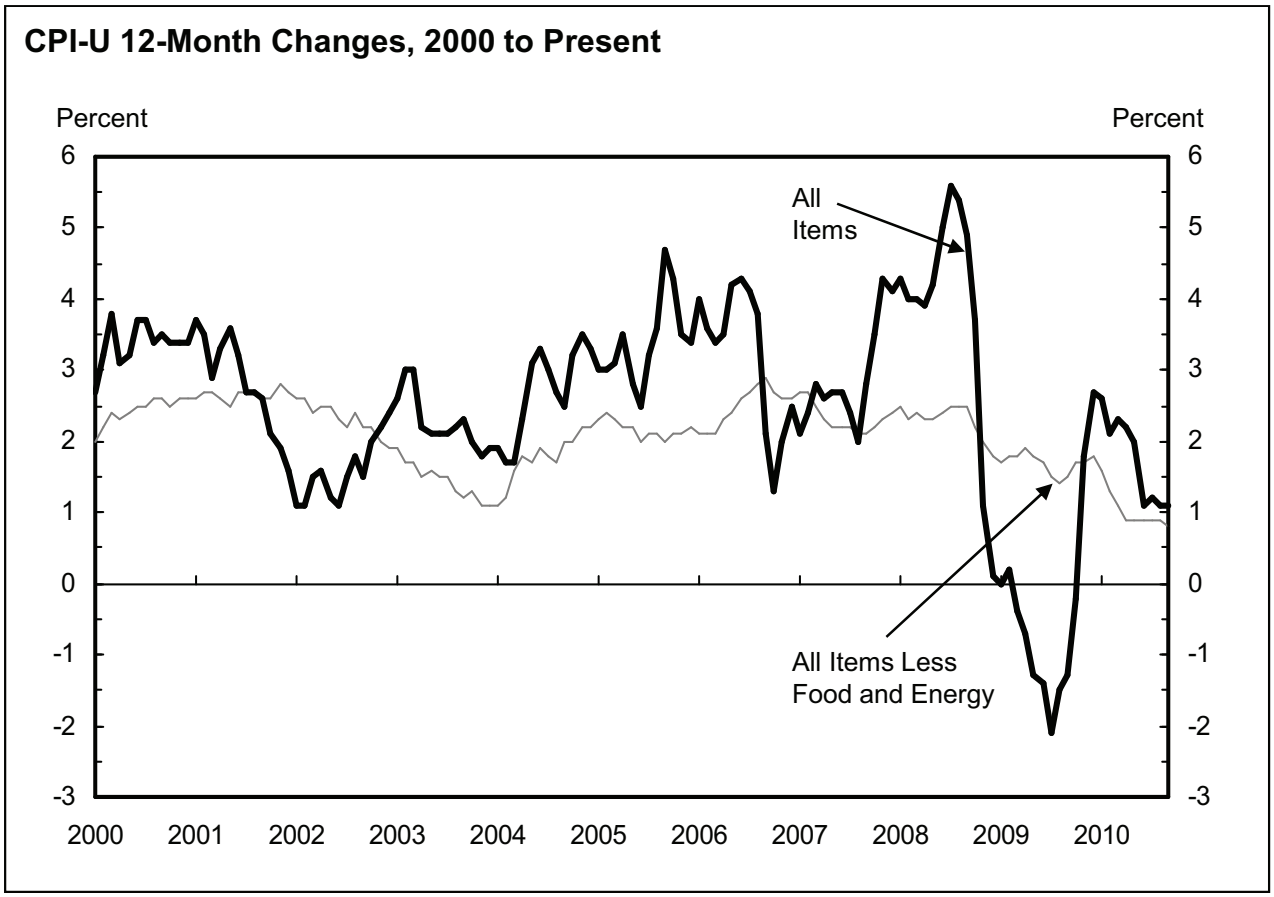
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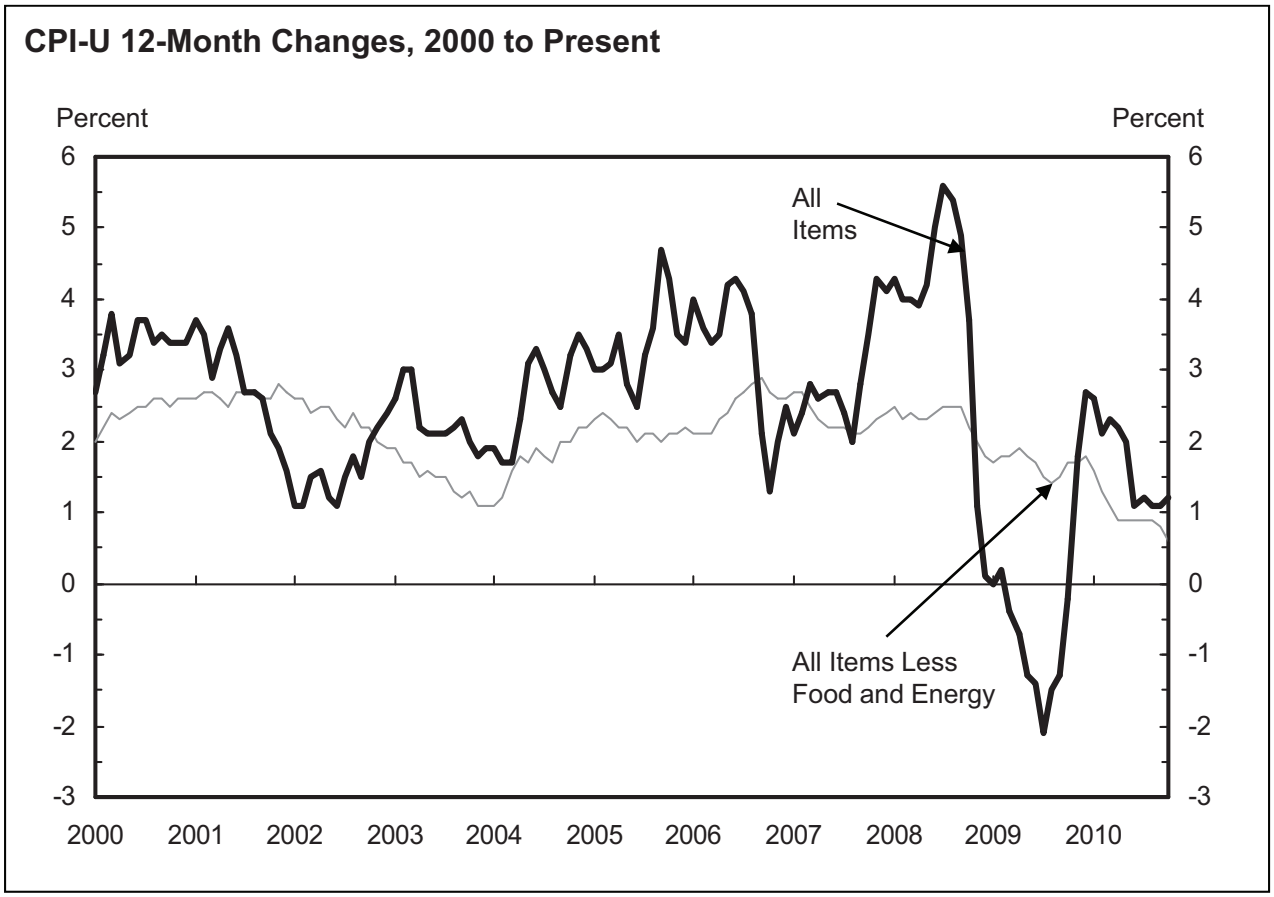
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2010

Current Price Topics: The Use of the CPI in Social Security Cost-of-Living Adjustments (COLAs)

More than 50 million people currently receive Social Security benefits.[1] In 1972, Congress passed legislation tying Social Security cost-of-living adjustments (COLAs) to changes in the Consumer Price Index. Specifically, these COLAs are based on the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), All Items, from the third quarter of one year to the third quarter of the next year.

COLA effective for 2009. The third quarter average 2007 CPI-W, All Items index stood at 203.596. The CPI-W average for the third quarter of 2008 was 215.495, an increase of 5.8 percent. (See table 1.) This 5.8-percent cost-of-living increase, which became effective in 2009, was the highest COLA in more than 25 years. The steep rise was due to both sharply higher gasoline prices, which climbed 35.2 percent from the third quarter of 2007 to the third quarter of 2008, and higher prices for food, which increased 6.2 percent over the same period.

Table 1. **CPI-W, All Items, third-quarter averages, 2007-10**

Year	July	August	September	Third-quarter average	Percent change from previous third quarter	Cost-of-living adjustment (percent)
2007	203.700	203.199	203.889	203.596		
2008	216.304	215.247	214.935	215.495	5.8	5.8
2009	210.526	211.156	211.322	211.001	–2.1	0.0
2010	213.898	214.205	214.306	214.136	1.5	0.0

COLA effective for 2010. From the third quarter of 2008 to the third quarter of 2009, the CPI-W actually *fell* 2.1 percent, due in large part to gasoline prices, which dropped 32.5 percent over that period. This was the first time the CPI-W, All Items index had fallen since Social Security COLAs were tied to the CPI. When the CPI-W falls, Social Security benefits do not fall. Instead, they remain unchanged.[2] For this reason, there was no COLA for 2010.

COLA effective for 2011. In the third quarter of 2010, the CPI-W stood at 214.136. Although this was higher than the 2009 third-quarter CPI-W average of 211.001, Social Security recipients will not receive a COLA in 2011. This is because, by legislation, the CPI-W must exceed its previous third-quarter peak, recorded in 2008, in order for there to be a positive COLA the next year. Put another way, because the third-quarter 2010 CPI-W level of 214.136 did not exceed its previous peak of 215.495 in 2008, there will be no automatic COLA in 2011. [3]

Current Price Trends: Rise in Energy Prices Drives Third-Quarter Retail Inflation Picture

All Items

The Consumer Price Index for All Urban Consumers (CPI-U), All Items, increased at a 2.7-percent seasonally adjusted annual rate (SAAR) during the third quarter of 2010. For the first 9 months of 2010, the index has increased at a 0.7-percent SAAR, compared with a rise of 2.7 percent in 2009.

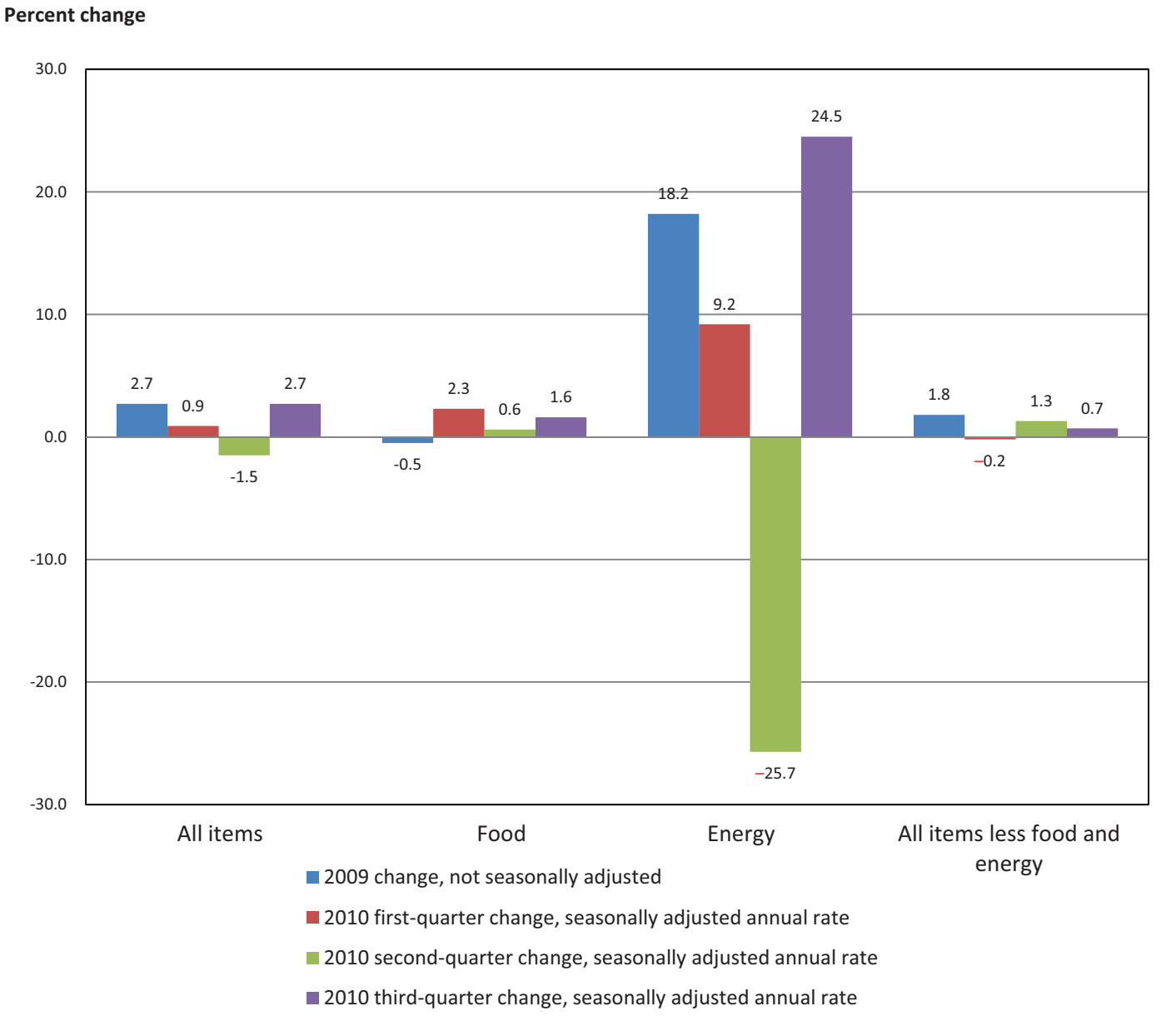
A turnaround in the energy index was the main cause of the third quarter upturn in the all-items index. The energy index increased at a 24.5-percent annual rate in the third quarter, after falling sharply in the second quarter. The index, which rose significantly in 2009, continued to climb in the first 9 months of 2010, but at a more modest pace. Inflation for the index for all items less food and energy continued to decelerate, with the increase for 2010 rising at one-third the rate posted in 2009. In contrast, the food index has risen modestly in 2010 after declining in 2009.

Energy

Energy remained the most volatile major CPI component. After climbing at a 9.2-percent SAAR in the first quarter of 2010 and declining at a 25.7-percent SAAR in the second quarter, the energy index jumped 24.5 percent in the third quarter. (See chart 1.) For the first 9 months of 2010, the energy index has risen at a 0.4-percent SAAR, after increasing 18.2 percent in all of 2009.

Within the energy component, the gasoline index increased at a 48.8-percent SAAR in the third quarter of 2010, after falling at a 38.9-percent SAAR in the second quarter. This trend continues the sharp changes seen in gasoline prices over the past few years. From July 2007 to July 2008, gasoline prices rose 37.9 percent. After crude oil prices peaked in July 2008 at more than $134 a barrel, they plummeted during the last 5 months of that year, to under $32 a barrel. At the retail level, gasoline prices fell by more than 50 percent.

Chart 1. **CPI-U percent changes: All Items, food, energy, and all Items less food and energy for 2009, first, second and third quarters, 2010.**



In 2009, pump prices turned sharply higher again, increasing more than 50 percent, with crude oil prices increasing to around $70 a barrel by the end of 2009.

The household energy index rose at a 1.9-percent SAAR in the third quarter of 2010, after falling 10.1 percent in the second quarter. All the major components of household energy rose in the third quarter. The natural gas index rose at a 1.8-percent SAAR in the third quarter, after declining at a 17.7-percent SAAR in the second quarter. For the first three quarters of 2010, the natural gas index increased at a 2.9-percent annual rate, after falling 18.1 percent in 2009. The electricity index rose 2.0 percent in the third quarter of 2010, identical to its first-quarter performance, but was down 7.1 percent in the second quarter. Electricity prices had declined 0.5 percent in 2009. The fuel oil index increased 0.1 percent in the third quarter of 2010, after falling at an 8.9-percent rate in the second quarter.

Food

Food prices rose at a 1.6-percent SAAR in the third quarter of 2010, after rising 0.6 percent in the second quarter. The food index has increased 1.5 percent so far in 2010, after slipping 0.5 percent in 2009. Grocery store food prices rose at a 1.2-percent SAAR in the third quarter, after a flat second quarter and an increase of 3.7 percent in the first quarter. Of the six major grocery store food

groups, the meats, poultry, fish, and eggs group increased the most in the third quarter, 3.2 percent. Prices for a variety of breakfast items climbed significantly in the third quarter, with coffee and egg prices up at SAARs of 13.0 percent and 32.8 percent, respectively. In addition, prices for bacon and breakfast sausage rose 29.6 percent. Most of the other food at home groups posted modest increases in the third quarter of 2010. Cereals and bakery products rose 2.3 percent, dairy products increased 2.2 percent, nonalcoholic beverages were up 2.1 percent, and other food at home increased 1.8 percent. In contrast, fruits and vegetables fell at a 5.7-percent SAAR in the third quarter, with fresh fruits falling 10.7 percent. Within fresh fruits, apple prices were down 21.2 percent and oranges fell 21.3 percent. These decreases more than offset an 8.6-percent increase in the banana index. The index for fresh vegetables decreased at a 2.5-percent SAAR in the third quarter, with lettuce falling 13.5 percent.

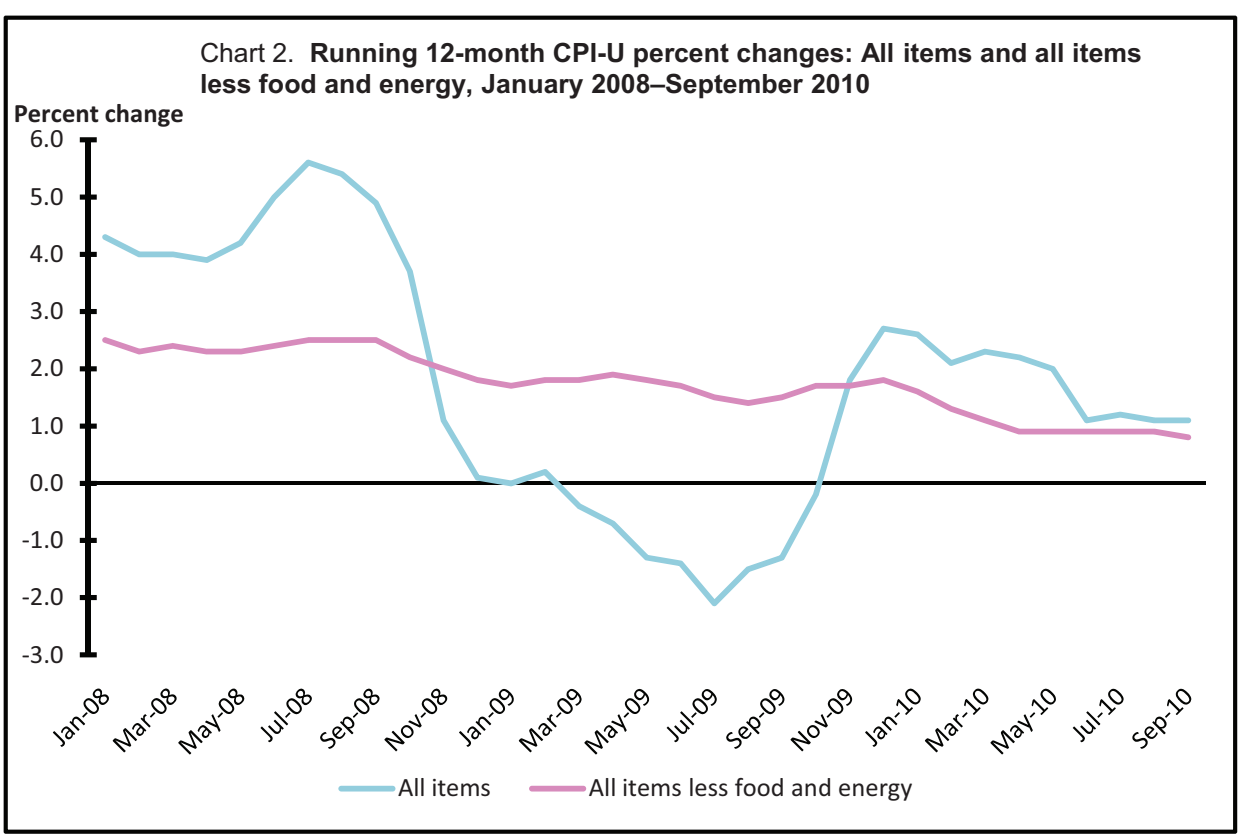
Prices for food away from home rose at a 2.3-percent SAAR in the third quarter, after rising at a 1.4-percent rate in the second quarter. Food at employee sites and schools jumped 9.2 percent in the third quarter of 2010, after more modest increases earlier in the year.

Both grocery store prices and the index for food away from home were up 1.4 percent over the past 12 months.

All items less food and energy

The index for all items less food and energy rose at a 0.7-percent SAAR in the third quarter of 2010, nearly half the 1.3-percent rate of increase recorded in the second quarter. This index had fallen at a 0.2-percent annual rate in the first quarter. The shelter index decelerated as well, increasing 0.4 percent in the third quarter after a 0.9-percent increase in the second quarter. Shelter prices had fallen 2.2 percent in the first quarter of 2010. Within shelter, owner's equivalent rent and rent of primary residence each rose at a 0.5-percent SAAR in the third quarter. Lodging away from home declined 5.1 percent in the third quarter, after a 23.1-percent spike in the second quarter.

The index for other goods and services rose at a 3.6-percent SAAR in the third quarter of 2010. Other significant components with increases included the medical care index, which grew 3.2 percent, and the index for new and used motor vehicles, which rose 1.8 percent. By contrast, declines in the third quarter were noted in apparel, which fell 0.9 percent, and recreation, which fell 2.3 percent. For the first time in many years, educational books and supplies fell; the drop in the third-quarter, 2010, SAAR was 3.8 percent. The index had increased 6.2 percent in the second quarter.



Household furnishings and operations declined 1.5 percent in the third quarter of 2010, compared with a 3.7-percent rate of increase in each of the previous two quarters. The index for airline fares reversed in the third quarter, falling 4.6 percent after a 14.3-

percent increase in the second quarter. The communication index was unchanged in the third quarter, after falling at a 1.3-percent rate in the second quarter.

The annual rate of inflation for all items less food and energy continued its deceleration in 2010. (See chart 2.) The 12-month percent change ending September 2010 was 0.8 percent, the smallest increase since March 1961. For the 5-year period from September 2004 to September 2009, this index had increased at a 2.2-percent annual rate.

The shelter index also has decelerated in recent years. The 12-month percent changes in shelter ending September 2006, 2007, 2008, and 2009 were 4.2 percent, 3.5 percent, 2.4 percent, and 0.7 percent, respectively. In 2010, shelter continues to pull down the index for all items less food and energy, with the current 12-month percent change for shelter standing at –0.4 percent. Other indexes contributing downward pressure on the annual index for all items less food and energy included household furnishings and operations, apparel, recreation, and communication. In contrast to prices for shelter, prices for used cars and trucks have increased 12.9 percent over the past 12 months.

Price movements described in this text reflect data released on October 15, 2010. Except as noted, all 12-month-and-longer percent changes reflect data that were not seasonally adjusted. Percent changes covering less than a year are based on seasonally adjusted annual rates, unless otherwise noted. CPI seasonally adjusted indexes and percent changes are subject to annual revision.

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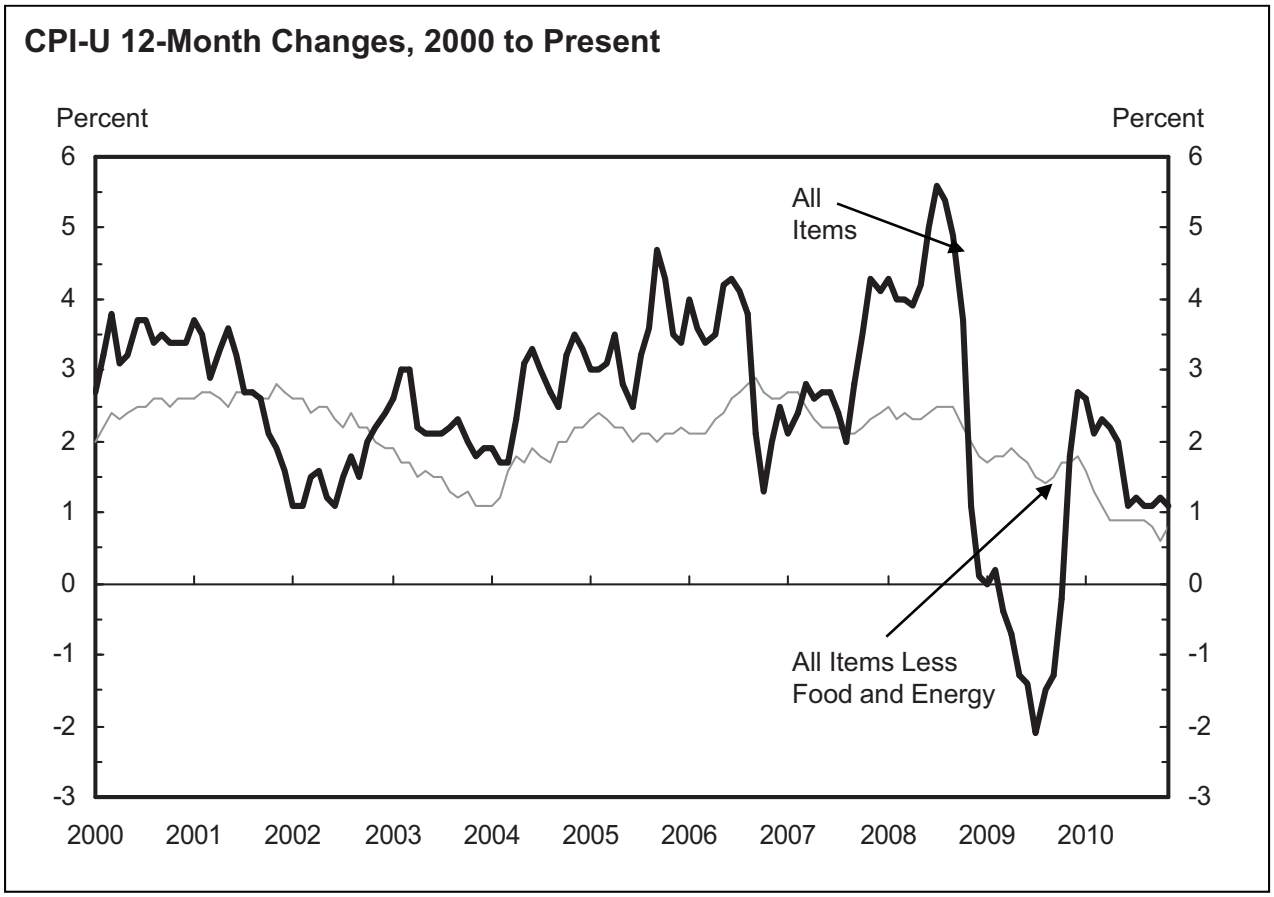
[1] See *Press Office Fact Sheet: Social Security Basic Facts* (U.S. Social Security Administration, Aug. 10, 2010), on the Internet at **http://www.ssa.gov/pressoffice/basicfact.htm** (visited November 1, 2010).

[2] That said, changes in Social Security benefits are potentially affected by factors other than COLAs, such as changes in Medicare premiums.

[3] More information on how the Social Security Administration uses the CPI to adjust benefits can be found in *Automatic Increases: Latest Cost-of-Living Adjustments* (U.S. Social Security Administration, Oct. 15, 2010), on the Internet at **http://www.ssa.gov/OACT/COLA/latestCOLA.html** (visited November 1, 2010).


CPI-U 12-Month Changes, 2000 to Present
Percent
Percent
6
5
4
3
2
1
0
-1
-2
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All Items
All Items Less Food and Energy
2000
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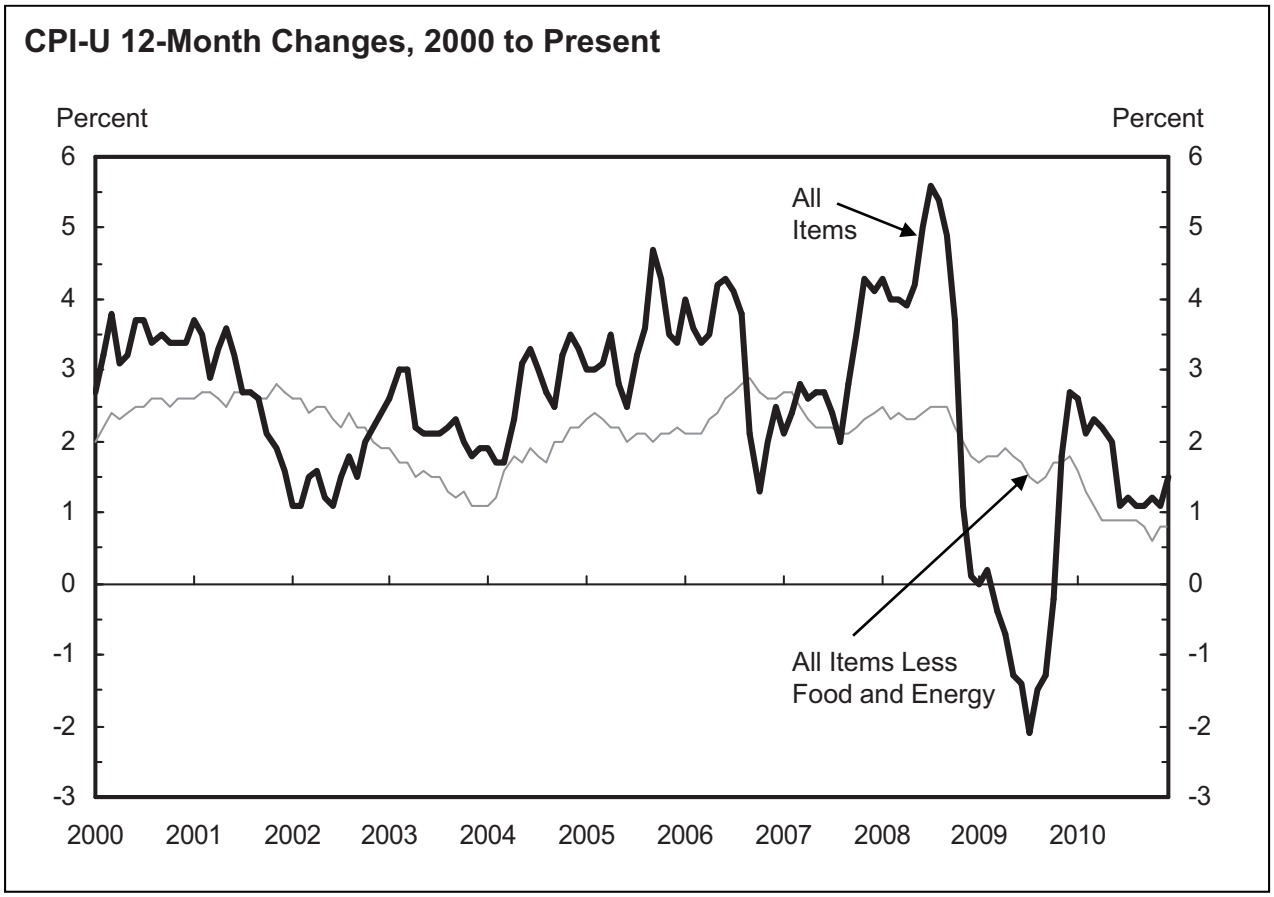
CPI-U 12-Month Changes, 2000 to Present
Percent
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6
5
4
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All Items
All Items Less Food and Energy
2000
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Recalculated Seasonally Adjusted Indexes to be Available on February 15, 2011

Each year with the release of the January CPI, seasonal adjustment factors are recalculated to reflect price movements from the just-completed calendar year. This routine annual recalculation may result in revisions to seasonally adjusted indexes for the previous 5 years. BLS will make available recalculated seasonally adjusted indexes, as well as recalculated seasonal adjustment factors, for the period January 2006 through December 2010, on Tuesday, February 15, 2011. This date is two working days before the scheduled release of the January 2011 CPI on Thursday, February 17, 2011.

The revised indexes and seasonal factors will be available on the internet. The address is http://www.bls.gov/cpi/cpisapage.htm. Look under Seasonal Adjustment in the CPI and select Revised Seasonally Adjusted Indexes and Factors, 2006-2010.

For further information please contact David Levin by electronic mail at: Levin.David@bls.gov or by telephone at: (202) 691-5261.

C-CPI-U Index Revisions

As scheduled, effective with release of data for January 2011, the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) will undergo its annual revision. C-CPI-U indexes for the 12 months of 2009 will be issued in final form – employing monthly expenditure weights from 2009. Values for the 12 months of 2010 will be revised and issued as interim, using expenditure weights from the 2007-2008 period. Calculation of the initial value of the January 2011 C-CPI-U index, and all subsequent months in 2010, will also be based upon 2007-2008 expenditure weights.

REPORT ON QUALITY CHANGES FOR 2011 MODEL VEHICLES

Passenger Cars

The value of quality changes for a sample of 2011 model year domestically produced passenger cars included in the PPI for October averaged $100.80, according to estimates by the U. S. Bureau of Labor Statistics (BLS). There was an average $7.57 increase in manufacturers' invoice prices for this year's models as compared with last year's models.

The retail equivalent value of these quality changes averaged $110.79. The average manufacturers' suggested list prices increased $5.97.

- $4.83 for safety improvements such as airbags and stability control.
- $105.96 for other quality changes such as changes in audio systems, powertrains, and changes in levels of standard or optional equipment.

Light Trucks

The value of quality changes for a sample of 2011 model year domestically produced light trucks included in the PPI for October averaged $391.85. There was an average $531.33 increase in manufacturers' invoice prices for this year's models as compared with last year's models.

The retail equivalent value of quality changes averaged $423.20. The average manufacturers' suggested list prices increased $460.98.

The $423.20 estimated retail value of quality change breaks down as follows:

- $101.24 for safety improvements such as changes to stability control and brakes.
- $321.96 for other quality changes such as changes in audio systems, seating, and changes in levels of standard or optional equipment.

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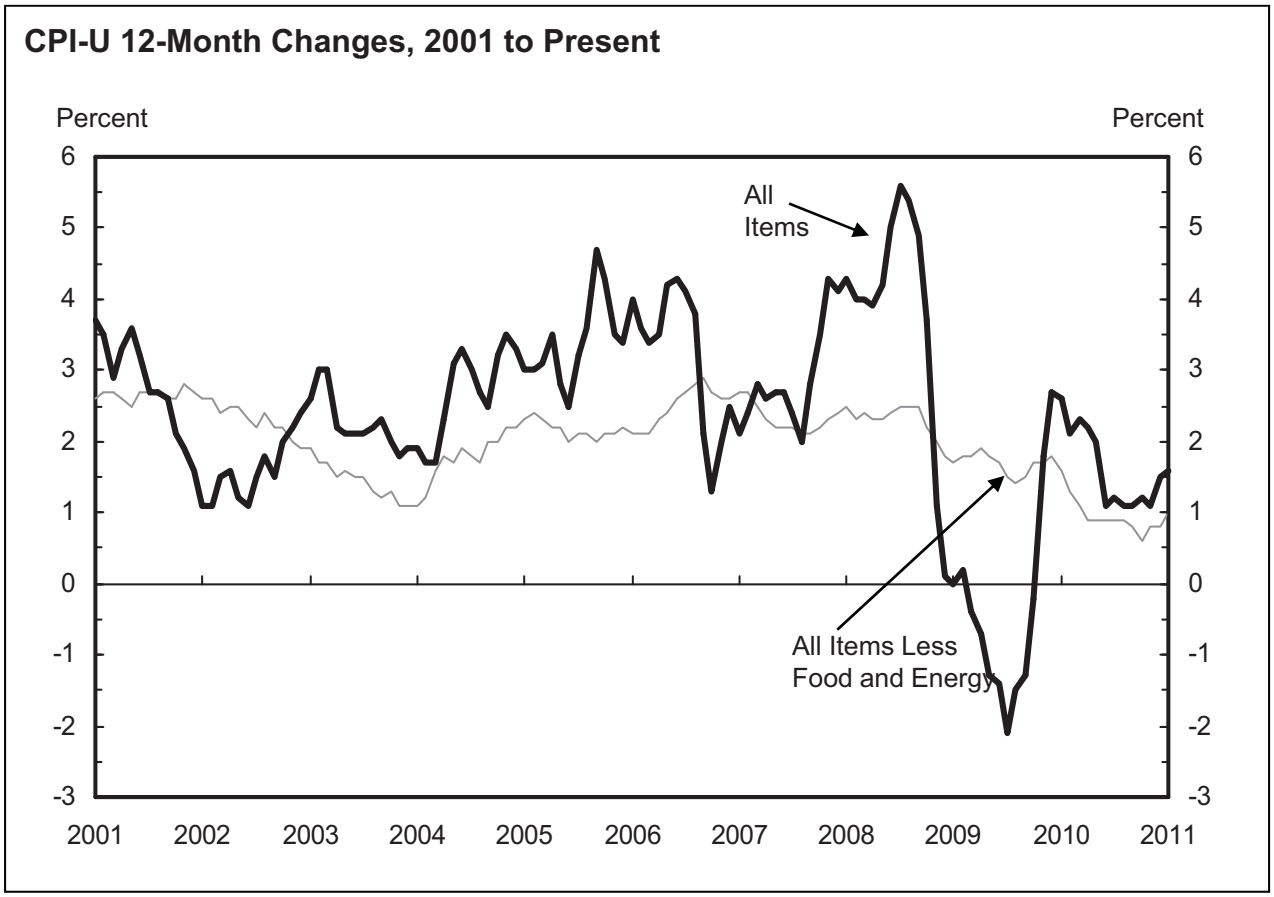
Estimates of the value of quality change are based on a review by the BLS of data supplied by producers for similarly equipped 2010 and 2011 domestically produced models priced for the PPI. Most of the estimates of quality changes in this release are derived from information supplied for the PPI for October. These data also form the basis of the new vehicle quality adjustment for the Consumer Price Index (CPI). However, it should be noted that, effective with the release of data for January 1999, changes made solely for the purpose of meeting air pollution standards are no longer considered quality improvements for CPI calculation purposes.

Articles Appearing in the CPI Detailed Report, 2005-2010

Chained CPI	"Note on Revisions to C-CPI-U," January 2005. "Changes in the CPI in 2006," January 2006. "C-CPI-U Index Revisions," December 2006. "C-CPI-U Index Revisions," December 2007. "C-CPI-U Index Revisions," January 2007-2008. "C-CPI-U Index Revisions," December 2008. "C-CPI-U Index Revisions," December 2009. "C-CPI-U Index Revisions," December 2010.
Elderly	"Experimental CPI for Americans 62 years of Age and Older, 1998-2003," July 2004.
Expenditure Weight Updates	"Planned Changes in the CPI in 2006," December 2005. "Changes in the CPI in 2006," January 2006.
General Information	"Consumer Price Index, 2004," February 2005. "CPI Levels to be Published to Three Decimal Places," July 2006-June 2007. "Consumer Prices Rose 3.4 Percent in 2005, about the same as last year," July 2006. "Price Measurement in the United States: a Decade after the Boskin Report," July 2006. "Updating the Housing Age-Bias Regression Model in the CPI," November 2006. "Consumer prices rose less in 2006 than in 2005," March & August 2007. "Consumer prices rose 4.1 percent in 2007, the largest increase since 1990," March 2008. "Consumer Prices rose only 0.1 percent in 2008, the smallest change since 1954," March 2009.
Research Series	"CPI Research Series using Current Methods, 1978-2006," December 2006. "CPI Research Series Using Current Methods, 1978-2008," April 2009.
Response Rates	"Response Rates for the CPIs, 2003," January 2005. "Response Rates for the CPIs, 2004," January 2006. "Response Rates for the CPIs, 2005," January 2007. "Response Rates for the CPIs, 2006," January 2008. "Response Rates for the CPIs, 2007," January 2009. "Response Rates for the CPIs, 2008," January 2010.
Sampling Error	"Note on Sampling Error in the Consumer Price Index" January-November 2007.
Seasonal Adjustment	"Intervention Analysis in Seasonal Adjustment," January 2005-2010. "A Note on Seasonally Adjusted and Unadjusted Data" January 2005-2010. "Over the Month Percent Changes," January 2003-2007. "Recalculated Seasonally Adjusted Indexes to Be Available on February 17, 2006," December 2005. "Recalculated Seasonally Adjusted Indexes to Be Available on February 16, 2007," December 2006. "Recalculated Seasonally Adjusted Indexes to Be Available on February 15, 2008," December 2007. "Recalculated Seasonally Adjusted Indexes to Be Available on February 20, 2009," December 2008. "Recalculated Seasonally Adjusted Month to Month % Change Differences," January 2008. "Revised Seasonally Adjusted Changes," January 2009. "Changes in Seasonal Adjustment Status for 2009," January 2009. "Seasonal adjustment factors for use with the 2009 All Urban Consumers indexes," January 2009. "Recalculated Seasonally Adjusted Indexes to be Available on February 17, 2010," December 2009. "Recalculated Seasonally Adjusted Indexes to be Available on February 15, 2011," December 2010.
Variance Estimates	"Variance Estimates for Changes in the CPI, January 2004-December 2004," February 2005. "Variance Estimates for Changes in the CPI, January 2005-December 2005," February 2006. "Variance Estimates for Changes in the CPI, January 2006-December 2006," February 2007. "Variance Estimates for Changes in the CPI, January 2007-December 2007," February 2008.

	"Variance Estimates for Changes in the CPI, January2008-December 2008," February 2009. "Variance Estimates for Changes in the CPI, January2008-December 2008," February 2010.
Vehicle Quality Changes	"Report on Quality Changes for 2006 Model Vehicles," December 2005. "Report on Quality Changes for 2007 Model Vehicles," December 2006. "Report on Quality Changes for 2008 Model Vehicles," December 2007. "Report on Quality Changes for 2009 Model Vehicles," December 2008. "Report on Quality Changes for 2010 Model Vehicles," December 2009. "Report on Quality Changes for 2010 Model Vehicles," December 2010.


CPI-U 12-Month Changes, 2001 to Present
Percent
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6
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4
3
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1
0
-1
-2
-3
All Items
All Items Less Food and Energy
2001
2002
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2010
2011

Revised seasonally adjusted changes

Over-the-month percent changes in the U.S. City Average Consumer Price Index for All Urban Consumers (CPI-U) for All Items and for All Items less food and energy, seasonally adjusted, using former and recalculated seasonal factors for 2010.

All Items

2010	Former	Recalculated	Difference
January	.2	.1	-.1
February	.0	.0	.0
March	.1	.0	-.1
April	-.1	.0	.1
May	-.2	-.1	.1
June	-.1	-.2	-.1
July	.3	.3	.0
August	.3	.2	-.1
September	.1	.2	.1
October	.2	.2	.0
November	.1	.1	.0
December	.5	.4	-.1

All Items less food and energy

2010	Former	Recalculated	Difference
January	-.1	-.1	.0
February	.1	.1	.0
March	.0	.0	.0
April	.0	.0	.0
May	.1	.1	.0
June	.2	.1	-.1
July	.1	.1	.0
August	.0	.1	.1
September	.0	.0	.0
October	.0	.0	.0
November	.1	.1	.0
December	.1	.1	.0

A Note on Seasonally Adjusted and Unadjusted Data

Because price data are used for different purposes by different groups, the Bureau of Labor Statistics publishes seasonally adjusted as well as unadjusted changes each month.

For analyzing general price trends in the economy, seasonally adjusted changes are usually preferred since they eliminate the effect of changes that normally occur at the same time and in about the same magnitude every year--such as price movements resulting from changing climatic conditions, production cycles, model changeovers, holidays, and sales.

The unadjusted data are of primary interest to consumers concerned about the prices they actually pay. Unadjusted data also are used extensively for escalation purposes. Many collective bargaining contract agreements and pension plans, for example, tie compensation changes to the Consumer Price Index before adjustment for seasonal variation.

Seasonal factors used in computing the seasonally adjusted indexes are derived by the X-12-ARIMA Seasonal Adjustment Method. Seasonally adjusted indexes and seasonal factors are computed annually. Each year, the last 5 years of seasonally adjusted data are revised. Data from January 2006 through December 2010 were replaced in January 2011. Exceptions to the usual revision schedule were: the updated seasonal data at the end of 1977 replaced data from 1967 through 1977; and, in January 2002, dependently seasonally adjusted series were revised for January 1987-December 2001 as a result of a change in the aggregation weights for dependently adjusted series. For further information, please see "Aggregation of Dependently Adjusted Seasonally Adjusted Series," in the October 2001 issue of the CPI Detailed Report.

Effective with the publication of data from January 2006 through December 2010 in January 2011, the Video and audio series and the Information technology, hardware and services series were changed from independently adjusted to dependently adjusted. This resulted in an increase in the number of seasonal components used in deriving seasonal movement of the All items and 54 other lower level aggregations, from 73 for the publication of January 1998 through December 2005 data to 82 for the publication of seasonally adjusted data for January 2006 and later. Each year the seasonal status of every series is reevaluated based upon certain statistical criteria. If any of the 82 components change their seasonal adjustment status from seasonally adjusted to not seasonally adjusted, not seasonally adjusted data will be used in the aggregation of the dependent series for the last 5 years, but the seasonally adjusted indexes before that period will not be changed. Note: 37 of the 82 components are not seasonally adjusted for 2011.

Seasonally adjusted data, including the all items index levels, are subject to revision for up to five years after their original release. For this reason, BLS advises against the use of these data in escalation agreements.

Effective with the calculation of the seasonal factors for 1990, the Bureau of Labor Statistics has used an enhanced seasonal adjustment procedure called Intervention Analysis Seasonal Adjustment for some CPI series. Intervention Analysis Seasonal Adjustment allows for better estimates of seasonally adjusted data. Extreme values and/or sharp movements which might distort the seasonal pattern are estimated and removed from the data prior to calculation of seasonal factors. Beginning with the calculation of seasonal factors for 1996, X-12-ARIMA software was used for Intervention Analysis Seasonal Adjustment.

For the seasonal factors introduced in January 2011, BLS adjusted 29 series using Intervention Analysis Seasonal Adjustment, including selected food and beverage items, motor fuels, electricity and vehicles. For example, this procedure was used for the Motor fuel series to offset the effects of events such as damage to oil refineries from Hurricane Katrina.

For a complete list of Intervention Analysis Seasonal Adjustment series and explanations, please refer to the article "Intervention Analysis Seasonal Adjustment", located on our website at http://www.bls.gov/cpi/cpisapage.htm.

For additional information on seasonal adjustment in the CPI, please write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, Washington, DC 20212 or contact David Levin at (202) 691-6968, or by e-mail at Levin.David@bls.gov. If you have general questions about the CPI, please call our information staff at (202) 691-7000.

C-CPI-U Index Revisions

As scheduled, effective with release of data for January 2011, the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) has undergone its annual revision. Because the current expenditure data required for the calculation of the C-CPI-U are available only with a time lag, the index is issued first in preliminary form, using the latest available expenditure data at the time of publication, and is subject to two subsequent revisions. Therefore, C-CPI-U indexes for the 12 months of 2009 will be issued in final form – employing monthly expenditure weights from 2009. Values for the 12 months of 2010 will be revised and issued as interim, using expenditure weights from the 2007-2008 period. Calculation of the initial value of the January 2011 C-CPI-U index, and all subsequent months in 2011, will also be based upon 2007-2008 expenditure weights.

For more information on the C-CPI-U, contact Rob Cage by telephone at (202) 691-6959 or by electronic mail at Cage.Rob@bls.gov .

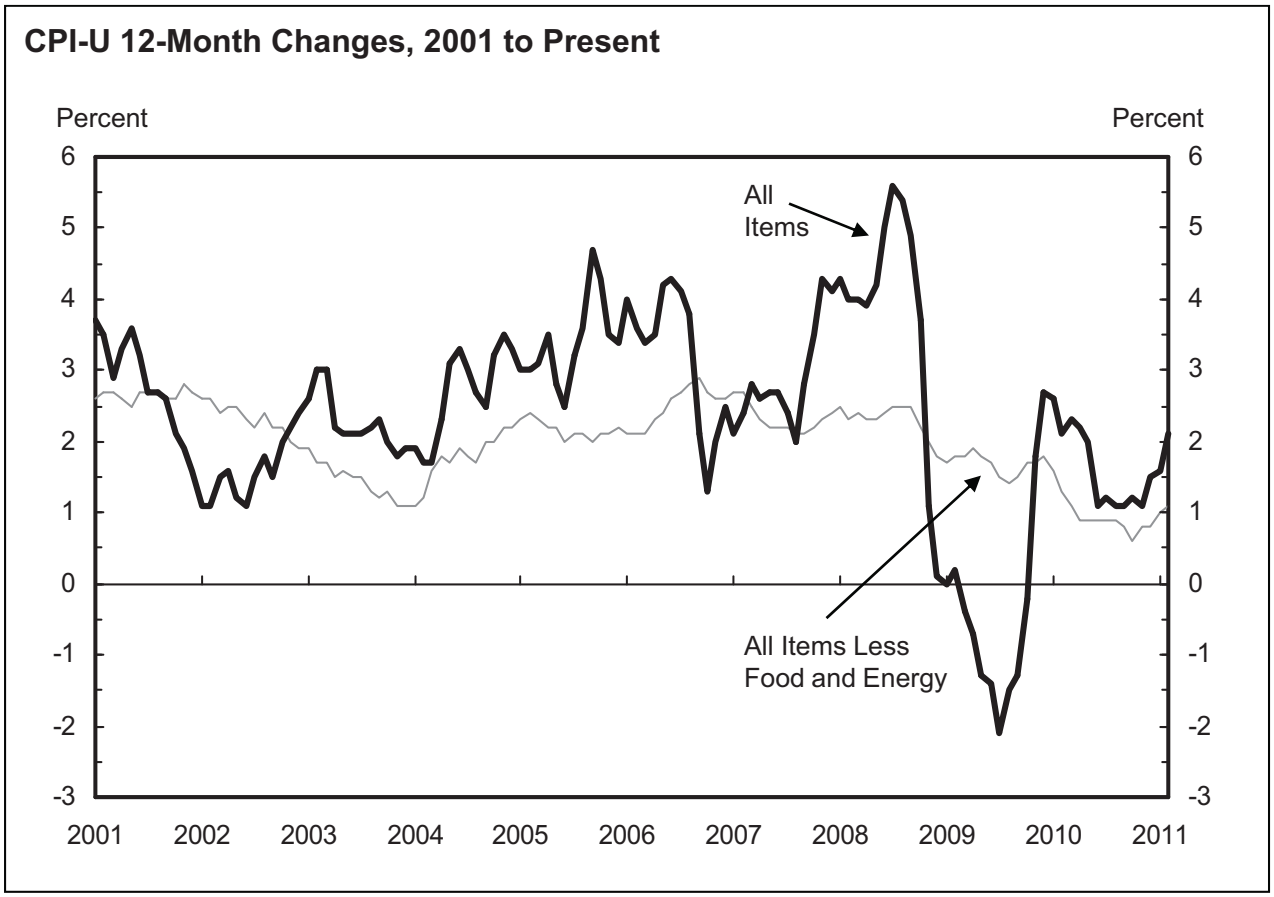
Effective with this release of CPI data, the following series have been re-titled:

- Recreation services has become Other recreation services
- Gas (piped) and electricity has become Energy services
- Canned fish and seafood has become Shelf stable fish and seafood

The Recreation services index did not include all services under the major group Recreation, specifically video and audio related services, pet services, and photography and film services are excluded. The new title, Other recreation services, reflects these exclusions.

Gas (piped) and electricity has been presented as Energy services in Table A of the CPI News Release since August 2009. At that time, the format text of the News Release was updated to focus on Food, Energy, and All items less food and energy instead of the major groups (Food, Housing, Apparel, Transportation, Medical care, Education and communication, Recreation, and Other goods and services). The title has been changed in the remainder of the publication tables in January 2011 to improve consistency.

The title for Canned fish and seafood has changed to Shelf stable fish and seafood to better reflect current packaging methods.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All Items Less Food and Energy
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2010
2011

Variance Estimates for Price Changes in the Consumer Price Index January -December 2010

Owen J. Shoemaker

This article presents variance estimates for 1-month, 2-month, 6-month, and 12-month percent changes in the Consumer Price Index for All Urban Consumers (CPI-U). Variance is a measure of the uncertainty caused by the use of a sample of retail prices, instead of the complete universe of retail prices. The estimates cover the period January 2010 through December 2010.[1] Each month the U.S. Bureau of Labor Statistics collects prices from a sample of approximately 83,100 commodities and services (C&S) quotes in approximately 26,600 outlets[2] around the United States for the Consumer Price Index (CPI).

The most commonly used measure of sampling variability is the *standard error* of the estimate – the square root of the variance. The standard error of the CPI's change can be used to construct confidence intervals to determine whether the change for a particular CPI series is significantly different from zero. This information should help users determine which index changes are significant.

Presentation of findings

The percent changes in the CPI along with their standard errors were estimated for the 12 months from January through December 2010. In summary, tables 1V through 5V show the median values of those percent changes, as well as the median values of the standard errors. Table 1V shows this information for U.S. city average, and tables 2V through 5V show the same information for the Northeast, Midwest, South, and West regions of the country.

For example, from January through December 2010, the 1-month changes in the U.S. city average all items index had a median value of 0.10 percent. The standard errors of those 12 estimates had a median value of 0.03 percent. Margins of error are usually expressed as a statistic's point estimate plus or minus two standard errors, so the margin of error on this CPI's 1-month change is approximately 0.10 percent plus or minus 0.06 percent. Therefore, in a typical 1-month period, the true change in the CPI was probably somewhere between 0.04 percent and 0.16 percent. The tables also show median percent changes and standard errors for 2- and 6-month intervals and for the full year 2010. Margins of error can be calculated for these intervals in the same way as for a 1-month period.

Analysis of findings

Analyzing the data reveals three significant observations. First, standard errors increase as one moves from the U.S. city average to individual regions of the country and from *all items* to individual item categories. Second, standard errors differ between item categories. Third, the standard errors decrease on a relative basis (standard error divided by price change), as the price change interval gets longer.

The primary reason standard errors increase as one moves from the U.S. city average to individual regions of the country is that sample sizes differ. In general, smaller sample sizes lead to larger standard

[1] In 1998 significant changes were made to the CPI's structure and sample, and a new variance calculation system was implemented. For information on variances from 1978-1986, 1993-1997 and then 1998 and 1999, see the *CPI Detailed Report* for February 1991, May 1994, February 1998, December 1999, and November 2000, respectively.
[2] In addition, BLS collects approximately 3,900 shelter quotes, used for both Rent and Rental Equivalence (REQ), each month.

errors. For example, the U.S. city average all items index is computed each month from approximately 87,000 prices (including all Rent and REQ quotes) throughout the United States, and its median standard error for 1-month changes is 0.03 percent. By contrast, the Northeast region all items index is computed from approximately 19,200 prices, and its median standard error is 0.07 percent. Regional indexes have larger standard errors because their sample sizes are smaller.

One can observe this same effect moving from the all items index to individual item categories. Again, the U.S. city average all items index is computed each month from approximately 87,000 prices, and its median 1-month standard error is 0.03 percent. By contrast, the U.S. city average recreation index is computed from approximately 5,200 prices, and its median 1-month standard error is 0.14 percent, more than four times as large. Again, smaller sample sizes lead to larger standard errors.

The second significant observation is that standard errors differ between item categories. There are two reasons for this. First, item categories differ in sample size. For example, the U.S. city average food and beverages index is computed from approximately 34,300 prices each month, while the U.S. city average recreation index is computed from approximately 5,200 prices. Therefore, it is not surprising that the recreation index has larger standard errors. Second, there are real differences in item category price behaviors caused by different selling practices, seasonal influences, and consumer demand. This is especially true for the apparel category, in which it is common for the prices of individual items to fluctuate by 50 percent or more each month. As a result, standard errors for apparel indexes are large.

The third observation is that standard errors generally tend to decrease, on a relative basis (standard error divided by price change), as the price change interval gets longer. For the U.S. city average all items index, the median standard error divided by the median percent change is 0.03/0.10 = 0.30 for 1-month changes, 0.04/0.19 = 0.21 for 2-month changes, 0.07/0.62 = 0.11 for 6-month changes, and 0.09/1.37 = 0.07. This shows that the relative accuracy of percent changes in the CPI generally improves as the price change interval gets longer. On an absolute basis, standard errors tend to increase, but at a decreasing rate.

Findings presented here indicate that users should exercise caution when using CPI estimates to make inferences about index changes for relatively short time periods, for individual goods and services, or for local areas. The standard errors of those estimates may be on the same order of magnitude as the estimates themselves; and, thus, few inferences about them are reliable.

Sources of error

One way of analyzing the error in a survey estimate is to divide the total error into two sources: *sampling error* and *non-sampling error*. Sampling error is the uncertainty in the CPI caused by the fact that a sample of retail prices is used to compute the CPI, instead of using the complete universe of retail prices. Non-sampling error is the rest of the error. Non-sampling error includes things such as incorrect information given by survey respondents, data processing errors, and so forth. Non-sampling error arises regardless of whether data are collected from a sample of retail prices or from the complete universe.

Another way of analyzing error is to divide it into *variance* and *bias*. The variance of the CPI is a measure of how close different estimates of the CPI would be to each other if it were possible to repeat the survey over and over using different samples. Of course, it is not feasible to repeat the survey multiple times, but statistical theory allows the CPI's variance to be estimated anyway. A small variance, for example, indicates that multiple independent samples would produce values that are consistently very close to each other. *Bias* is the difference between the CPI's *expected* value and its *true* value. A statistic

may have a small variance but a large bias, or it may have a large variance but a small bias. For an index to be considered accurate, both its variance and bias need to be small.

The Bureau of Labor Statistics (BLS) is constantly trying to reduce the error in the CPI. Variance and sampling error are reduced by using a sample of retail prices that is as large as possible, given resource constraints. BLS has developed a model that optimizes the allocation of resources by indicating the number of prices that should be observed in each geographic area and each item category, in order to minimize the variance of the U.S. city average all items index. BLS reduces non-sampling error through a series of computerized and professional data reviews, as well as through continuous survey process improvements and theoretical research.

Replication and variance estimation

An important advantage of using sampling is that the CPI's variance can be estimated directly from the sample data. Starting in 1978, the CPI's sample design has accommodated variance estimation by using two or more independent samples of items and outlets in each geographic area. This allows two or more statistically independent estimates of the index to be made. The independent samples are called *replicates*, and the set of all observed prices is called the *full sample*.

BLS collects CPI data in 38 geographic areas across the United States. These areas consist of 31 *self-representing* areas and 7 *non-self-representing* areas. Self-representing areas are large metropolitan areas, such as the Boston, St. Louis, and San Francisco metropolitan areas. Non-self-representing areas are collections of smaller metropolitan areas. For example, one non-self-representing area is a collection of 32 small metropolitan areas in the Northeast region (Buffalo, Hartford, Providence, Bangor, and others), of which 8 were randomly selected to represent the entire set. Within each of the 38 areas, price data are collected for 211 item categories called *item strata*. Together the 211 item strata cover all consumer purchases. Examples of item strata are bananas, women's dresses, and electricity.

Multiplying the number of areas by the number of item strata gives 8,018 (= 38 × 211) different area and item combinations for which price indexes need to be calculated. Separate price indexes are calculated for each one of these 8,018 area and item combinations. After all 8,018 of these *basic-level* indexes are calculated, they are aggregated to form *higher-level* indexes, using expenditure estimates from the Consumer Expenditure Survey as their weights. Examples of higher-level geographic areas are the four regions (Northeast, Midwest, South, and West); and examples of higher-level item categories are the eight major groups (food & beverages, housing, apparel, transportation, medical care, education and communication, recreation, and other goods and services). The highest level of geographic aggregation is the U.S. city average, and the highest level of item aggregation is all items.

Variances are computed with a Stratified Random Groups Method, in which variances are computed separately for certain subsets of areas and items and are then combined to produce the variance of the entire area and item combination. Subsets of items are formed by the intersection of the item category with each of the eight major groups.

Let $CPI(A,I,f,t)$ denote the index value where A = area, I = item category, f indicates that it is the full-sample value, and t = month; and let $CPI(A,I,f,t-k)$ denote the value of the same index in month = $t-k$. In general, the upper-case letter A denotes a *set* of areas, such as the Northeast or Midwest region of the country; and the upper-case letter I denotes a higher-level item category, such as all items or all items less food and energy. Also let $CPI(A,I,r,t)$ and $CPI(A,I,r,t-k)$ be the corresponding index values for replicate = r. Most areas have two replicates, but some have more. Then, the full-sample k-month percent change

between months $t-k$ and t is computed by dividing $CPI(A,I,f,t)$ by $CPI(A,I,f,t-k)$, subtracting 1, and multiplying by 100:

$$PC(A,I,f,t,t-k) = \left(\frac{CPI(A,I,f,t)}{CPI(A,I,f,t-k)} - 1 \right) \times 100$$

Every index has a weight $W(A,I,f)$ or $W(A,I,r)$ associated with it, which is used to combine the index with other indexes to produce indexes for larger geographic areas and larger item categories. For example, the weights are used to combine all 8,018 basic-level indexes into higher-level indexes such as the U.S. city average all items index. The product of an index and its weight is called a *cost weight*, $CW(A,I,r,t) = CPI(A,I,r,t) \times W(A,I,r)$, and is an estimate of the total cost in area = A for consumption of item category = I in month = t.

For the Stratified Random Groups method used here, replicate percent changes are defined as follows: full sample cost weights are used for every geographic area within area = A except for one of the areas. In the omitted area, the full sample cost weight is replaced by a replicate cost weight. Let the lower case letter a denote one of the 38 basic-level areas included in area = A, and let the lower case letter i denote the intersection of item category = I with one of the 8 major groups. Then, the replicate percent change, for area = a, item subset = i, replicate = r, between months $t-k$ and t, is computed as:

$$PC_S(a,i,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,i,f,t) + CW(a,i,r,t)}{CW(A,I,f,t-k) - CW(a,i,f,t-k) + CW(a,i,r,t-k)} - 1 \right) \times 100$$

for self-representing areas. For non-self-representing areas, the replicate percent change, for area = a, item category = I, replicate = r, between months $t-k$ and t, is computed as:

$$PC_N(a,I,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,I,f,t) + CW(a,I,r,t)}{CW(A,I,f,t-k) - CW(a,I,f,t-k) + CW(a,I,r,t-k)} - 1 \right) \times 100$$

where:

$$CW(A,I,f,t) = \sum_{a \subset A} \sum_{i \subset I} CW(a,i,f,t)$$
$$CW(A,I,f,t) = \sum_{a \subset A} CW(a,I,f,t)$$
$$CW(a,I,f,t) = \sum_{i \subset I} CW(a,i,f,t)$$

and likewise for replicates. The symbol "$a \subset A$" means that the sum is over all basic-level areas within area = A, and the symbol $i \subset I$ means that the sum is over all item categories that are intersections of item category = I with a major group.

Then, the variance is computed with the following Stratified Random Groups Variance Estimation Formula:

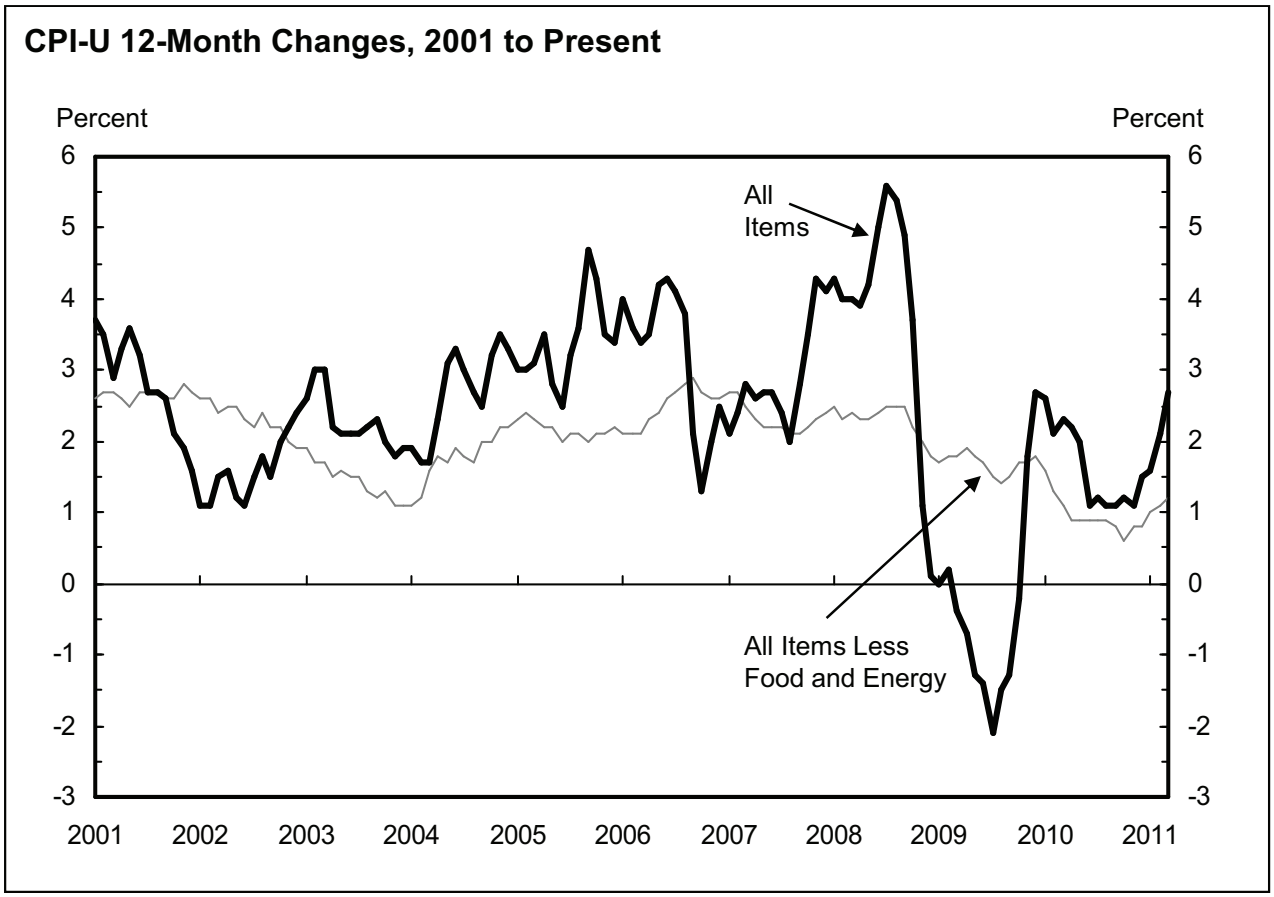
$$\begin{aligned} V[PC(A,I,f,t,t-k)] &= \sum_{i \subset I} \sum_{a \subset A \cap S} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_S(a,i,r,t,t-k) - PC(A,I,t,t-k) \right)^2 \\ &+ \sum_{a \subset A \cap N} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_N(a,I,r,t,t-k) - PC(A,I,t,t-k) \right)^2 \end{aligned}$$

where S and N are the sets of all self-representing and non-self-representing areas in the CPI's geographic sample, respectively; and A∩S and A∩N are the sets of all self-representing and non-self-representing areas within area = A. The number R_a is the number of replicates in area = a.

Finally, the standard error of the percent change is computed by taking the square root of its variance:

$$SE[\,PC(A, I, f, t, t-k)\,] \;=\; \sqrt{V[PC(A, I, f, t, t-k)]}\;.$$

For more information, write to the CPI Information Office, BLS - Room 3130, 2 Massachusetts Avenue, N.E., Washington, DC 20212, or call Owen Shoemaker at 202-691-6918.


CPI-U 12-Month Changes, 2001 to Present
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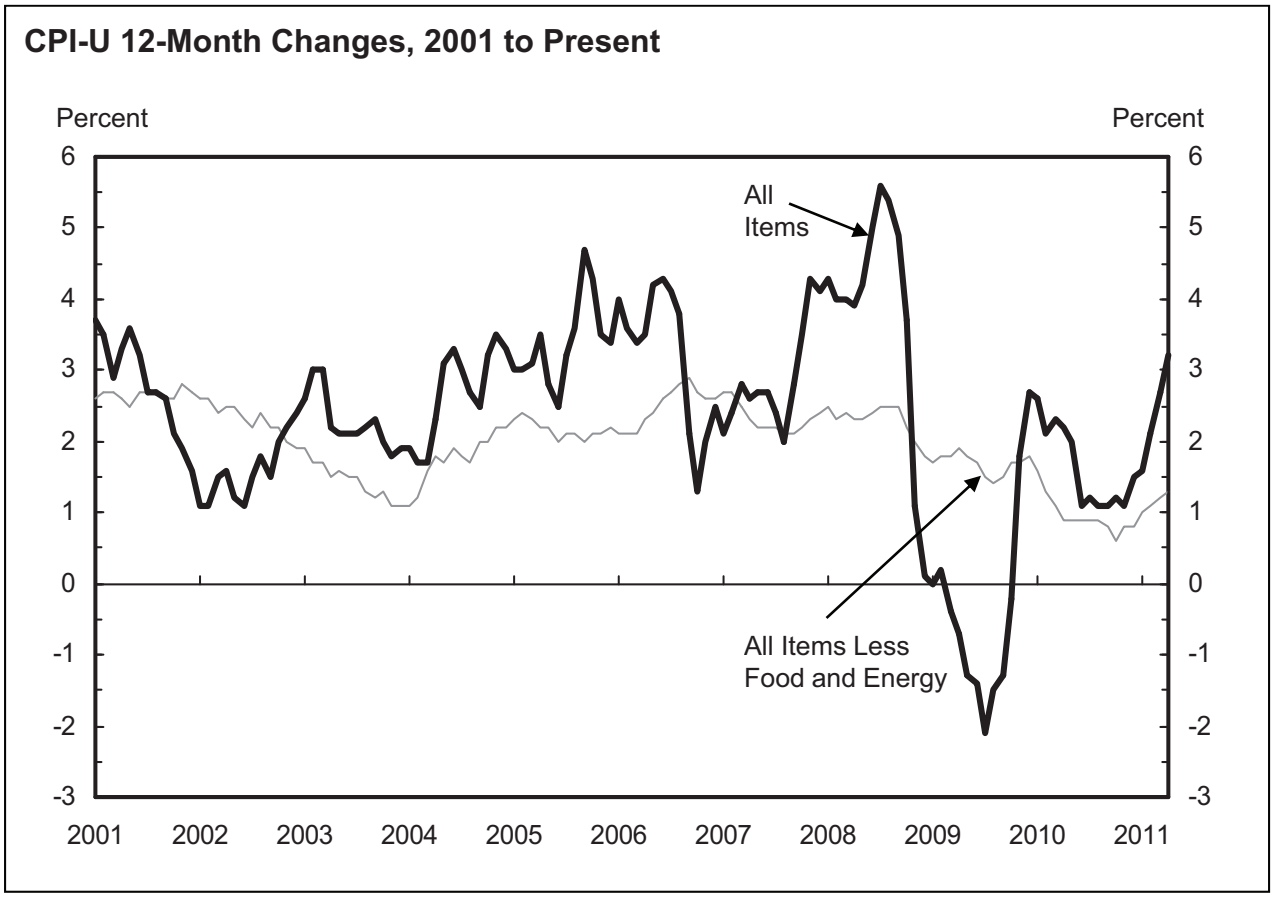
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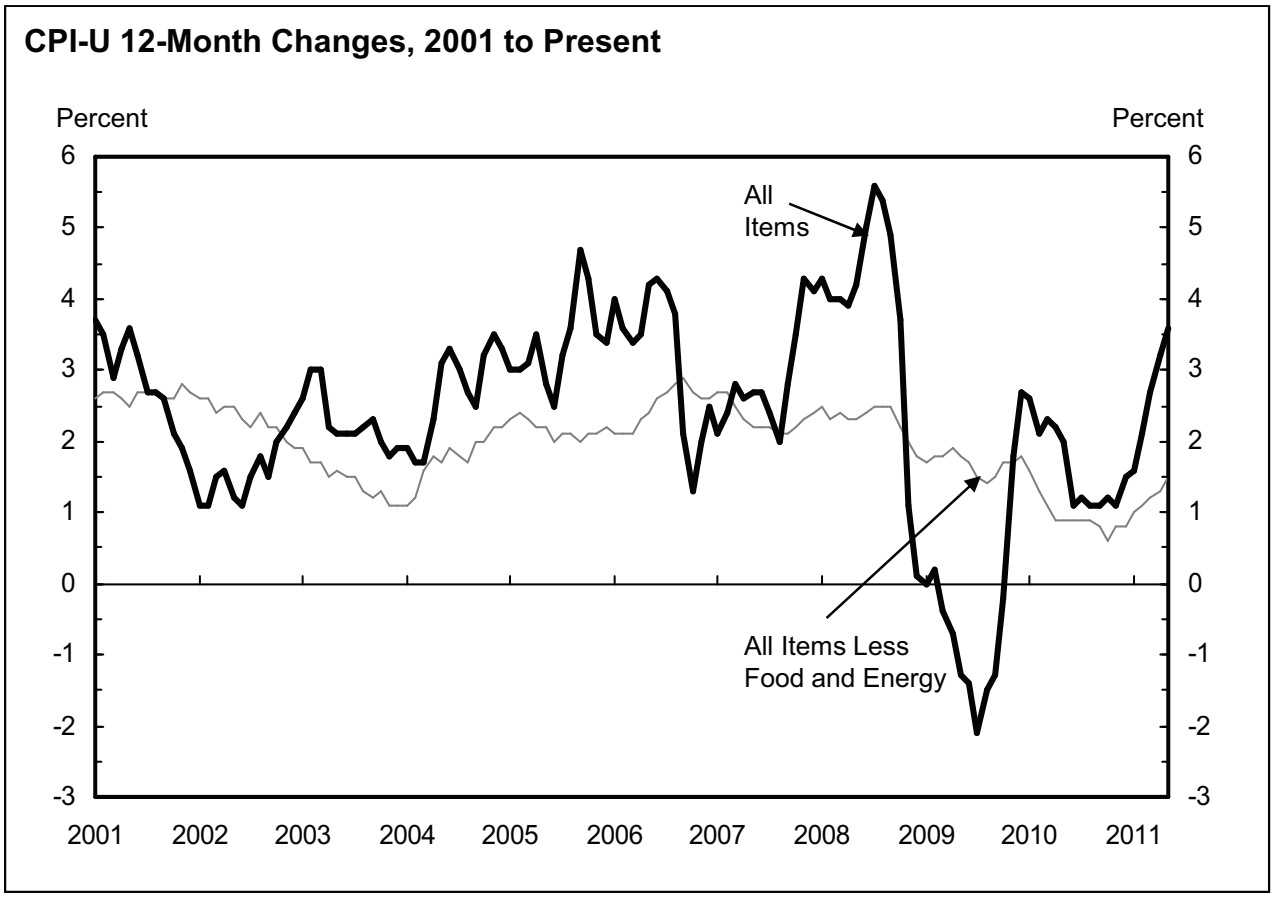
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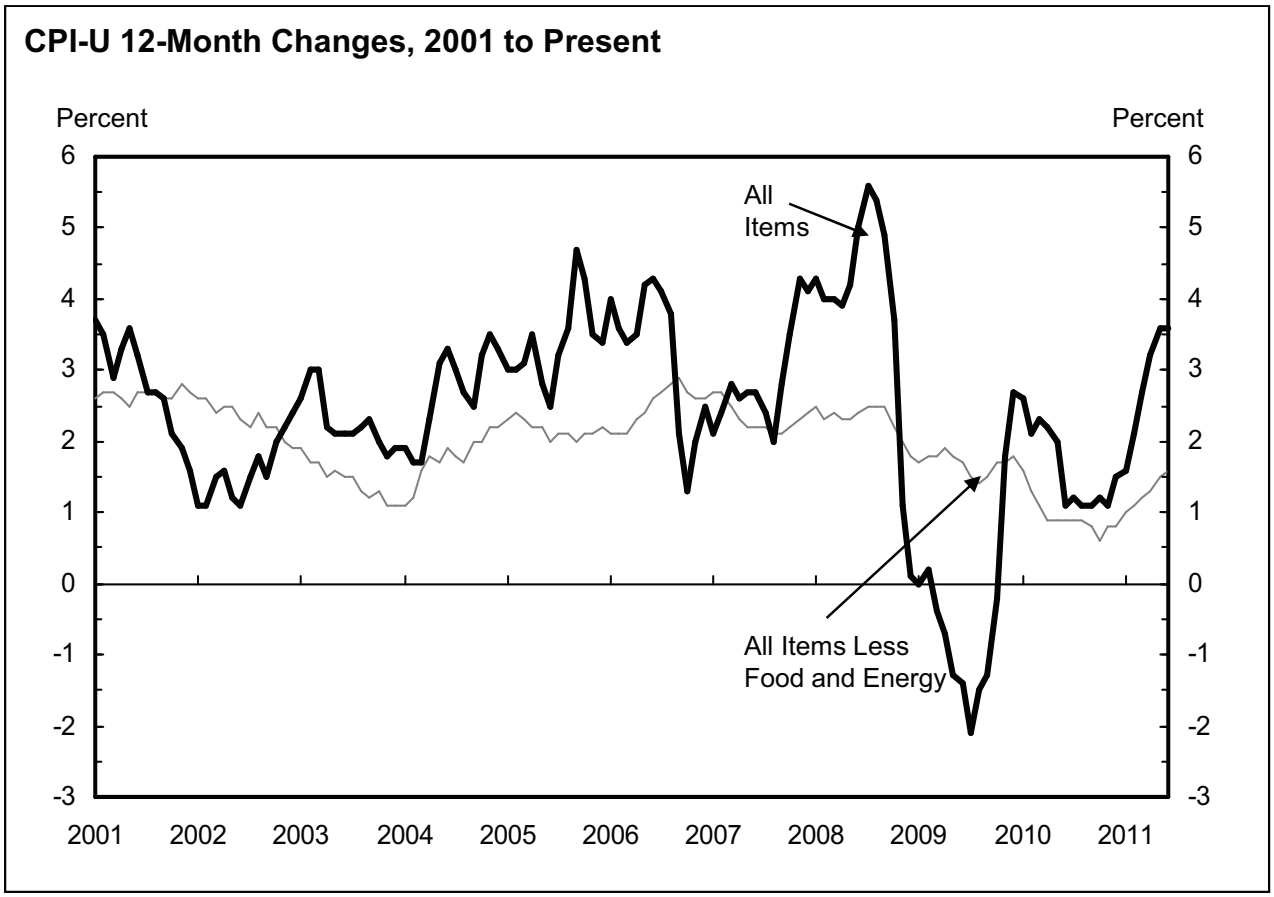
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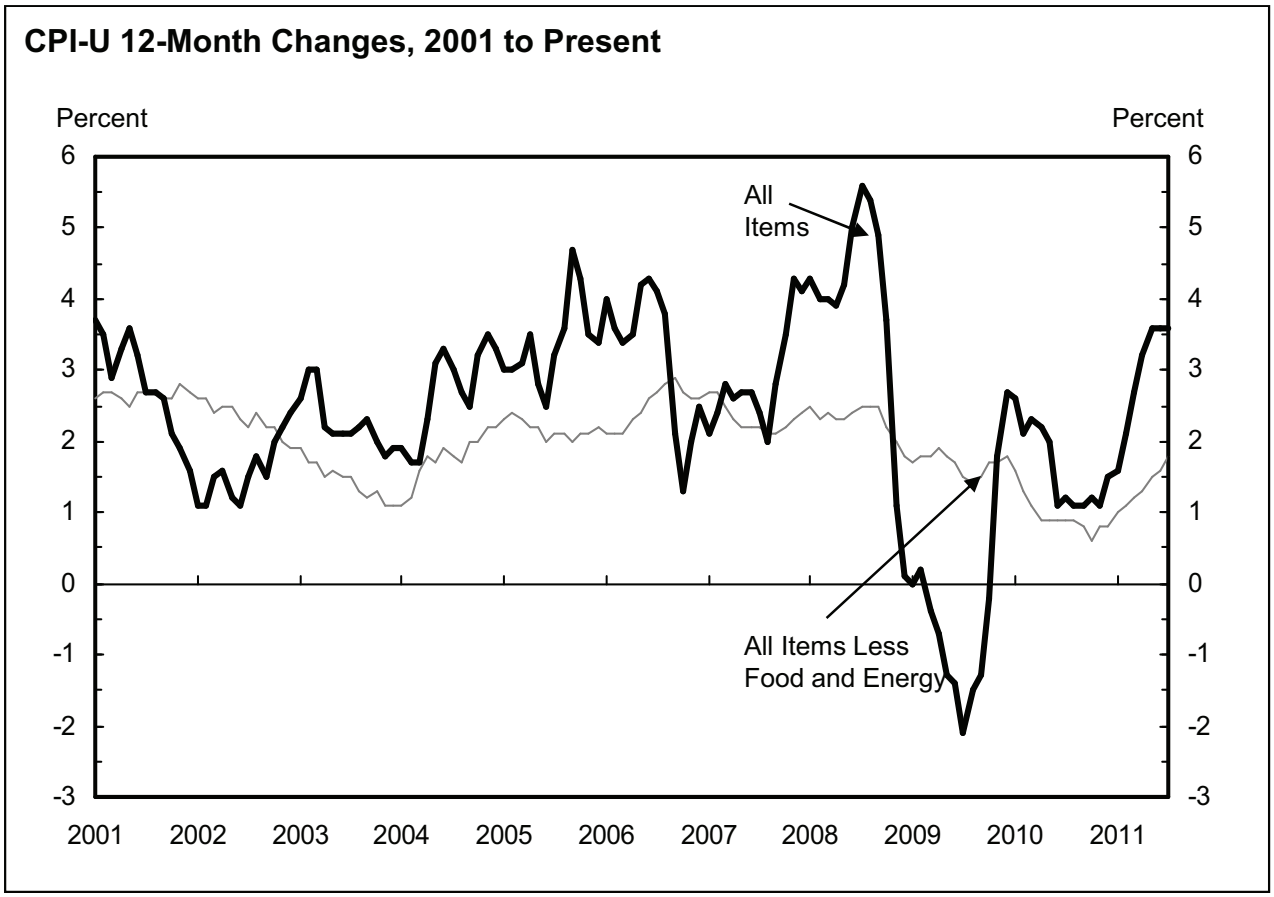
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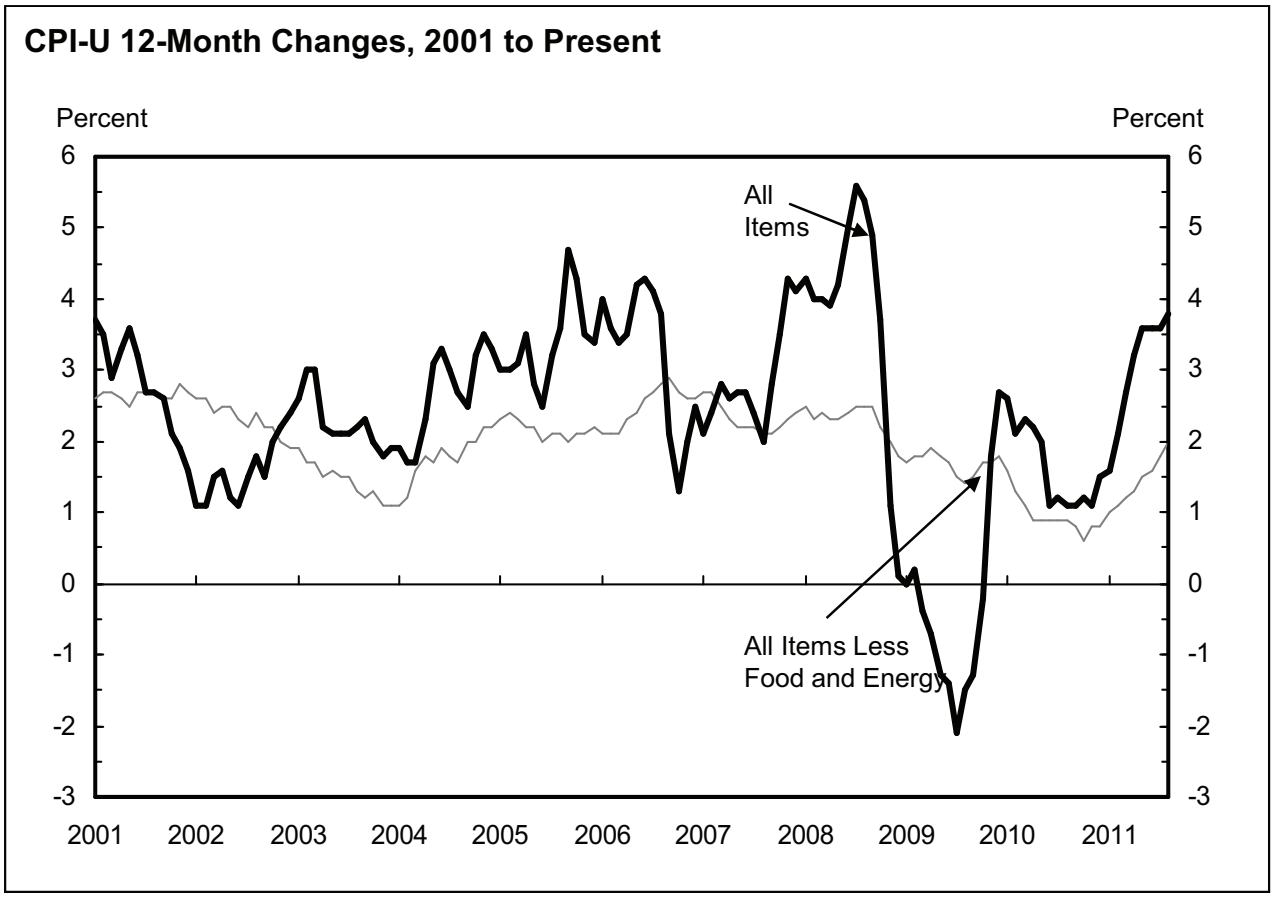
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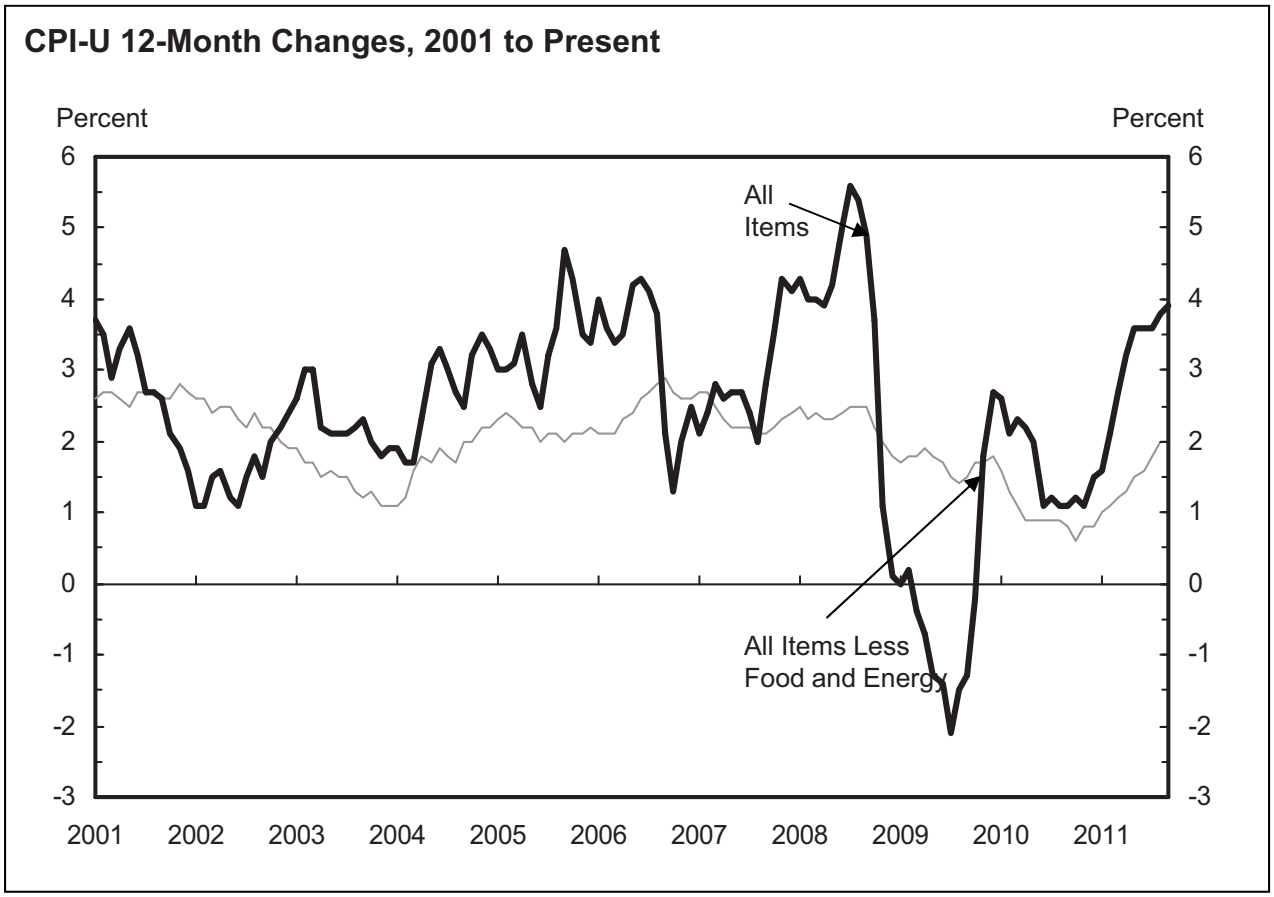
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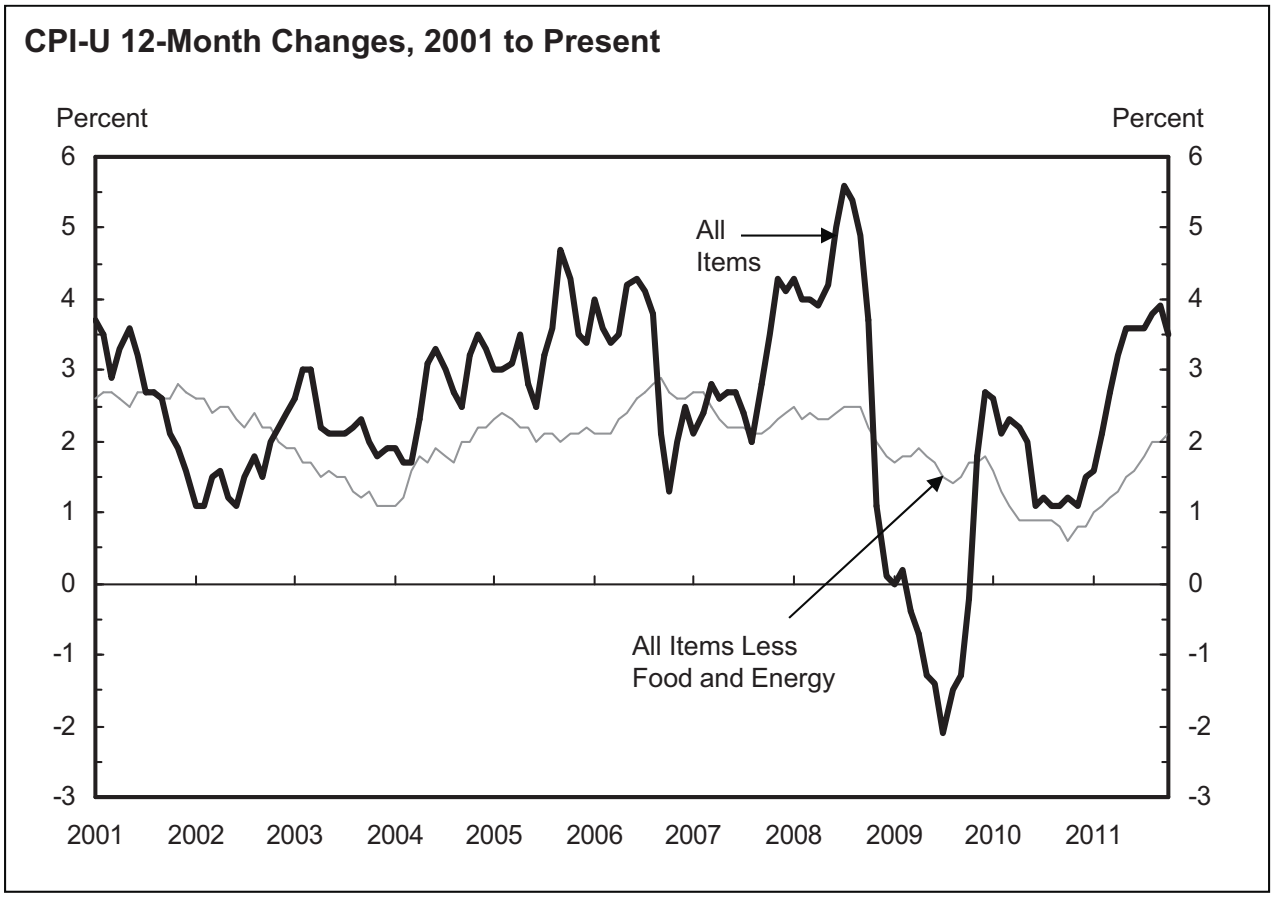
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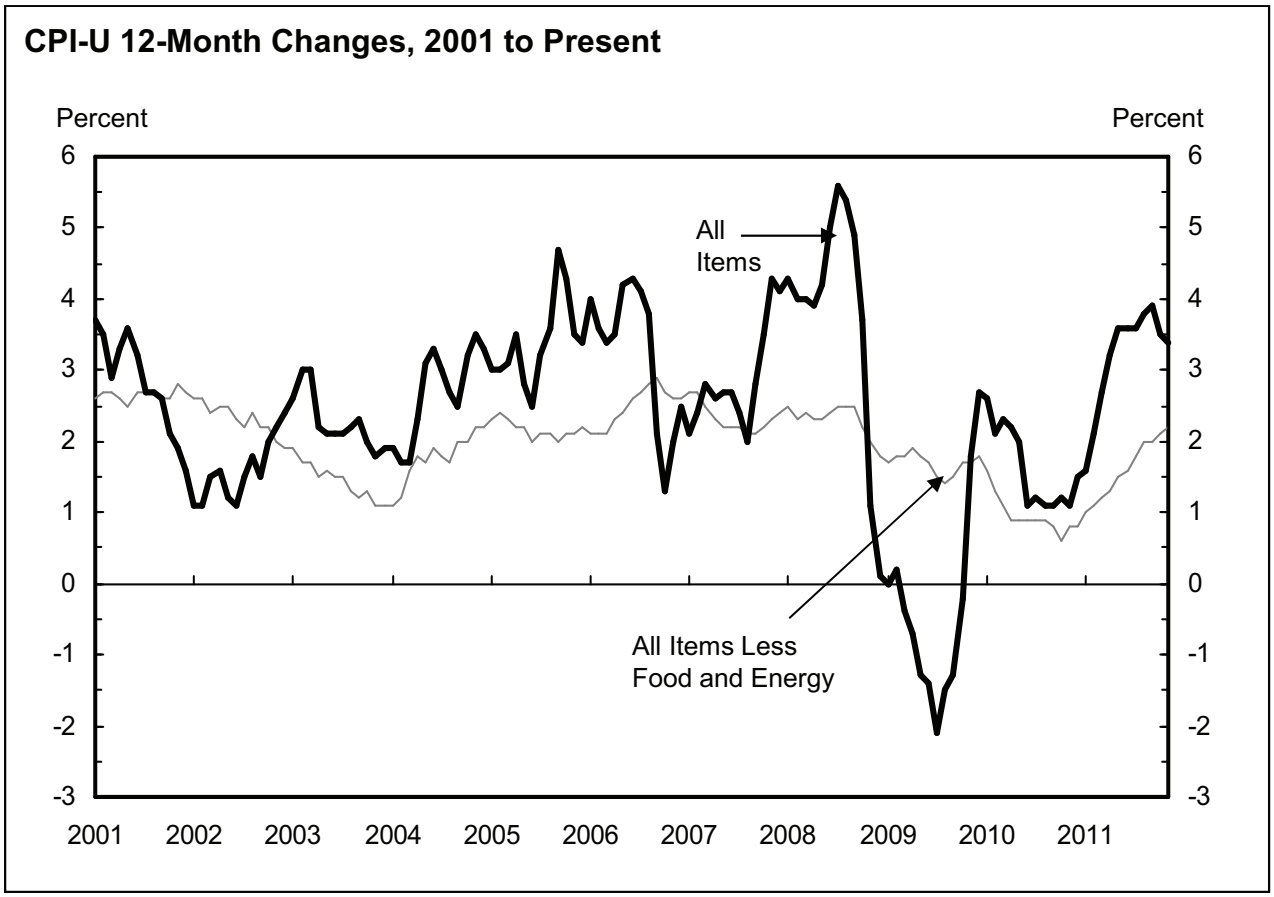
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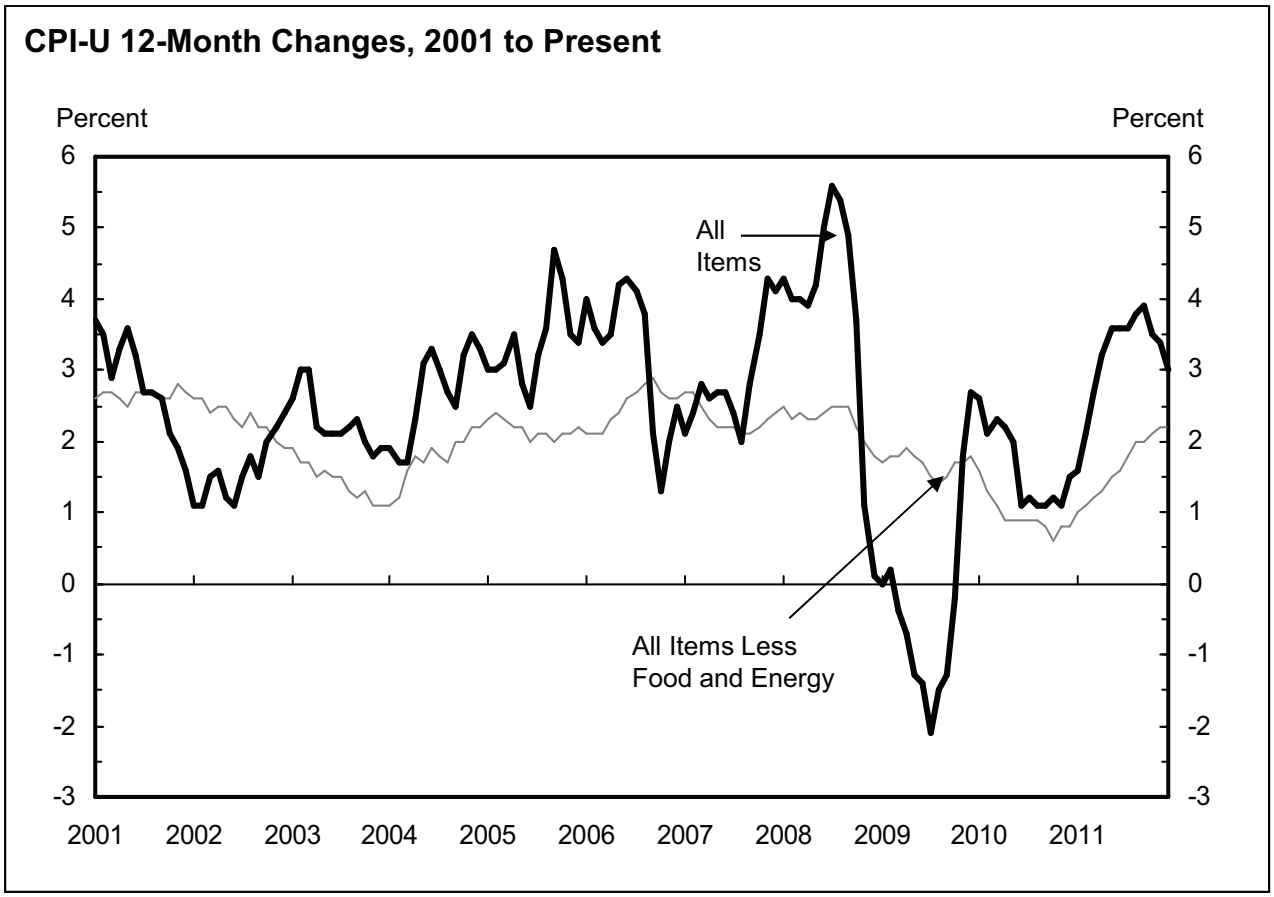
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Redesigning the Consumer Price Index (CPI) Press Release Tables

The format of the tables contained in the CPI News Release will change beginning with the CPI News Release for March, 2012, which will be issued on Friday, April 13, 2012. News Release tables are currently available as part of the News Release pdf and html files, and independently in html format. The new tables will also be available in Excel format. In addition, the BLS will begin issuing monthly companion Excel files, which will contain additional index level and CPI-W information.

These tables were made available for public comment during October 2011. In response to the public comments, the BLS will issue Excel files each month, as companions to the News Release. There will be CPI-U and CPI-W files, and in addition to the data contained in the News Release tables, the Excel files will contain index values. Samples of the companion Excel files will be available with the February CPI News Release in March 2012. Samples of the new CPI press release tables are available now at http://www.bls.gov/cpi/mock-ups.htm.

In August 2009, the Bureau of Labor Statistics (BLS) restructured the text of the CPI press release to focus on the price movements of three broad expenditure categories, namely Food, Energy, and All items less food and energy. Table A within the CPI press release text was also updated in August 2009 to reflect this new structure. Before August 2009, the text of the CPI press release had focused on eight CPI 'major groups' (Food and beverages; Housing; Apparel; Transportation; Medical care; Recreation; Education and communication; and Other goods and services).

While the text of the CPI press release was restructured in 2009, seven additional CPI press release tables continued to be published using the eight major groups. BLS has redesigned these press release tables, to reflect the focus on Food, Energy, and All items less food and energy. Within these three broad categories, CPI item series will be further divided into commodities and services. The CPI News Release will contain these updated tables beginning with the March 2012 News Release, to be issued on Friday, April 13, 2012.

Beyond the redesign in the structure of the CPI press release tables, several other improvements to these tables have been made.

The new Table 1 gives a summary of the index series which typically contribute to changes in the Consumer Price Index for All Urban Consumers (CPI-U).

The new Table 2 will show the full publication stub using the new structure for the CPI-U, including 11 new items series that were created to augment the redesign in the publication structure. Table 3 will show aggregate item series (e.g., Transportation) that do not fall under the Food, Energy, and All items less food and energy structure.

Table 4 will show the All items indexes at the local, regional, and city-size class levels.

Table 5 will show the Chained Consumer Price Index for All Urban Consumers (C-CPI-U), and presents a history of annual percentage changes in the C-CPI-U compared to the CPI-U.

Table 6 will focus on 1-month seasonally adjusted changes in the CPI-U, while table 7 will focus on 12-month not seasonally adjusted changes. Tables 6 and 7 will present three additional pieces of data to help users better interpret index changes. First, these tables will show the 'effect' each item has on the price change for All items. For example, if the effect of food is 0.4, and the index for All items increased 1.2 percent, it can be said that increases in food prices accounted for 0.4 / 1.2, or 33.3 percent, of the increase in overall prices for that period. Said another way, had food prices been unchanged, the All items index only would have increased 0.8 percent (or 1.2 percent for All items, minus the 0.4 effect for Food). Effects can be negative as well. For example, if the effect of food was a negative 0.1, and the All items index rose 0.5 percent, the All items index actually would have been 0.1 percent higher (or 0.6 percent) had food prices been unchanged.

Second, standard errors for percent changes will be shown on tables 6 and 7. Confidence intervals for statistics can be created using standard errors; e.g., roughly 95% confidence intervals can be constructed using two standard errors. For example, if an item increased 3.7 percent, and its standard error was 0.6 percent, the 95% confidence interval for that price change can be said to be 3.7 percent plus or minus two standard errors, or 3.7 percent plus or minus 1.2 percent.

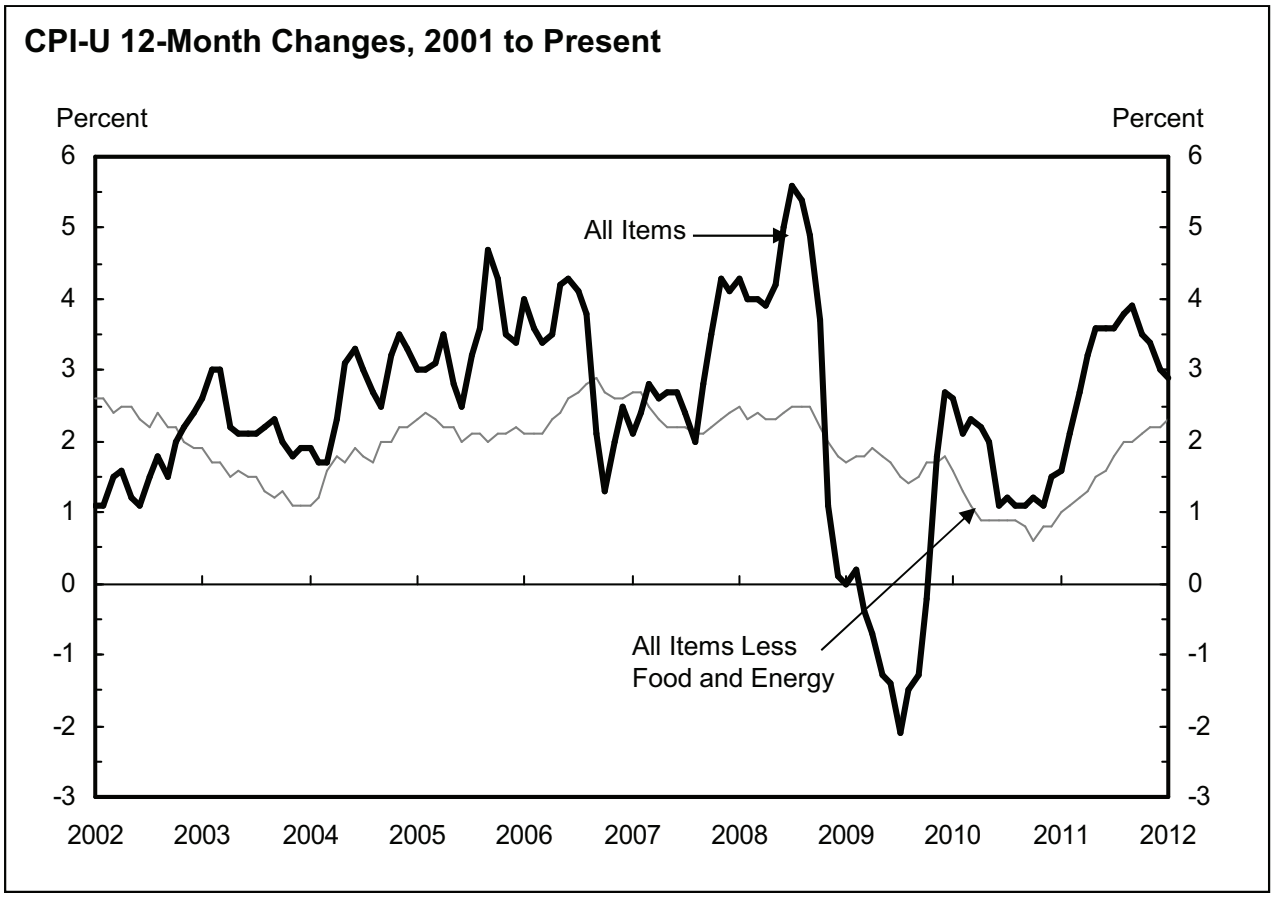
Finally, each item series in tables 6 and 7 will show the last time that item had a price change as large (or as small) as the percent change published that period. For example, if bananas rose 3.7 percent, and that was its largest increase since November 2007, that would be noted in the new tables.

In addition, most of the existing tables show the 'relative importance', or weight, of each item category as of the previous December. The relative importance columns in the new tables will be improved in that they will be updated monthly to reflect the change in relative prices over time.

Finally, there will no longer be any press release tables that focus on the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). That said, the CPI-W All items index level and percent changes will still be noted in the text of the press release, and a companion Excel file with CPI-W information will be available.

Expenditure Weight Update

Effective with the release of the January 2012 CPI on February 17, 2012, the Bureau of Labor Statistics (BLS) will update the consumption expenditure weights in the Consumer Price Index for All Urban Consumers (CPI-U) and Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) to the 2009-10 period. The updated expenditure weights for these indexes will replace the 2007-2008 weights that were introduced effective with the January 2010 CPI release. As originally announced by BLS in December 1998, CPI expenditure weights will continue to be updated at two-year intervals.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C-CPI-U Index Revisions

As scheduled, effective with this release of data for January 2012, the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) has undergone its annual revision. Because the current expenditure data required for the calculation of the C-CPI-U are available only with a time lag, the index is issued first in preliminary form, using the latest available expenditure data at the time of publication, and is subject to two subsequent revisions. Therefore, C-CPI-U indexes for the 12 months of 2010 are issued in final form – employing monthly expenditure weights from 2010. Values for the 12 months of 2011 are revised and issued as interim, using expenditure weights from the 2009-2010 period. Calculation of the initial value of the January 2012 C-CPI-U index, and all subsequent months in 2012, will also be based upon 2009-2010 expenditure weights.

For more information on the C-CPI-U, contact Rob Cage by telephone at (202) 691-6959 or by electronic mail at Cage.Rob@bls.gov.

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increases in food prices accounted for 0.4 / 1.2, or 33.3 percent, of the increase in overall prices for that period. Said another way, had food prices been unchanged, the All items index only would have increased 0.8 percent (or 1.2 percent for All items, minus the 0.4 effect for Food). Effects can be negative as well. For example, if the effect of food was a negative 0.1, and the All items index rose 0.5 percent, the All items index actually would have been 0.1 percent higher (or 0.6 percent) had food prices been unchanged.

Second, standard errors for percent changes will be shown on tables 6 and 7. Confidence intervals for statistics can be created using standard errors; e.g., roughly 95 percent confidence intervals can be constructed using two standard errors. For example, if an item increased 3.7 percent, and its standard error was 0.6 percent, the 95 percent confidence interval for that price change can be said to be 3.7 percent plus or minus two standard errors, or 3.7 percent plus or minus 1.2 percent.

Finally, each item series in tables 6 and 7 will show the last time that item had a price change as large (or as small) as the percent change published that period. For example, if bananas rose 3.7 percent, and that was its largest increase since November 2007, that would be noted in the new tables.

In addition, most of the existing tables show the 'relative importance', or weight, of each item category as of the previous December. The relative importance columns in the new tables will be improved in that they will be updated monthly to reflect the change in relative prices over time.

Finally, there will no longer be any press release tables that focus on the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). That said, the CPI-W All items index level and percent changes will still be noted in the text of the press release, and a companion XLS file with CPI-W information will be available.

A Note on Seasonally Adjusted and Unadjusted Data

Because price data are used for different purposes by different groups, the Bureau of Labor Statistics publishes seasonally adjusted as well as unadjusted changes each month.

For analyzing general price trends in the economy, seasonally adjusted changes are usually preferred since they eliminate the effect of changes that normally occur at the same time and in about the same magnitude every year--such as price movements resulting from changing climatic conditions, production cycles, model changeovers, holidays, and sales.

The unadjusted data are of primary interest to consumers concerned about the prices they actually pay. Unadjusted data also are used extensively for escalation purposes. Many collective bargaining contract agreements and pension plans, for example, tie compensation changes to the Consumer Price Index before adjustment for seasonal variation.

Seasonal factors used in computing the seasonally adjusted indexes are derived by the X-12-ARIMA Seasonal Adjustment Method. Seasonally adjusted indexes and seasonal factors are computed annually. Each year, the last 5 years of seasonally adjusted data are revised. Data from January 2007 through December 2011 were replaced in January 2012. Exceptions to the usual revision schedule were: the updated seasonal data at the end of 1977 replaced data from 1967 through 1977; and, in January 2002, dependently seasonally adjusted series were revised for January 1987-December 2001 as a result of a change in the aggregation weights for dependently adjusted series. For further information, please see "Aggregation of Dependently Adjusted Seasonally Adjusted Series," in the October 2001 issue of the CPI Detailed Report.

Effective with the publication of data from January 2006 through December 2010 in January 2011, the Video and audio series and the Information technology, hardware and services series were changed from independently adjusted to dependently adjusted. This resulted in an increase in the number of seasonal components used in deriving seasonal movement of the All items and 54 other lower level aggregations, from 73 for the publication of January 1998 through December 2005 data to 82 for the publication of seasonally adjusted data for January 2006 and later. Each year the seasonal status of every series is reevaluated based upon certain statistical criteria. If any of the 82 components change their seasonal adjustment status from seasonally adjusted to not seasonally adjusted, not seasonally adjusted data will be used in the aggregation of the dependent series for the last 5 years, but the seasonally adjusted indexes before that period will not be changed. Note: 38 of the 82 components are not seasonally adjusted for 2012.

Seasonally adjusted data, including the all items index levels, are subject to revision for up to five years after their original release. For this reason, BLS advises against the use of these data in escalation agreements.

Effective with the calculation of the seasonal factors for 1990, the Bureau of Labor Statistics has used an enhanced seasonal adjustment procedure called Intervention Analysis Seasonal Adjustment for some CPI series. Intervention Analysis Seasonal Adjustment allows for better estimates of seasonally adjusted data. Extreme values and/or sharp movements which might distort the seasonal pattern are estimated and removed from the data prior to calculation of seasonal factors. Beginning with the calculation of seasonal factors for 1996, X-12-ARIMA software was used for Intervention Analysis Seasonal Adjustment.

For the seasonal factors introduced in January 2012, BLS adjusted 31 series using Intervention Analysis Seasonal Adjustment, including selected food and beverage items, motor fuels, electricity and vehicles. For example, this procedure was used for the Motor fuel series to offset the effects of events such as damage to oil refineries from Hurricane Katrina.

For a complete list of Intervention Analysis Seasonal Adjustment series and explanations, please refer to the article "Intervention Analysis Seasonal Adjustment", located on our website at http://www.bls.gov/cpi/cpisapage.htm.

For additional information on seasonal adjustment in the CPI, please write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, Washington, DC 20212 or contact David Levin at (202) 691-6968, or by e-mail at Levin.David@bls.gov. If you have general questions about the CPI, please call our information staff at (202) 691-7000.

Revised seasonally adjusted changes

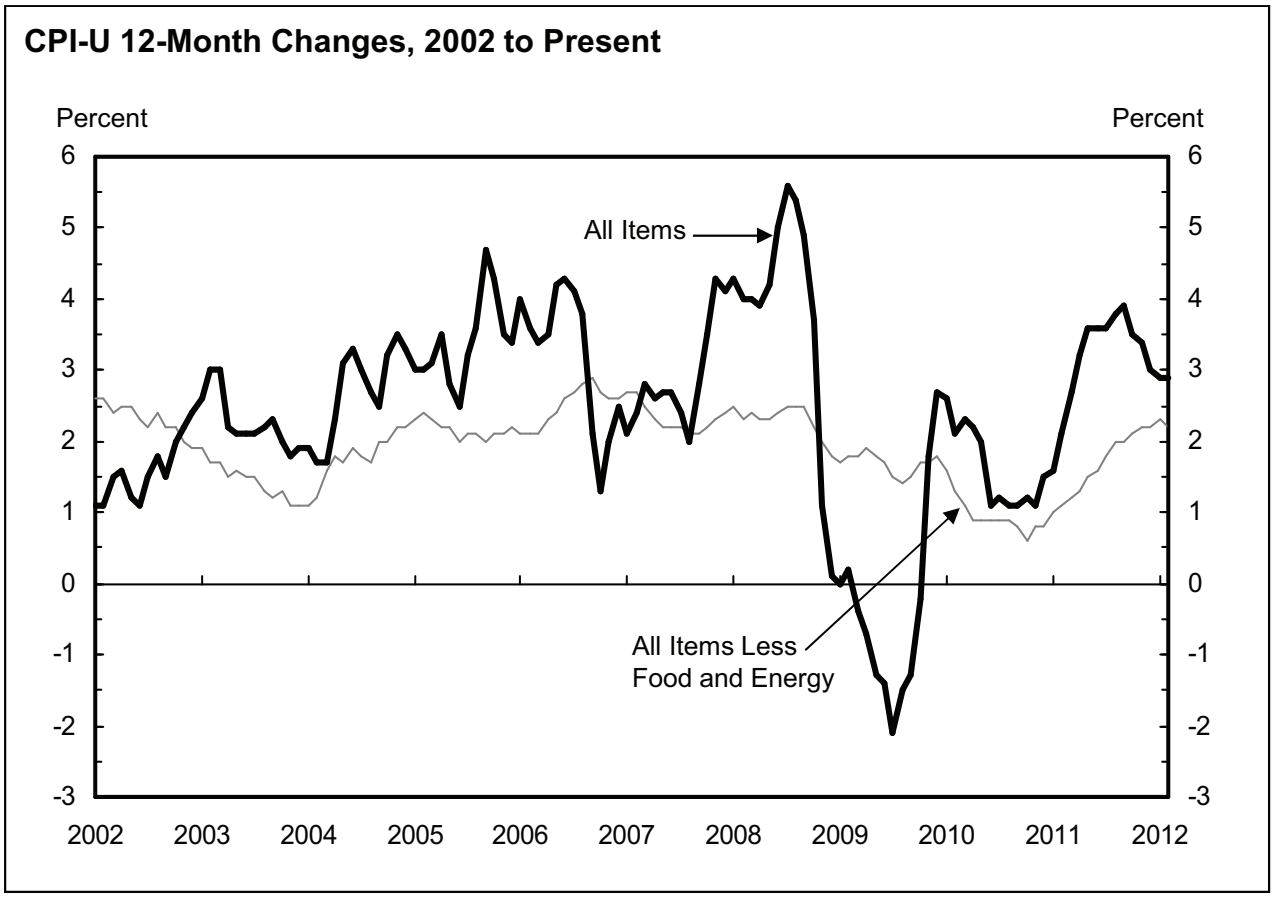
Over-the-month percent changes in the U.S. City Average Consumer Price Index for All Urban Consumers (CPI-U) for All Items and for All Items less food and energy, seasonally adjusted, using former and recalculated seasonal factors for 2011.

All Items

2011	Former	Recalculated	Difference
January	.4	.3	-.1
February	.5	.4	-.1
March	.5	.5	.0
April	.4	.4	.0
May	.2	.3	.1
June	-.2	.1	.3
July	.5	.3	-.2
August	.4	.3	-.1
September	.3	.3	.0
October	-.1	.0	.1
November	.0	.1	.1
December	.0	.0	.0

All Items less food and energy

2011	Former	Recalculated	Difference
January	.2	.2	.0
February	.2	.2	.0
March	.1	.2	.1
April	.2	.2	.0
May	.3	.3	.0
June	.3	.2	-.1
July	.2	.2	.0
August	.2	.2	.0
September	.1	.1	.0
October	.1	.2	.1
November	.2	.2	.0
December	.1	.1	.0


CPI-U 12-Month Changes, 2002 to Present
Percent
Percent
6
5
4
3
2
1
0
-1
-2
-3
All Items
All Items Less
Food and Energy
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

C-CPI-U Index Revisions

As scheduled, effective with this release of data for January 2012, the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) has undergone its annual revision. Because the current expenditure data required for the calculation of the C-CPI-U are available only with a time lag, the index is issued first in preliminary form, using the latest available expenditure data at the time of publication, and is subject to two subsequent revisions. Therefore, C-CPI-U indexes for the 12 months of 2010 are issued in final form – employing monthly expenditure weights from 2010. Values for the 12 months of 2011 are revised and issued as interim, using expenditure weights from the 2009-2010 period. Calculation of the initial value of the January 2012 C-CPI-U index, and all subsequent months in 2012, will also be based upon 2009-2010 expenditure weights.

For more information on the C-CPI-U, contact Rob Cage by telephone at (202) 691-6959 or by electronic mail at Cage.Rob@bls.gov.

Redesigning the Consumer Price Index (CPI) Press Release Tables

The format of the tables contained in the CPI News Release will change beginning with the CPI News Release for March, 2012, which will be issued on Friday, April 13, 2012. News Release tables are currently available as part of the News Release pdf and html files, and independently in html format. The new tables will also be available in XLS format. In addition, the BLS will begin issuing monthly companion XLS files, which will contain additional index level and CPI-W information.

These tables were made available for public comment during October 2011. In response to the public comments, the BLS will issue XLS files each month, as companions to the News Release. There will be CPI-U and CPI-W files, and in addition to the data contained in the News Release tables, the Excel files will contain index values. Samples of the new CPI press release tables and companion XLS files are available now at http://www.bls.gov/cpi/mock-ups.htm.

In August 2009, the Bureau of Labor Statistics (BLS) restructured the text of the CPI press release to focus on the price movements of three broad expenditure categories, namely Food, Energy, and All items less food and energy. Table A within the CPI press release text was also updated in August 2009 to reflect this new structure. Before August 2009, the text of the CPI press release had focused on eight CPI 'major groups' (Food and beverages; Housing; Apparel; Transportation; Medical care; Recreation; Education and communication; and Other goods and services).

While the text of the CPI press release was restructured in 2009, seven additional CPI press release tables continued to be published using the eight major groups. BLS has redesigned these press release tables, to reflect the focus on Food, Energy, and All items less food and energy. Within these three broad categories, CPI item series will be further divided into commodities and services. The CPI News Release will contain these updated tables beginning with the March 2012 News Release, to be issued on Friday, April 13, 2012.

Beyond the redesign in the structure of the CPI press release tables, several other improvements to these tables have been made.

The new Table 1 gives a summary of the index series which typically contribute to changes in the Consumer Price Index for All Urban Consumers (CPI-U).

The new Table 2 will show the full publication stub using the new structure for the CPI-U, including 11 new items series that were created to augment the redesign in the publication structure. Table 3 will show aggregate item series (e.g., Transportation) that do not fall under the Food, Energy, and All items less food and energy structure.

Table 4 will show the All items indexes at the local, regional, and city-size class levels.

Table 5 will show the Chained Consumer Price Index for All Urban Consumers (C-CPI-U), and presents a history of annual percentage changes in the C-CPI-U compared to the CPI-U.

Table 6 will focus on 1-month seasonally adjusted changes in the CPI-U, while table 7 will focus on 12-month not seasonally adjusted changes. Tables 6 and 7 will present three additional pieces of data to help users better interpret index changes. First, these tables will show the 'effect' each item has on the price change for All items. For example, if the effect of food is 0.4, and the index for All items increased 1.2 percent, it can be said that increases in food prices accounted for 0.4 / 1.2, or 33.3 percent, of the increase in overall prices for that period. Said another way, had food prices been unchanged, the All items index only would have increased 0.8 percent (or 1.2 percent for All items, minus the 0.4 effect for Food). Effects can be negative as well. For example, if the effect of food was a negative 0.1, and the All items index rose 0.5 percent, the All items index actually would have been 0.1 percent higher (or 0.6 percent) had food prices been unchanged.

Second, standard errors for percent changes will be shown on tables 6 and 7. Confidence intervals for statistics can be created using standard errors; e.g., roughly 95 percent confidence intervals can be constructed using two standard errors. For example, if an item increased 3.7 percent, and its standard error was 0.6 percent, the 95 percent confidence interval for that price change can be said to be 3.7 percent plus or minus two standard errors, or 3.7 percent plus or minus 1.2 percent.

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In addition, most of the existing tables show the 'relative importance', or weight, of each item category as of the previous December. The relative importance columns in the new tables will be improved in that they will be updated monthly to reflect the change in relative prices over time.

Finally, there will no longer be any press release tables that focus on the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). That said, the CPI-W All items index level and percent changes will still be noted in the text of the press release, and a companion XLS file with CPI-W information will be available.

Variance Estimates for Price Changes in the Consumer Price Index January–December 2011

Owen J. Shoemaker

This article presents variance estimates for 1-month, 2-month, 6-month, and 12-month percent changes in the Consumer Price Index for All Urban Consumers (CPI-U). Variance is a measure of the uncertainty caused by the use of a sample of retail prices, instead of the complete universe of retail prices. The estimates cover the period January 2011 through December 2011.[1] Each month the U.S. Bureau of Labor Statistics collects prices from a sample of approximately 83,300 commodities and services (C&S) quotes in approximately 26,400 outlets[2] around the United States for the Consumer Price Index (CPI).

The most commonly used measure of sampling variability is the *standard error* of the estimate – the square root of the variance. The standard error of the CPI's change can be used to construct confidence intervals to determine whether the change for a particular CPI series is significantly different from zero. This information should help users determine which index changes are significant.

Presentation of findings

The percent changes in the CPI along with their standard errors were estimated for the 12 months from January through December 2011. In summary, tables 1V through 5V show the median values of those percent changes, as well as the median values of the standard errors. Table 1V shows this information for U.S. city average, and tables 2V through 5V show the same information for the Northeast, Midwest, South, and West regions of the country.

For example, from January through December 2011, the 1-month changes in the U.S. city average all items index had a median value of 0.21 percent. The standard errors of those 12 estimates had a median value of 0.03 percent. Margins of error are usually expressed as a statistic's point estimate plus or minus two standard errors, so the margin of error on this CPI's 1-month change is approximately 0.21 percent plus or minus 0.06 percent. Therefore, in a typical 1-month period, the true change in the CPI was probably somewhere between 0.15 percent and 0.27 percent. The tables also show median percent changes and standard errors for 2- and 6-month intervals and for the full year 2011. Margins of error can be calculated for these intervals in the same way as for a 1-month period.

Analysis of findings

Analyzing the data reveals three significant observations. First, standard errors increase as one moves from the U.S. city average to individual regions of the country and from *all items* to individual item categories. Second, standard errors differ between item categories. Third, the standard errors decrease on a relative basis (standard error divided by price change), as the price change interval gets longer.

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[1] In 1998 significant changes were made to the CPI's structure and sample, and a new variance calculation system was implemented. For information on variances from 1978-1986, 1993-1997 and then 1998 and 1999, see the *CPI Detailed Report* for February 1991, May 1994, February 1998, December 1999, and November 2000, respectively.
[2] In addition, BLS collects approximately 4,800 shelter quotes, used for both Rent and Rental Equivalence (REQ), each month.

The primary reason standard errors increase as one moves from the U.S. city average to individual regions of the country is that sample sizes differ. In general, smaller sample sizes lead to larger standard errors. For example, the U.S. city average all items index is computed each month from approximately 88,100 prices (including all Rent and REQ quotes) throughout the United States, and its median standard error for 1-month changes is 0.03 percent. By contrast, the Northeast region all items index is computed from approximately 19,500 prices, and its median standard error is 0.07 percent. Regional indexes have larger standard errors because their sample sizes are smaller.

One can observe this same effect moving from the all items index to individual item categories. Again, the U.S. city average all items index is computed each month from approximately 88,100 prices, and its median 1-month standard error is 0.03 percent. By contrast, the U.S. city average recreation index is computed from approximately 5,400 prices, and its median 1-month standard error is 0.15 percent, five times as large. Again, smaller sample sizes lead to larger standard errors.

The second significant observation is that standard errors differ between item categories. There are two reasons for this. First, item categories differ in sample size. For example, the U.S. city average food and beverages index is computed from approximately 35,400 prices each month, while the U.S. city average recreation index is computed from approximately 5,400 prices. Therefore, it is not surprising that the recreation index has larger standard errors. Second, there are real differences in item category price behaviors caused by different selling practices, seasonal influences, and consumer demand. This is especially true for the apparel category, in which it is common for the prices of individual items to fluctuate by 50 percent or more each month. As a result, standard errors for apparel indexes are large.

The third observation is that standard errors generally tend to decrease, on a relative basis (standard error divided by price change), as the price change interval gets longer. For the U.S. city average all items index, the median standard error divided by the median percent change is 0.03/0.21 = 0.14 for 1-month changes, 0.04/0.40 = 0.10 for 2-month changes, 0.07/1.92 = 0.04 for 6-month changes, and 0.07/3.46 = 0.02 for 12-month changes. This shows that the relative accuracy of percent changes in the CPI generally improves as the price change interval gets longer. On an absolute basis, standard errors tend to increase, but at a decreasing rate.

Findings presented here indicate that users should exercise caution when using CPI estimates to make inferences about index changes for relatively short time periods, for individual goods and services, or for local areas. The standard errors of those estimates may be on the same order of magnitude as the estimates themselves; and, thus, few inferences about them are reliable.

Sources of error

One way of analyzing the error in a survey estimate is to divide the total error into two sources: *sampling error* and *non-sampling error*. Sampling error is the uncertainty in the CPI caused by the fact that a sample of retail prices is used to compute the CPI, instead of using the complete universe of retail prices. Non-sampling error is the rest of the error. Non-sampling error includes things such as incorrect information given by survey respondents, data processing errors, and so forth. Non-sampling error arises regardless of whether data are collected from a sample of retail prices or from the complete universe.

Another way of analyzing error is to divide it into *variance* and *bias*. The variance of the CPI is a measure of how close different estimates of the CPI would be to each other if it were possible to repeat the survey over and over using different samples. Of course, it is not feasible to repeat the survey multiple times, but statistical theory allows the CPI's variance to be estimated anyway. A small variance, for example, indicates that multiple independent samples would produce values that are consistently very

close to each other. *Bias* is the difference between the CPI's *expected* value and its *true* value. A statistic may have a small variance but a large bias, or it may have a large variance but a small bias. For an index to be considered accurate, both its variance and bias need to be small.

The Bureau of Labor Statistics (BLS) is constantly trying to reduce the error in the CPI. Variance and sampling error are reduced by using a sample of retail prices that is as large as possible, given resource constraints. BLS has developed a model that optimizes the allocation of resources by indicating the number of prices that should be observed in each geographic area and each item category, in order to minimize the variance of the U.S. city average all items index. BLS reduces non-sampling error through a series of computerized and professional data reviews, as well as through continuous survey process improvements and theoretical research.

Replication and variance estimation

An important advantage of using sampling is that the CPI's variance can be estimated directly from the sample data. Starting in 1978, the CPI's sample design has accommodated variance estimation by using two or more independent samples of items and outlets in each geographic area. This allows two or more statistically independent estimates of the index to be made. The independent samples are called *replicates*, and the set of all observed prices is called the *full sample*.

BLS collects CPI data in 38 geographic areas across the United States. These areas consist of 31 *self-representing* areas and 7 *non-self-representing* areas. Self-representing areas are large metropolitan areas, such as the Boston, St. Louis, and San Francisco metropolitan areas. Non-self-representing areas are collections of smaller metropolitan areas. For example, one non-self-representing area is a collection of 32 small metropolitan areas in the Northeast region (Buffalo, Hartford, Providence, Bangor, and others), of which 8 were randomly selected to represent the entire set. Within each of the 38 areas, price data are collected for 211 item categories called *item strata*. Together the 211 item strata cover all consumer purchases. Examples of item strata are bananas, women's dresses, and electricity.

Multiplying the number of areas by the number of item strata gives 8,018 (= 38 × 211) different area and item combinations for which price indexes need to be calculated. Separate price indexes are calculated for each one of these 8,018 area and item combinations. After all 8,018 of these *basic-level* indexes are calculated, they are aggregated to form *higher-level* indexes, using expenditure estimates from the Consumer Expenditure Survey as their weights. Examples of higher-level geographic areas are the four regions (Northeast, Midwest, South, and West); and examples of higher-level item categories are the eight major groups (food & beverages, housing, apparel, transportation, medical care, education and communication, recreation, and other goods and services). The highest level of geographic aggregation is the U.S. city average, and the highest level of item aggregation is all items.

Variances are computed with a Stratified Random Groups Method, in which variances are computed separately for certain subsets of areas and items and are then combined to produce the variance of the entire area and item combination. Subsets of items are formed by the intersection of the item category with each of the eight major groups.

Let $CPI(A,I,f,t)$ denote the index value where A = area, I = item category, f indicates that it is the full-sample value, and t = month; and let $CPI(A,I,f,t-k)$ denote the value of the same index in month = $t-k$. In general, the upper-case letter A denotes a *set* of areas, such as the Northeast or Midwest region of the country; and the upper-case letter I denotes a higher-level item category, such as all items or all items less food and energy. Also let $CPI(A,I,r,t)$ and $CPI(A,I,r,t-k)$ be the corresponding index values for replicate = r. Most areas have two replicates, but some have more. Then, the full-sample k-month percent change

between months $t-k$ and t is computed by dividing $CPI(A,I,f,t)$ by $CPI(A,I,f,t-k)$, subtracting 1, and multiplying by 100:

$$PC(A,I,f,t,t-k) = \left(\frac{CPI(A,I,f,t)}{CPI(A,I,f,t-k)} - 1 \right) \times 100$$

Every index has a weight $W(A,I,f)$ or $W(A,I,r)$ associated with it, which is used to combine the index with other indexes to produce indexes for larger geographic areas and larger item categories. For example, the weights are used to combine all 8,018 basic-level indexes into higher-level indexes such as the U.S. city average all items index. The product of an index and its weight is called a *cost weight*, $CW(A,I,r,t) = CPI(A,I,r,t) \times W(A,I,r)$, and is an estimate of the total cost in area = A for consumption of item category = I in month = t.

For the Stratified Random Groups method used here, replicate percent changes are defined as follows: full sample cost weights are used for every geographic area within area = A except for one of the areas. In the omitted area, the full sample cost weight is replaced by a replicate cost weight. Let the lower case letter a denote one of the 38 basic-level areas included in area = A, and let the lower case letter i denote the intersection of item category = I with one of the 8 major groups. Then, the replicate percent change, for area = a, item subset = i, replicate = r, between months $t-k$ and t, is computed as:

$$PC_S(a,i,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,i,f,t) + CW(a,i,r,t)}{CW(A,I,f,t-k) - CW(a,i,f,t-k) + CW(a,i,r,t-k)} - 1 \right) \times 100$$

for self-representing areas. For non-self-representing areas, the replicate percent change, for area = a, item category = I, replicate = r, between months $t-k$ and t, is computed as:

$$PC_N(a,I,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,I,f,t) + CW(a,I,r,t)}{CW(A,I,f,t-k) - CW(a,I,f,t-k) + CW(a,I,r,t-k)} - 1 \right) \times 100$$

where:

$$CW(A,I,f,t) = \sum_{a \subset A} \sum_{i \subset I} CW(a,i,f,t)$$
$$CW(A,I,f,t) = \sum_{a \subset A} CW(a,I,f,t)$$
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and likewise for replicates. The symbol "$a \subset A$" means that the sum is over all basic-level areas within area = A, and the symbol $i \subset I$ means that the sum is over all item categories that are intersections of item category = I with a major group.

Then, the variance is computed with the following Stratified Random Groups Variance Estimation Formula:

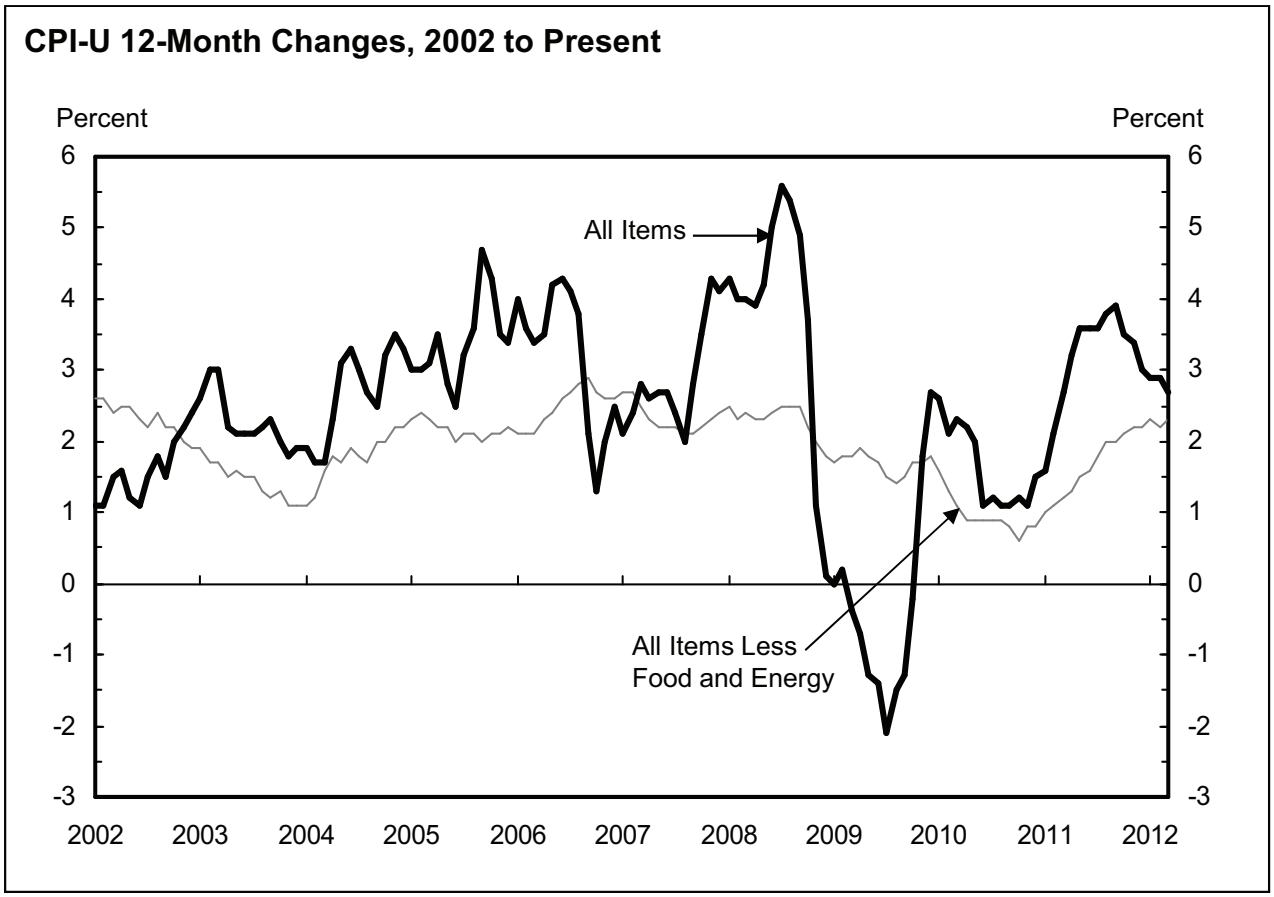
$$V[PC(A,I,f,t,t-k)] = \sum_{i \subset I} \sum_{a \subset A \cap S} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_S(a,i,r,t,t-k) - PC(A,I,t,t-k) \right)^2$$
$$+ \sum_{a \subset A \cap N} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_N(a,I,r,t,t-k) - PC(A,I,t,t-k) \right)^2$$

where S and N are the sets of all self-representing and non-self-representing areas in the CPI's geographic sample, respectively; and A∩S and A∩N are the sets of all self-representing and non-self-representing areas within area = A. The number R_a is the number of replicates in area = a.

Finally, the standard error of the percent change is computed by taking the square root of its variance:

$$SE[\,PC(A, I, f, t, t-k)\,] \;=\; \sqrt{V[PC(A, I, f, t, t-k)]}\;.$$

For more information, write to the CPI Information Office, BLS - Room 3130, 2 Massachusetts Avenue, N.E., Washington, DC 20212, or call Owen Shoemaker at 202-691-6918.


CPI-U 12-Month Changes, 2002 to Present
Percent
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6
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-1
-2
-3
All Items
All Items Less
Food and Energy
2002
2003
2004
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2006
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2008
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2010
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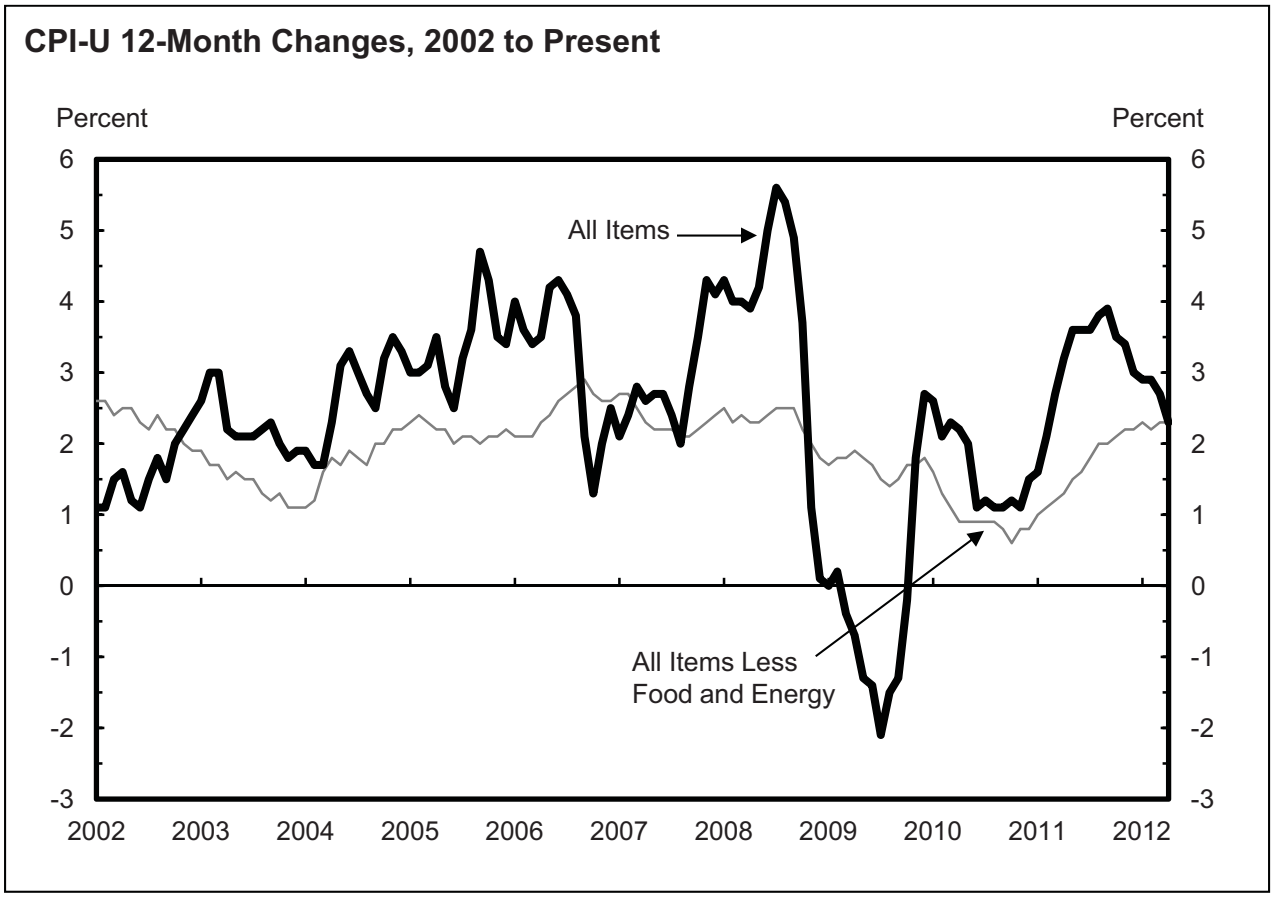
2012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Beyond the redesign in the structure of the CPI news release tables, several other improvements to these tables have been made.

The new Table 1 gives a summary of the index series which typically contribute to changes in the Consumer Price Index for All Urban Consumers (CPI-U).

The new Table 2 shows the full publication stub using the new structure for the CPI-U, including 11 new items series that were created to augment the redesign in the publication structure. Table 3 shows aggregate item series (e.g., Transportation) that do not fall under the Food, Energy, and All items less food and energy structure.

Table 4 shows the All items indexes at the local, regional, and city-size class levels.

Table 5 shows the Chained Consumer Price Index for All Urban Consumers (C-CPI-U), and presents a history of annual percentage changes in the C-CPI-U compared to the CPI-U.

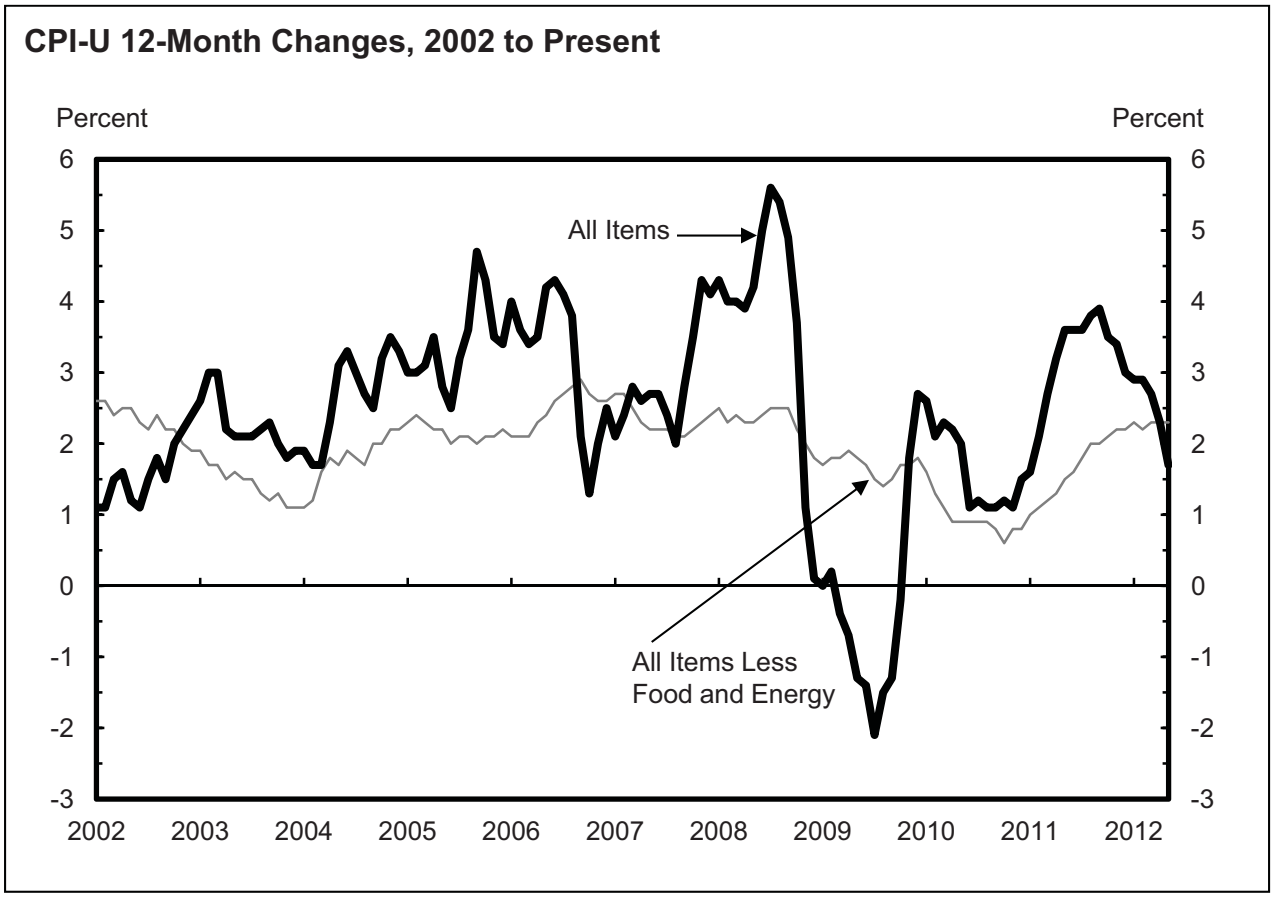
Table 6 focuses on 1-month seasonally adjusted changes in the CPI-U, while table 7 focuses on 12-month not seasonally adjusted changes. Tables 6 and 7 present three additional pieces of data to help users better interpret index changes. First, these tables show the 'effect' each item has on the price change for All items. For example, if the effect of food is 0.4, and the index for All items increased 1.2 percent, it can be said that increases in food prices accounted for 0.4 / 1.2, or 33.3 percent, of the increase in overall prices for that period. Said another way, had food prices been unchanged, the All items index only would have increased 0.8 percent (or 1.2 percent for All items, minus the 0.4 effect for Food). Effects can be negative as well. For example, if the effect of food was a negative 0.1, and the All items index rose 0.5 percent, the All items index actually would have been 0.1 percent higher (or 0.6 percent) had food prices been unchanged.

Second, standard errors for percent changes are shown on tables 6 and 7. Confidence intervals for statistics can be created using standard errors; e.g., roughly 95 percent confidence intervals can be constructed using two standard errors. For example, if an item increased 3.7 percent, and its standard error was 0.6 percent, the 95 percent confidence interval for that price change can be said to be 3.7 percent plus or minus two standard errors, or 3.7 percent plus or minus 1.2 percent.

Finally, each item series in tables 6 and 7 show the last time that item had a price change as large (or as small) as the percent change published that period. For example, if bananas rose 3.7 percent, and that was its largest increase since November 2007, that would be noted in the new tables.

In addition, most of the previous tables showed the 'relative importance', or weight, of each item category as of the previous December. The relative importance columns in the new tables are improved in that they are updated monthly to reflect the change in relative prices over time.

Finally, there are no longer any news release tables that focus on the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). That said, the CPI-W All items index level and percent changes will still be noted in the text of the news release, and a companion XLS file with CPI-W information will be available.


CPI-U 12-Month Changes, 2002 to Present
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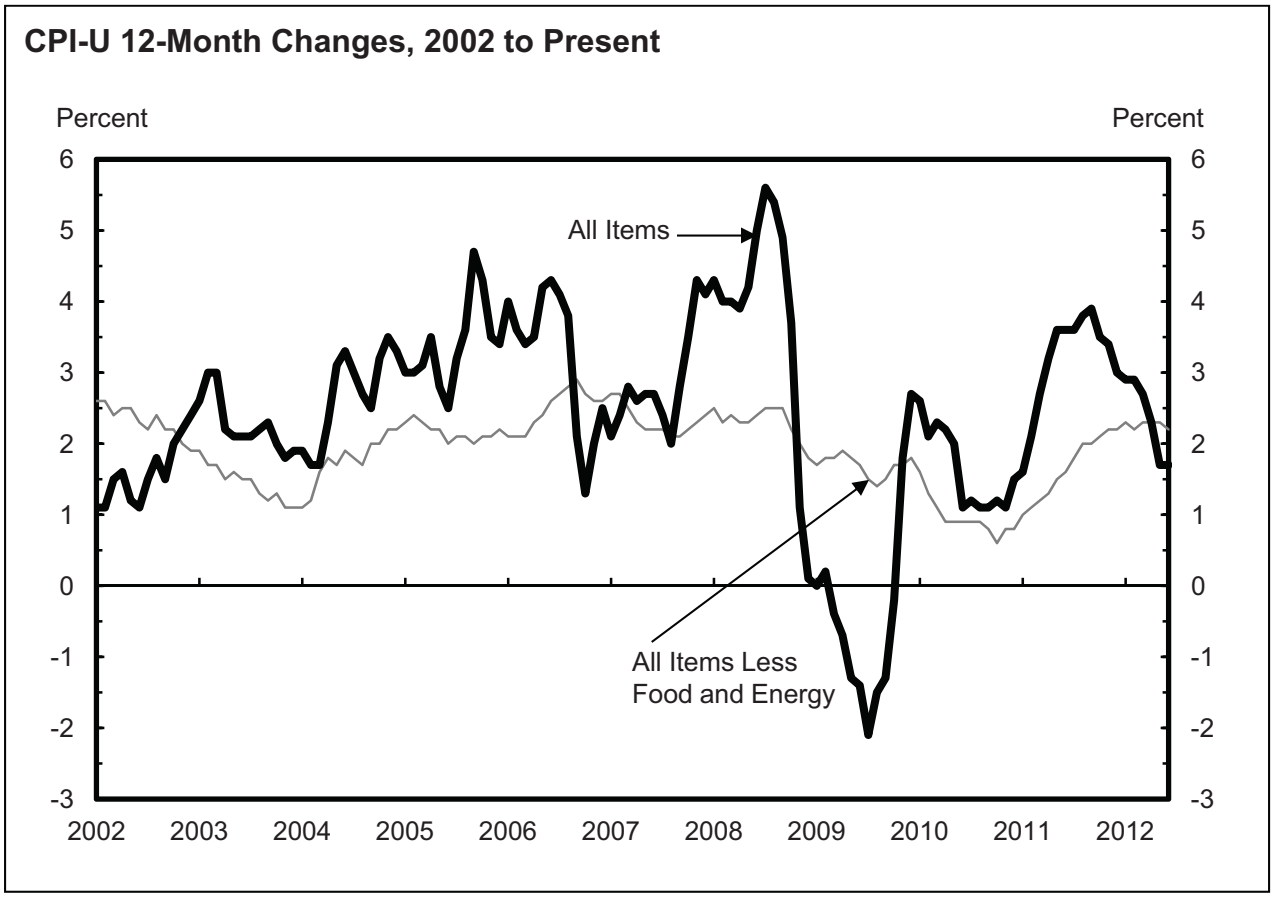
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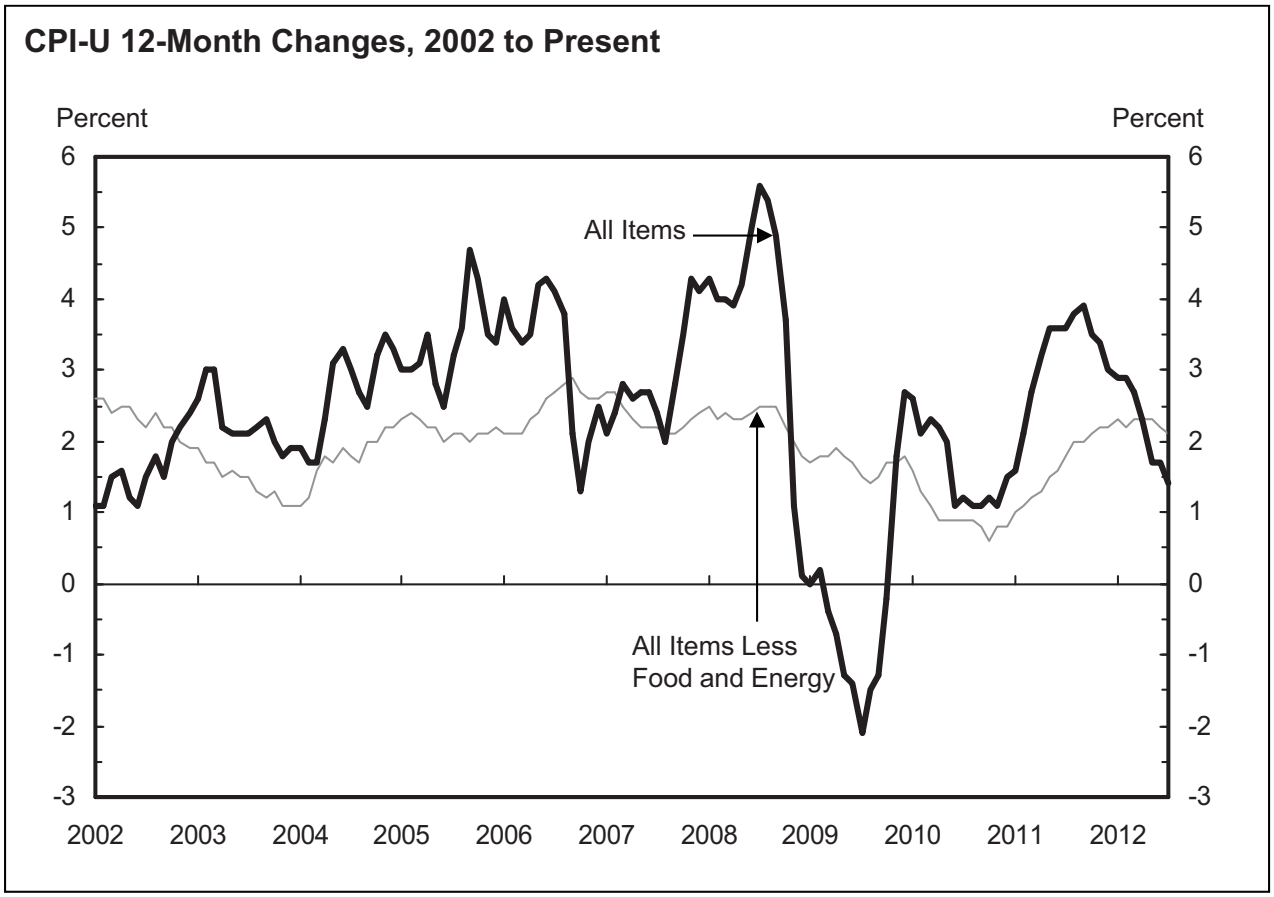
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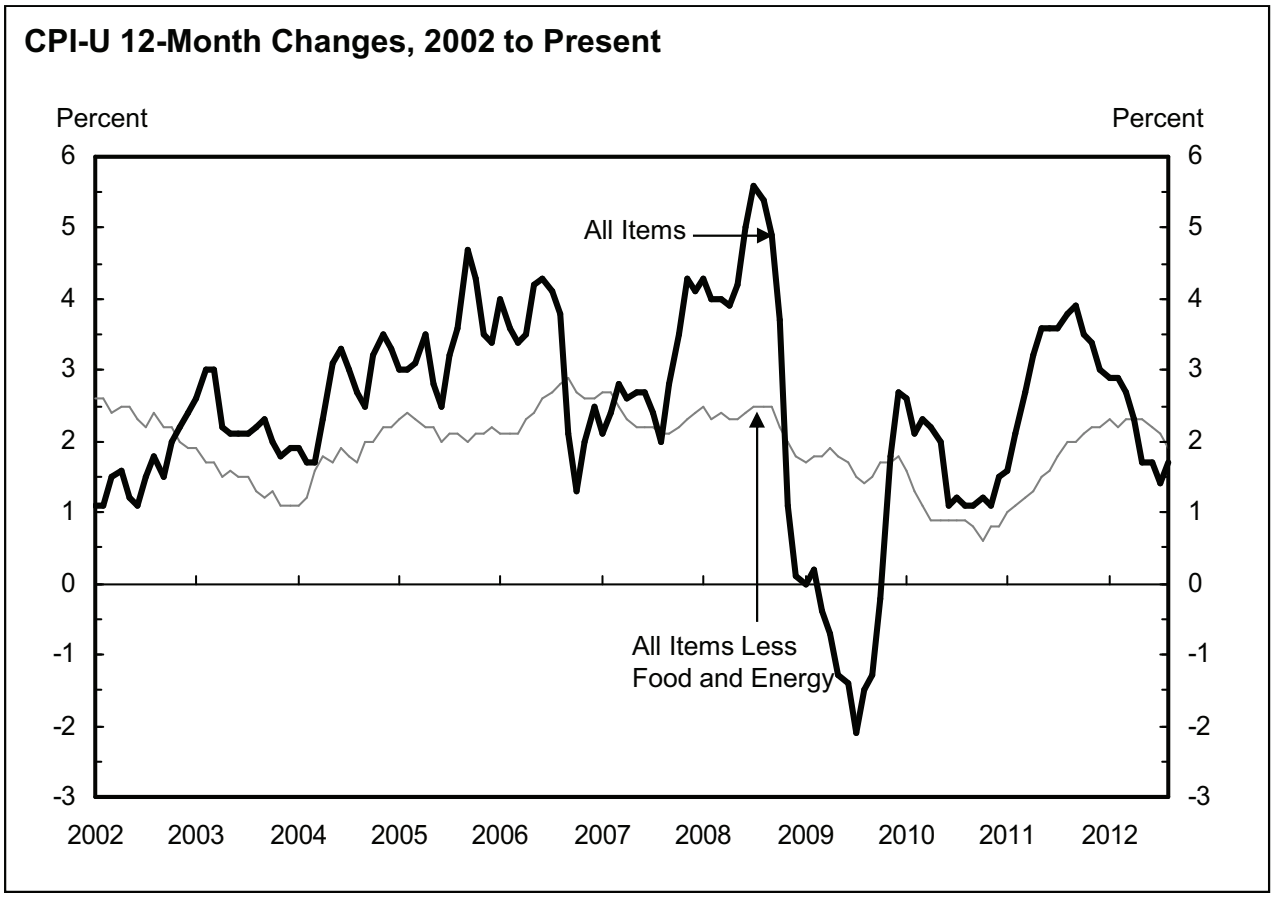
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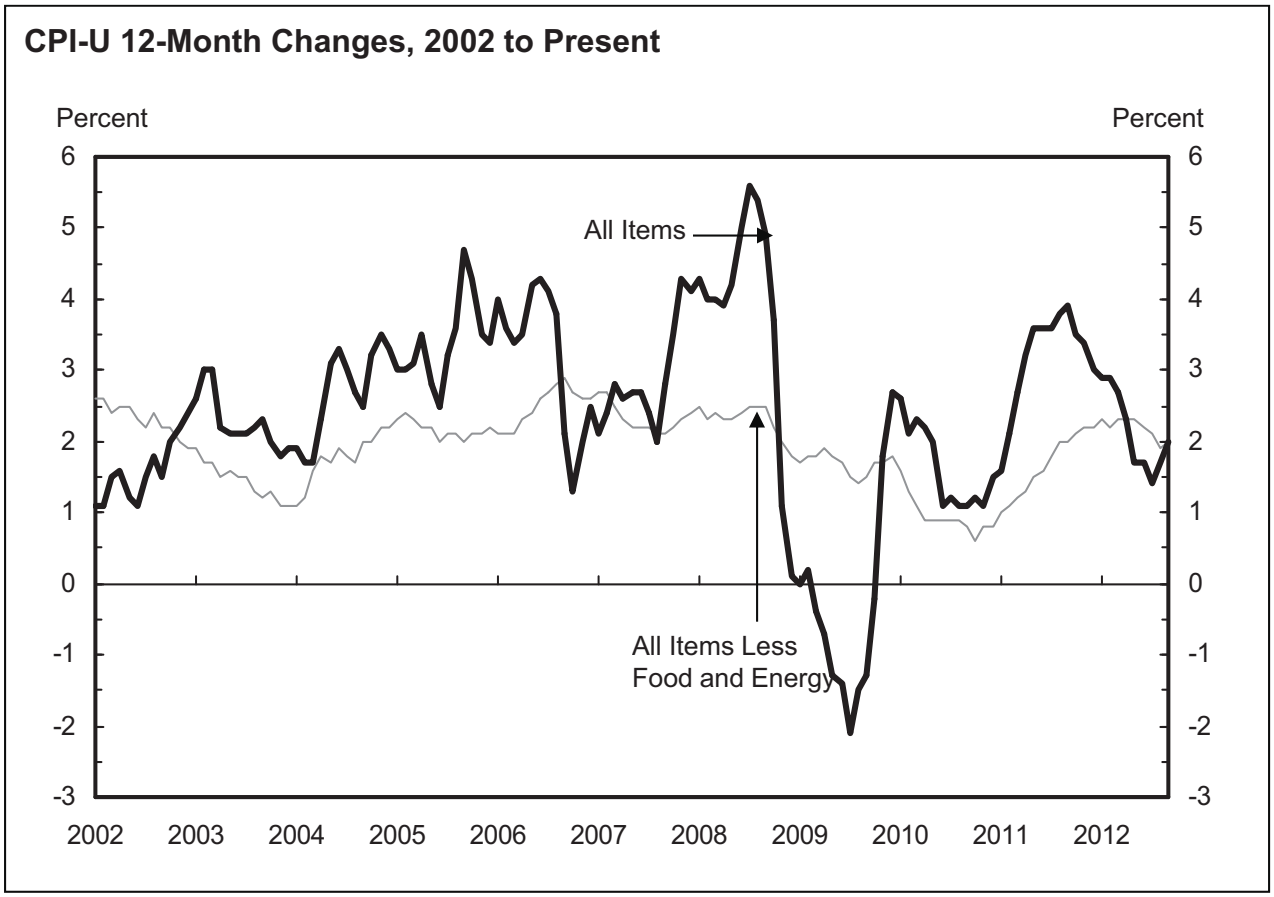
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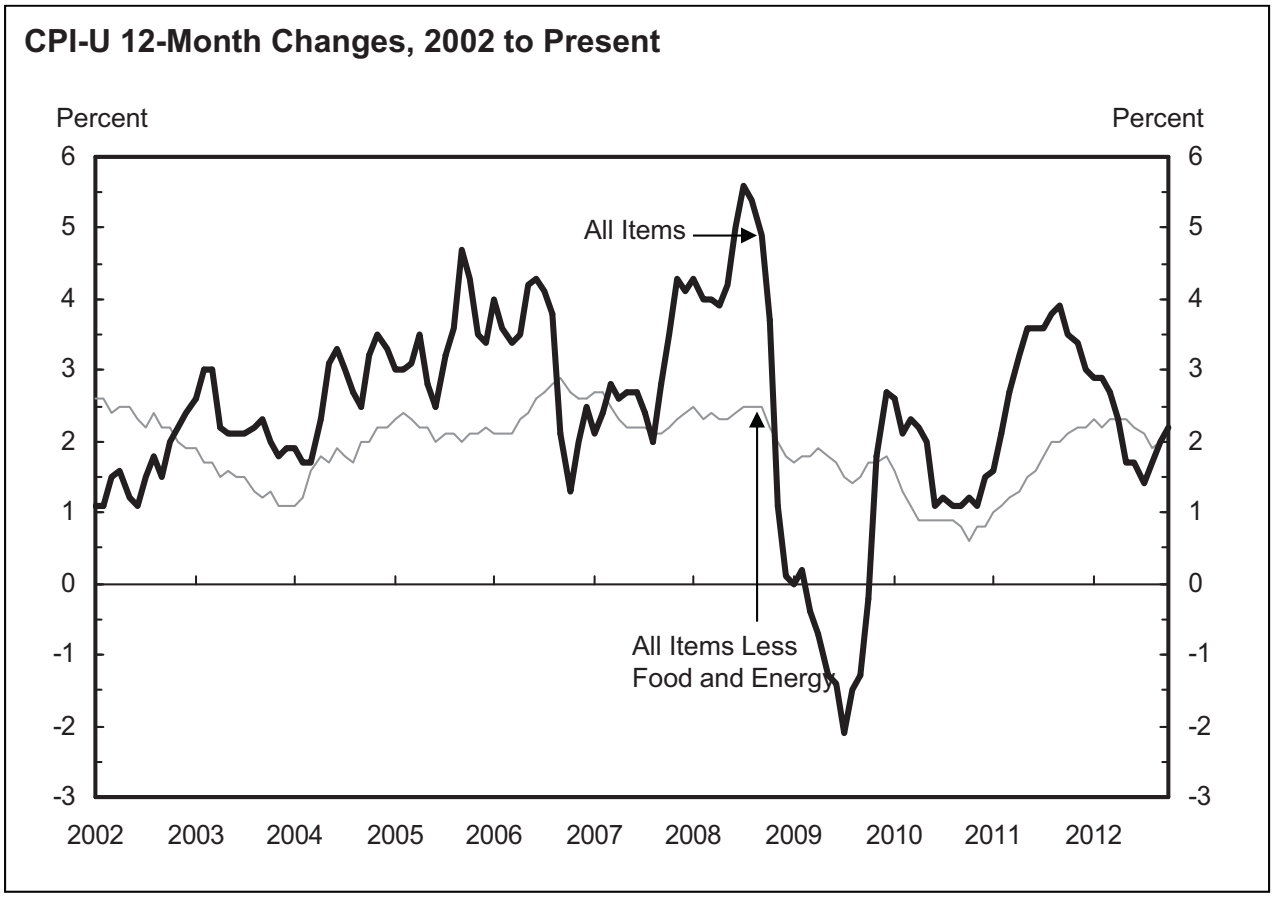
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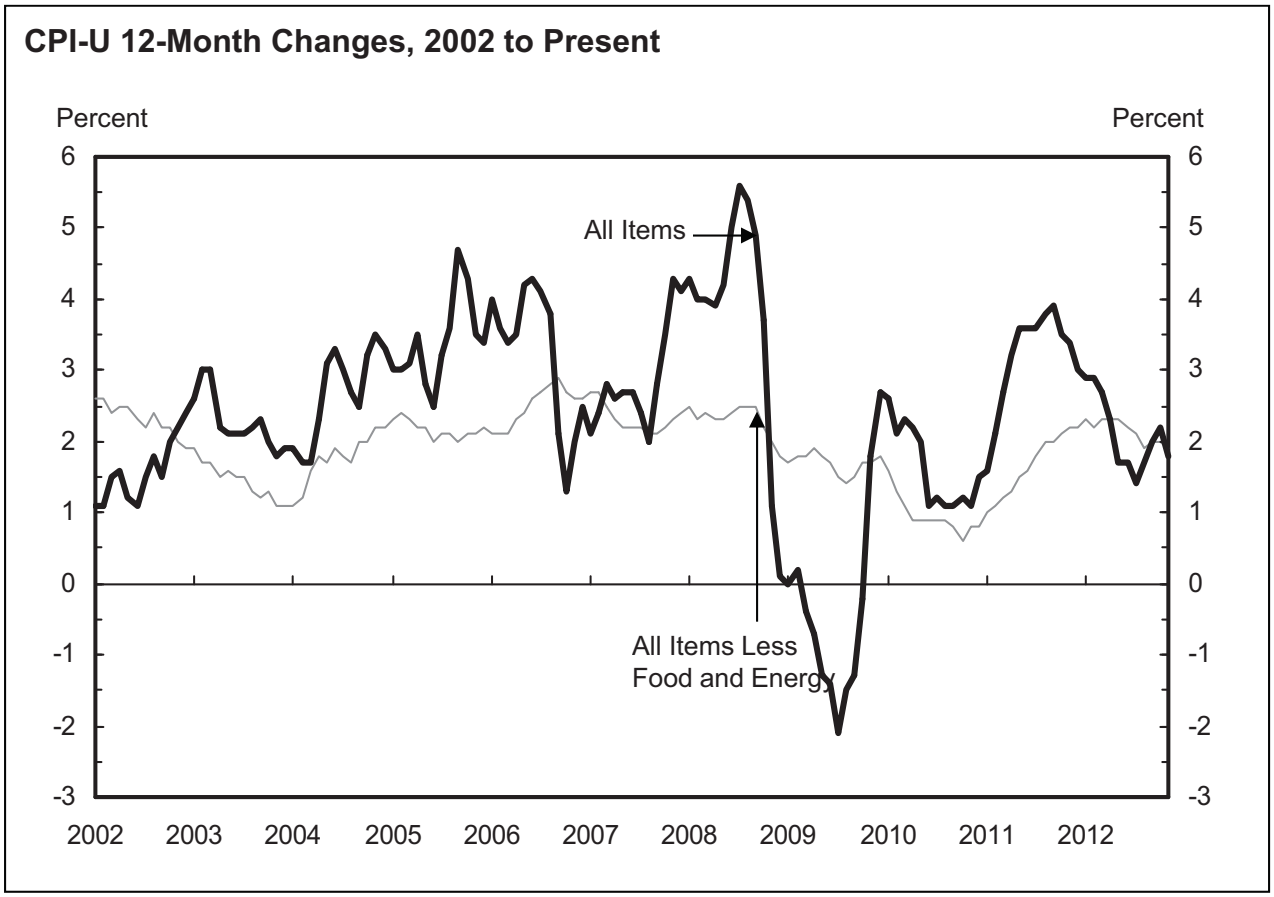
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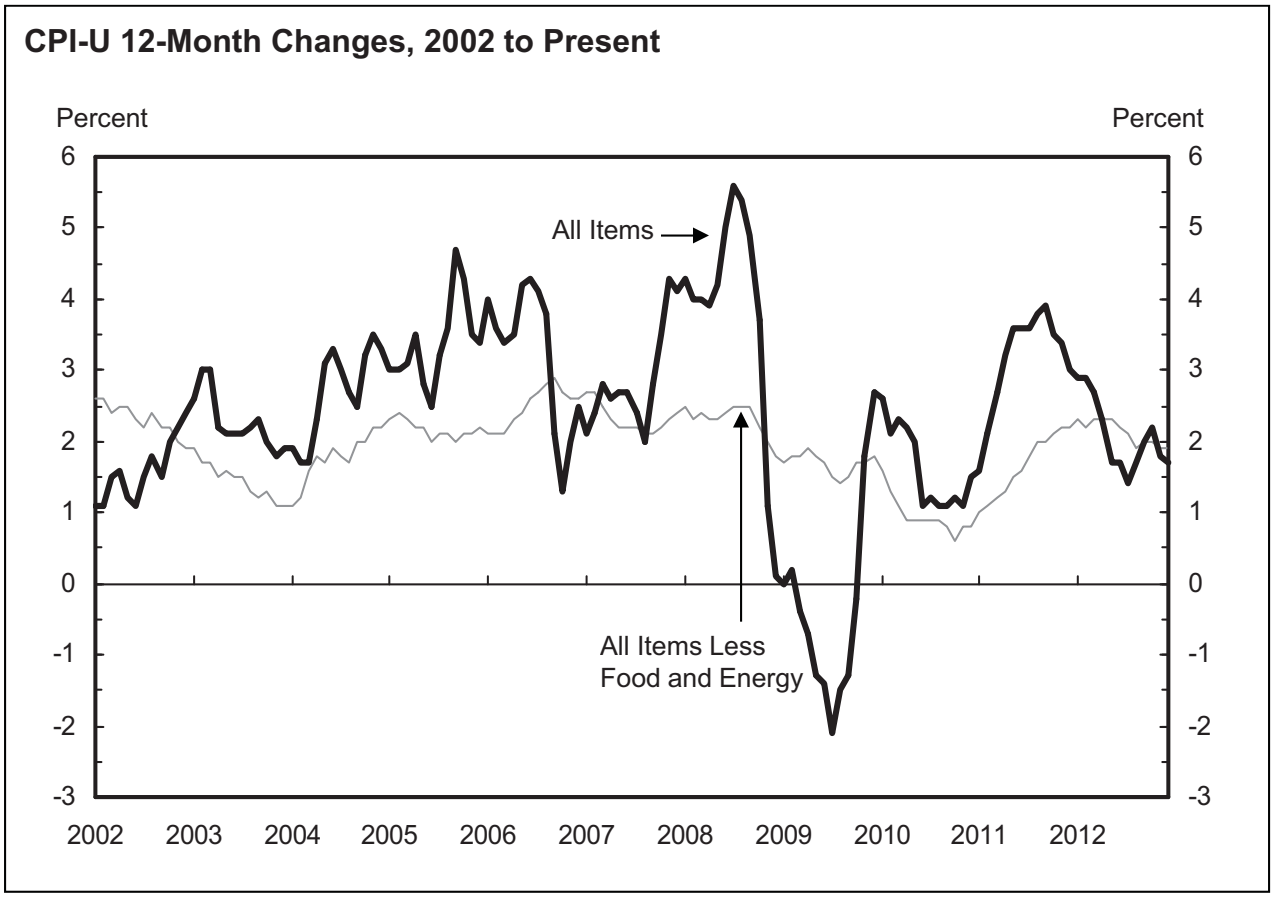
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Recalculated Seasonally Adjusted Indexes to be Available on February 19, 2013

Each year with the release of the January CPI, seasonal adjustment factors are recalculated to reflect price movements from the just-completed calendar year. This routine annual recalculation may result in revisions to seasonally adjusted indexes for the previous 5 years. BLS will make available recalculated seasonally adjusted indexes, as well as recalculated seasonal adjustment factors, for the period January 2008 through December 2012, on Tuesday, February 19, 2013. This date is two working days before the scheduled release of the January 2013 CPI on Thursday, February 21, 2013.

The revised indexes and seasonal factors will be available on the internet. The address is http://www.bls.gov/cpi/cpisapage.htm. Look under Seasonal Adjustment in the CPI and select Revised Seasonally Adjusted Indexes and Factors, 2008-2012.

For further information please contact Christopher Graci by electronic mail at Graci.Christopher@bls.gov or by telephone at (202) 691-5826, or Carlyle Jackson by electronic mail at Jackson.Carlyle@bls.gov or by telephone at (202) 691-6984.

REPORT ON QUALITY CHANGES FOR 2013 MODEL VEHICLES

In accordance with usual practice, most new-model-year passenger cars and light motor trucks were introduced into the Producer Price Index (PPI) with the release of data for October 2012.

Passenger Cars

The value of quality changes for a sample of 2013 model year domestically produced passenger cars included in the Producer Price Index (PPI) for October averaged $89.53, according to estimates by the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor. This change represents 39.5 percent of the average $226.88 increase in manufacturers' invoice prices for this year's models as compared with last year's models.

The retail equivalent value of these quality changes averaged $98.17, representing 31.9 percent of the average $307.59 over-the-year increase in manufacturer's suggested list prices.

Light Trucks

The value of quality changes for a sample of 2013 model year domestically produced light trucks included in the PPI for October averaged $256.53. This change represents 43.5 percent of the average $589.16 increase in manufacturers' invoice prices for this year's models as compared with last year's models.

The retail equivalent value of quality changes averaged $278.48, representing 35.3 percent of the average $789.02 over-the-year increase in manufacturer's suggested list prices.

For technical information regarding quality changes for 2013 model year motor vehicles, contact Thaddious Foster at Foster.Thaddious@bls.gov or (202) 692-6443. For general PPI information, contact the PPI Section of Index Analysis and Public Information, at ppi-info@bls.gov or (202) 691-7705.

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Estimates of the value of quality change are based on a review by the BLS of data supplied by producers for similarly equipped 2012 and 2013 domestically produced models priced for the Producer Price Index. Most of the estimates of quality changes in this release are derived from information supplied for the Producer Price Index for October. These data also form the basis of the new vehicle quality adjustment for the Consumer Price Index (CPI). However, it should be noted that, effective with the release of data for January 1999, changes made solely for the purpose of meeting air pollution standards are no longer considered quality improvements for CPI calculation purposes.

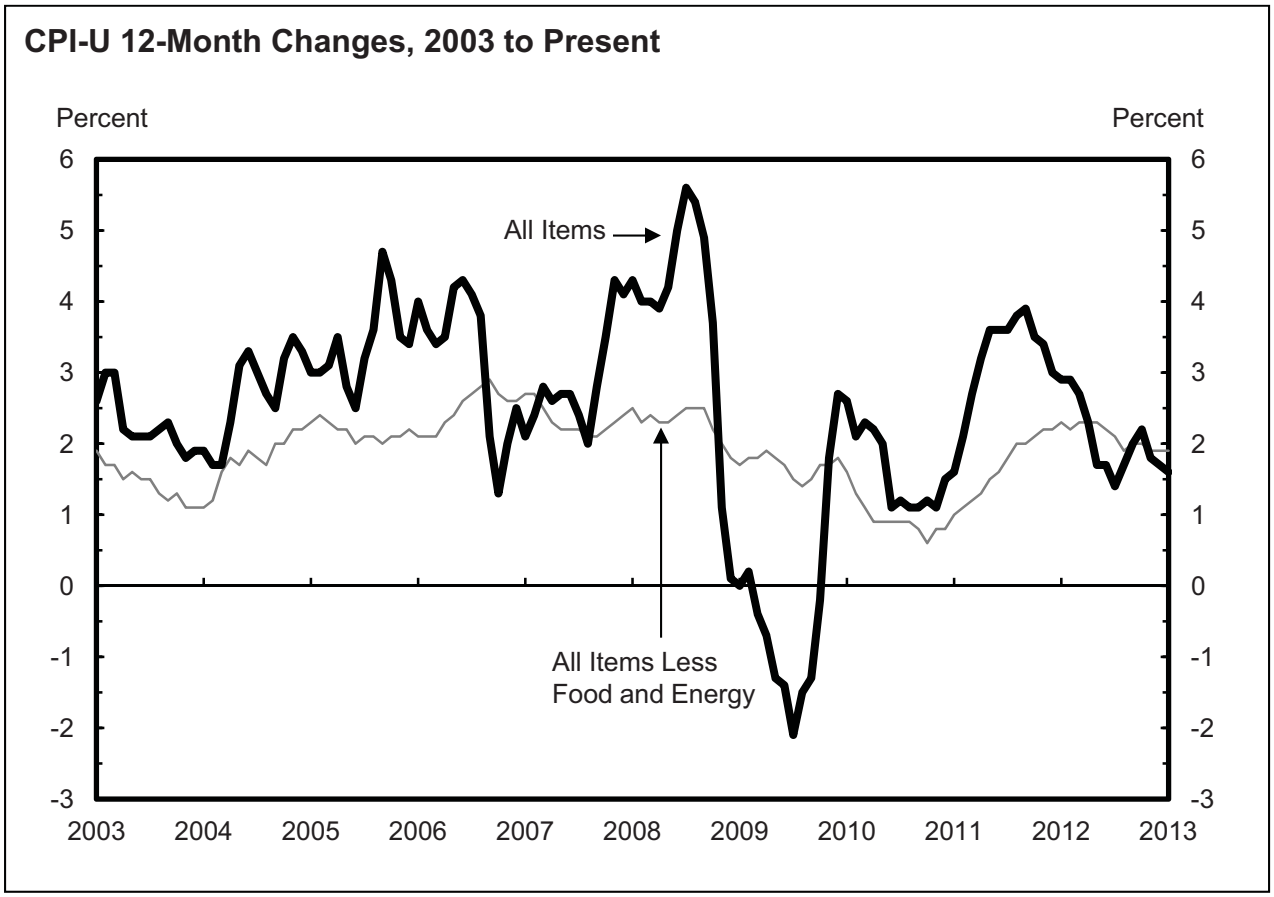
Articles Appearing in the CPI Detailed Report, 2007-2012

Chained CPI	"C-CPI-U Index Revisions," December 2007. "C-CPI-U Index Revisions," January & December 2008. "C-CPI-U Index Revisions," January & December 2009. "C-CPI-U Index Revisions," January & December 2010. "C-CPI-U Index Revisions," January 2011.
Expenditure Weight Updates	"Expenditure Weight Update," December 2009. "Expenditure Weight Update," January 2010. "Expenditure Weight Update," December 2011.
General Information	"CPI Levels to Three Decimal Places," May-June 2007. "Consumer prices rose less in 2006 than in 2005," August 2007. "Consumer prices rose 4.1 percent in 2007, the largest increase since 1990," March 2008. "Consumer Prices rose only 0.1 percent in 2008, the smallest change since 1954," March 2009. "Item Structure and Publication Changes for January 2010," January 2010. "Experimental CPI for Americans 62 Years of Age and Older, 1998-2009, March 2010. "Current Price Topics: The Use of CPI in Poverty Measurement," April 2010. "Current Price Topics: The Use of the CPI in Adjusting Federal Income Tax Brackets," July 2010. "Current Price Topics: The Use of the CPI in Social Security Cost-of-Living Adjustments," October 2010. "Redesigning the CPI News Release Tables," September 2011, December 2011, January 2012, February 2012, March 2012, April 2012.
Research Series	"CPI Research Series Using Current Methods, 1978-2008," April 2009. "CPI Research Series Using Current Methods, 1978-2009," April 2010. "CPI Research Series Using Current Methods, 1978-20010," March 2011.
Response Rates	"Response Rates for the CPIs, 2007," January 2008. "Response Rates for the CPIs, 2008," January 2009. "Response Rates for the CPIs, 2009," January 2010. "Response Rates for the CPIs, 2010," January 2011. "Response Rates for the CPIs, 2011," January 2012.
Sampling Error	"Note on Sampling Error in the Consumer Price Index" May-November 2007.
Seasonal Adjustment	"Intervention Analysis in Seasonal Adjustment," January 2008-2010. "A Note on Seasonally Adjusted and Unadjusted Data" January 2008-2012. "Recalculated Seasonally Adjusted Indexes to Be Available on February 20, 2008," December 2007. "Recalculated Seasonally Adjusted Indexes to be Available on February 20, 2009," December 2008. "Recalculated Seasonally Adjusted Month to Month Percent Change Differences," January 2008. "Revised Seasonally Adjusted Changes," January 2009-2012. "Changes in Seasonal Adjustment Status for 2009," January 2009. "Seasonal adjustment factors for use with the 2009 All Urban Consumers indexes," January 2009. "Recalculated Seasonally Adjusted Indexes to be Available on February 17, 2010," December 2009. "Recalculated Seasonally Adjusted Indexes to be Available on February 15, 2011," December 2010.
Variance Estimates	"Variance Estimates for Price Changes in the CPI, January 2007-December 2007," February 2008. "Variance Estimates for Price Changes in the CPI, January 2008-December 2008," February 2009.

"Variance Estimates for Price Changes in the CPI, January 2009-December 2009," February 2010.
"Variance Estimates for Price Changes in the CPI, January 2010-December 2010," February 2011.
"Variance Estimates for Price Changes in the CPI, January 2011-December 2011," February 2012.

Vehicle Quality Changes

"Report on Quality Changes for 2008 Model Vehicles," December 2007.
"Report on Quality Changes for 2009 Model Vehicles," December 2008.
"Report on Quality Changes for 2010 Model Vehicles," December 2009.
"Report on Quality Changes for 2011 Model Vehicles," December 2010.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C-CPI-U Index Revisions

As scheduled, effective with this release of data for January 2013, the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) has undergone its annual revision. Because the current expenditure data required for the calculation of the C-CPI-U are available only with a time lag, the index is issued first in preliminary form, using the latest available expenditure data at the time of publication, and is subject to two subsequent revisions. Therefore, C-CPI-U indexes for the 12 months of 2011 are issued in final form – employing monthly expenditure weights from 2011. Values for the 12 months of 2012 are revised and issued as interim, using expenditure weights from the 2009-2010 period. Calculation of the initial value of the January 2013 C-CPI-U index, and all subsequent months in 2013, will also be based upon 2009-2010 expenditure weights.

Discontinuation of Department Store Inventory Indexes

The Bureau of Labor Statistics will discontinue publication of its Department Store Inventory indexes after the release of the December 2013 CPI in mid-January 2014, and these values will no longer be uploaded to the Labstat database. For further information please contact Sharon Gibson at 202-691-6968 or gibson.sharon@bls.gov.

Publication Changes for Average Price Series

The Bureau of Labor Statistics will discontinue publication of three average price series after the release of the June 2013 CPI in mid-July 2013. They are:

- utility (piped) gas, 40 therms;
- utility (piped) gas, 100 therms; and
- electricity, 500 kilowatt hours.

The Bureau will, however, continue to publish average prices for utility (piped) gas on a per therm basis, and will continue to publish electricity prices on a per kilowatt hour basis. As such, users will be able to convert these data to any consumption amount. CPI Detailed Report table *P1. Average residential prices for utility (piped) gas, electricity, and fuel oil, U.S. city average and selected areas* will no longer be published. Data for fuel oil #2, per gallon (3.785 liters) will continue to be available in the CPI Average Price Data public database.

A Note on Seasonally Adjusted and Unadjusted Data

Because price data are used for different purposes by different groups, the Bureau of Labor Statistics publishes seasonally adjusted as well as unadjusted changes each month.

For analyzing general price trends in the economy, seasonally adjusted changes are usually preferred since they eliminate the effect of changes that normally occur at the same time and in about the same magnitude every year--such as price movements resulting from changing climatic conditions, production cycles, model changeovers, holidays, and sales.

The unadjusted data are of primary interest to consumers concerned about the prices they actually pay. Unadjusted data also are used extensively for escalation purposes. Many collective bargaining contract agreements and pension plans, for example, tie compensation changes to the Consumer Price Index before adjustment for seasonal variation.

Seasonal factors used in computing the seasonally adjusted indexes are derived by the X-12-ARIMA Seasonal Adjustment Method. Seasonally adjusted indexes and seasonal factors are computed annually. Each year, the last 5 years of seasonally adjusted data are revised. Data from January 2008 through December 2012 were replaced in January 2013. Exceptions to the usual revision schedule were: the updated seasonal data at the end of 1977 replaced data from 1967 through 1977; and, in January 2002, dependently seasonally adjusted series were revised for January 1987-December 2001 as a result of a change in the aggregation weights for dependently adjusted series. For further information, please see "Aggregation of Dependently Adjusted Seasonally Adjusted Series," in the October 2001 issue of the CPI Detailed Report.

Effective with the publication of data from January 2006 through December 2010 in January 2011, the Video and audio series and the Information technology, hardware and services series were changed from independently adjusted to dependently adjusted. This resulted in an increase in the number of seasonal components used in deriving seasonal movement of the All items and 54 other lower level aggregations, from 73 for the publication of January 1998 through December 2005 data to 82 for the publication of seasonally adjusted data for January 2006 and later. Each year the seasonal status of every series is reevaluated based upon certain statistical criteria. If any of the 82 components change their seasonal adjustment status from seasonally adjusted to not seasonally adjusted, not seasonally adjusted data will be used in the aggregation of the dependent series for the last 5 years, but the seasonally adjusted indexes before that period will not be changed. Note: 37 of the 82 components are not seasonally adjusted for 2013.

Seasonally adjusted data, including the all items index levels, are subject to revision for up to five years after their original release. For this reason, BLS advises against the use of these data in escalation agreements.

Effective with the calculation of the seasonal factors for 1990, the Bureau of Labor Statistics has used an enhanced seasonal adjustment procedure called Intervention Analysis Seasonal Adjustment for some CPI series. Intervention Analysis Seasonal Adjustment allows for better estimates of seasonally adjusted data. Extreme values and/or sharp movements which might distort the seasonal pattern are estimated and removed from the data prior to calculation of seasonal factors. Beginning with the calculation of seasonal factors for 1996, X-12-ARIMA software was used for Intervention Analysis Seasonal Adjustment.

For the seasonal factors introduced in January 2013, BLS adjusted 31 series using Intervention Analysis Seasonal Adjustment, including selected food and beverage items, motor fuels, electricity and vehicles. For example, this procedure was used for the Motor fuel series to offset the effects of events such as damage to oil refineries from Hurricane Katrina.

For a complete list of Intervention Analysis Seasonal Adjustment series and explanations, please refer to the article "Intervention Analysis Seasonal Adjustment", located on our website at http://www.bls.gov/cpi/cpisapage.htm.

For additional information on seasonal adjustment in the CPI, please write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, Washington, DC 20212 or contact Chris Graci at (202) 691-5826, or by e-mail at graci.christopher@bls.gov or contact Carlyle Jackson at (202) 691-6984, or by e-mail at jackson.carlyle@bls.gov. If you have general questions about the CPI, please call our information staff at (202) 691-7000.

Revised seasonally adjusted changes

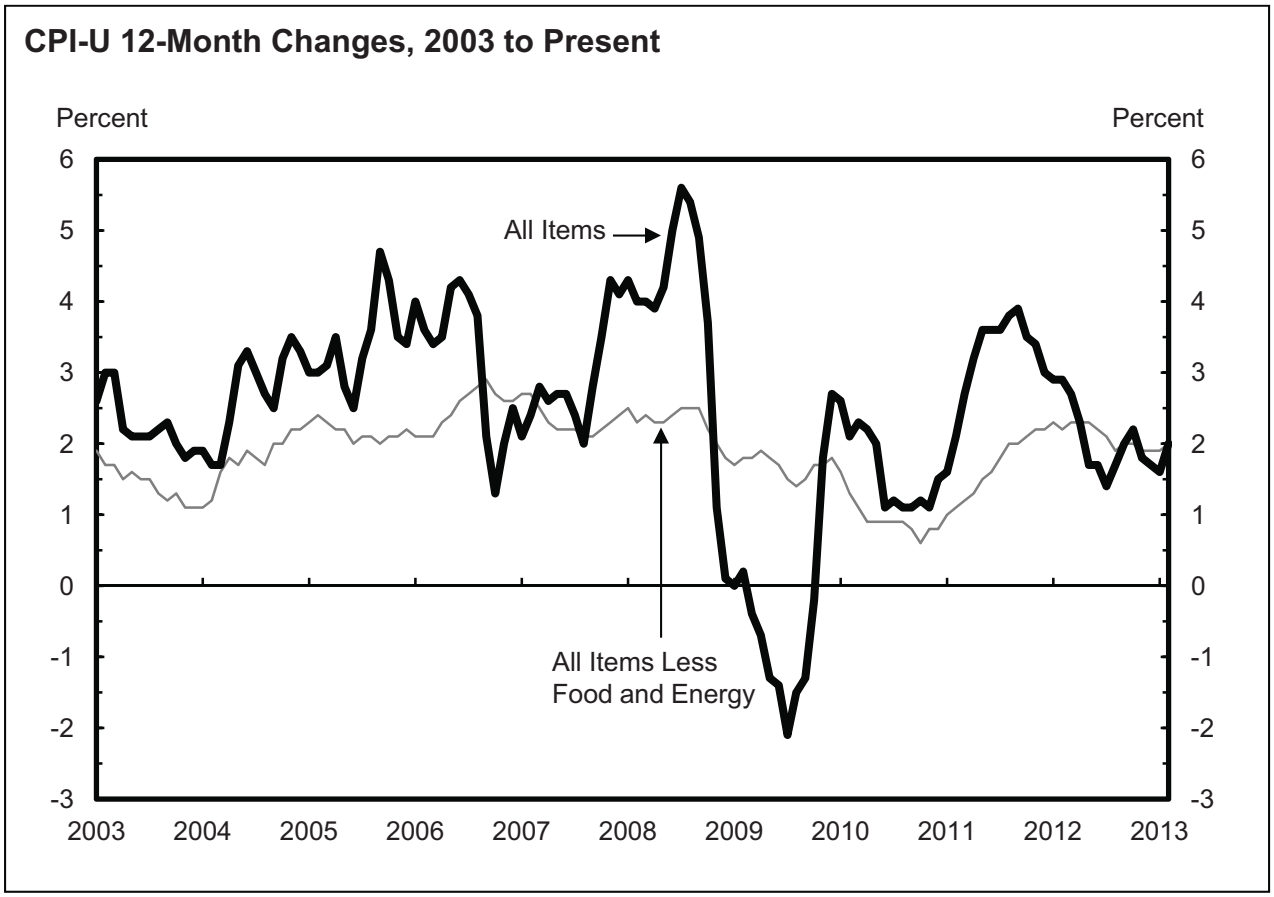
Over-the-month percent changes in the U.S. City Average Consumer Price Index for All Urban Consumers (CPI-U) for All Items and for All Items less food and energy, seasonally adjusted, using former and recalculated seasonal factors for 2012.

All Items

2012	Former	Recalculated	Difference
January	.2	.2	.0
February	.4	.3	-.1
March	.3	.3	.0
April	.0	.0	.0
May	-.3	-.1	.2
June	.0	.1	.1
July	.0	.0	.0
August	.6	.5	-.1
September	.6	.5	-.1
October	.1	.2	.1
November	-.3	-.2	.1
December	.0	.0	.0

All Items less food and energy

2012	Former	Recalculated	Difference
January	.2	.2	.0
February	.1	.1	.0
March	.2	.2	.0
April	.2	.2	.0
May	.2	.2	.0
June	.2	.2	.0
July	.1	.1	.0
August	.1	.1	.0
September	.1	.2	.1
October	.2	.2	.0
November	.1	.1	.0
December	.1	.1	.0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Variance Estimates for Price Changes in the Consumer Price Index January–December 2012

Owen J. Shoemaker

This article presents variance estimates for 1-month, 2-month, 6-month, and 12-month percent changes in the Consumer Price Index for All Urban Consumers (CPI-U). Variance is a measure of the uncertainty caused by the use of a sample of retail prices, instead of the complete universe of retail prices. The estimates cover the period January 2012 through December 2012.[1] Each month the U.S. Bureau of Labor Statistics collects prices from a sample of approximately 83,400 commodities and services (C&S) quotes in approximately 25,600 outlets[2] around the United States for the Consumer Price Index (CPI).

The most commonly used measure of sampling variability is the *standard error* of the estimate – the square root of the variance. The standard error of the CPI's change can be used to construct confidence intervals to determine whether the change for a particular CPI series is significantly different from zero. This information should help users determine which index changes are significant.

Presentation of findings

The percent changes in the CPI along with their standard errors were estimated for the 12 months from January through December 2012. In summary, tables 1V through 5V show the median values of those percent changes, as well as the median values of the standard errors. Table 1V shows this information for U.S. city average, and tables 2V through 5V show the same information for the Northeast, Midwest, South, and West regions of the country.

For example, from January through December 2012, the 1-month changes in the U.S. city average all items index had a median value of 0.13 percent. The standard errors of those 12 estimates had a median value of 0.04 percent. Margins of error are usually expressed as a statistic's point estimate plus or minus two standard errors, so the margin of error on the CPI's 1-month change is approximately 0.13 percent plus or minus 0.08 percent. Therefore, in a typical 1-month period in 2012, the true change in the CPI was probably somewhere between 0.05 percent and 0.21 percent. The tables also show median percent changes and standard errors for 2- and 6-month intervals and for the full year 2012. Margins of error can be calculated for these intervals in the same way as for a 1-month period.

Analysis of findings

Analyzing the data reveals three significant observations. First, standard errors increase as one moves from the U.S. city average to individual regions of the country and from *all items* to individual item categories. Second, standard errors differ between item categories. Third, the standard errors decrease on a relative basis (standard error divided by price change), as the price change interval gets longer.

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[1] In 1998 significant changes were made to the CPI's structure and sample, and a new variance calculation system was implemented. For information on variances from 1978-1986, 1993-1997 and then 1998 and 1999, see the *CPI Detailed Report* for February 1991, May 1994, February 1998, December 1999, and November 2000, respectively.
[2] In addition, BLS collects approximately 5,800 shelter quotes, used for both Rent and Rental Equivalence (REQ), each month.

The primary reason standard errors increase as one moves from the U.S. city average to individual regions of the country is that sample sizes differ. In general, smaller sample sizes lead to larger standard errors. For example, the U.S. city average all items index is computed each month from approximately 89,200 prices (including Rent and REQ quotes) throughout the United States, and its median standard error for 1-month changes is 0.04 percent. By contrast, the Northeast region all items index is computed from approximately 19,300 prices, and its median standard error is 0.07 percent. Regional indexes have larger standard errors because their sample sizes are smaller.

One can observe this same effect moving from the all items index to individual item categories. Again, the U.S. city average all items index is computed each month from approximately 89,200 prices, and its median 1-month standard error is 0.04 percent. By contrast, the U.S. city average recreation index is computed from approximately 5,400 prices, and its median 1-month standard error is 0.15 percent, nearly four times as large. Again, smaller sample sizes typically lead to larger standard errors.

The second significant observation is that standard errors differ between item categories. There are two reasons for this. First, item categories differ in sample size. For example, the U.S. city average food and beverages index is computed from approximately 35,500 prices each month, while the U.S. city average recreation index is computed from approximately 5,400 prices. Therefore, it is not surprising that the recreation index has larger standard errors. Second, there are real differences in item category price behaviors caused by different selling practices, seasonal influences, and consumer demand. This is especially true for the apparel category, in which it is common for the prices of individual items to fluctuate by 50 percent or more each month. As a result, standard errors for apparel indexes are large.

The third observation is that standard errors generally tend to decrease, on a relative basis (standard error divided by price change), as the price change interval gets longer. For the U.S. city average all items index, the median standard error divided by the median percent change is 0.04/0.13 = 0.31 for 1-month changes, 0.06/0.29 = 0.21 for 2-month changes, 0.07/0.98 = 0.07 for 6-month changes, and 0.08/1.88 = 0.04 for 12-month changes. This shows that the relative accuracy of percent changes in the CPI generally improves as the price change interval gets longer. On an absolute basis, standard errors tend to increase, but at a decreasing rate.

Findings presented here indicate that users should exercise caution when using CPI estimates to make inferences about index changes for relatively short time periods, for individual goods and services, or for local areas. The standard errors of those estimates may be on the same order of magnitude as the estimates themselves; and, thus, few inferences about them are reliable.

Sources of error

One way of analyzing the error in a survey estimate is to divide the total error into two sources: *sampling error* and *non-sampling error*. Sampling error is the uncertainty in the CPI caused by the fact that a sample of retail prices is used to compute the CPI, instead of using the complete universe of retail prices. Non-sampling error is the rest of the error. Non-sampling error includes things such as incorrect information given by survey respondents, data processing errors, and so forth. Non-sampling error arises regardless of whether data are collected from a sample of retail prices or from the complete universe.

Another way of analyzing error is to divide it into *variance* and *bias*. The variance of the CPI is a measure of how close different estimates of the CPI would be to each other if it were possible to repeat the survey over and over using different samples. Of course, it is not feasible to repeat the survey multiple times, but statistical theory allows the CPI's variance to be estimated anyway. A small variance, for example, indicates that multiple independent samples would produce values that are consistently very

close to each other. *Bias* is the difference between the CPI's *expected* value and its *true* value. A statistic may have a small variance but a large bias, or it may have a large variance but a small bias. For an index to be considered accurate, both its variance and bias need to be small.

The Bureau of Labor Statistics (BLS) is constantly trying to reduce the error in the CPI. Variance and sampling error are reduced by using a sample of retail prices that is as large as possible, given resource constraints. BLS has developed a model that optimizes the allocation of resources by indicating the number of prices that should be observed in each geographic area and each item category, in order to minimize the variance of the U.S. city average all items index. BLS reduces non-sampling error through a series of computerized and professional data reviews, as well as through continuous survey process improvements and theoretical research.

Replication and variance estimation

An important advantage of using sampling is that the CPI's variance can be estimated directly from the sample data. Starting in 1978, the CPI's sample design has accommodated variance estimation by using two or more independent samples of items and outlets in each geographic area. This allows two or more statistically independent estimates of the index to be made. The independent samples are called *replicates*, and the set of all observed prices is called the *full sample*.

BLS collects CPI data in 38 geographic areas across the United States. These areas consist of 31 *self-representing* areas and 7 *non-self-representing* areas. Self-representing areas are large metropolitan areas, such as the Boston, St. Louis, and San Francisco metropolitan areas. Non-self-representing areas are collections of smaller metropolitan areas. For example, one non-self-representing area is a collection of 32 small metropolitan areas in the Northeast region (Buffalo, Hartford, Providence, Bangor, and others), of which 8 were randomly selected to represent the entire set. Within each of the 38 areas, price data are collected for 211 item categories called *item strata*. Together the 211 item strata cover all consumer purchases. Examples of item strata are bananas, women's dresses, and electricity.

Multiplying the number of areas by the number of item strata gives 8,018 (= 38 × 211) different area and item combinations for which price indexes need to be calculated. Separate price indexes are calculated for each one of these 8,018 area and item combinations. After all 8,018 of these *basic-level* indexes are calculated, they are aggregated to form *higher-level* indexes, using expenditure estimates from the Consumer Expenditure Survey as their weights. Examples of higher-level geographic areas are the four regions (Northeast, Midwest, South, and West); and examples of higher-level item categories are the eight major groups (food & beverages, housing, apparel, transportation, medical care, education and communication, recreation, and other goods and services). The highest level of geographic aggregation is the U.S. city average, and the highest level of item aggregation is all items.

Variances are computed with a Stratified Random Groups Method, in which variances are computed separately for certain subsets of areas and items and are then combined to produce the variance of the entire area and item combination. Subsets of items are formed by the intersection of the item category with each of the eight major groups.

Let $CPI(A,I,f,t)$ denote the index value where A = area, I = item category, f indicates that it is the full-sample value, and t = month; and let $CPI(A,I,f,t-k)$ denote the value of the same index in month = $t-k$. In general, the upper-case letter A denotes a *set* of areas, such as the Northeast or Midwest region of the country; and the upper-case letter I denotes a higher-level item category, such as all items or all items less food and energy. Also let $CPI(A,I,r,t)$ and $CPI(A,I,r,t-k)$ be the corresponding index values for replicate = r. Most areas have two replicates, but some have more. Then, the full-sample k-month percent change

between months $t-k$ and t is computed by dividing *CPI(A,I,f,t)* by *CPI(A,I,f,t−k)*, subtracting 1, and multiplying by 100:

$$PC(A,I,f,t,t-k) = \left(\frac{CPI(A,I,f,t)}{CPI(A,I,f,t-k)} - 1 \right) \times 100$$

Every index has a weight *W(A,I,f)* or *W(A,I,r)* associated with it, which is used to combine the index with other indexes to produce indexes for larger geographic areas and larger item categories. For example, the weights are used to combine all 8,018 basic-level indexes into higher-level indexes such as the U.S. city average all items index. The product of an index and its weight is called a *cost weight*, $CW(A,I,r,t) = CPI(A,I,r,t) \times W(A,I,r)$, and is an estimate of the total cost in area = A for consumption of item category = I in month = t.

For the Stratified Random Groups method used here, replicate percent changes are defined as follows: full sample cost weights are used for every geographic area within area = A except for one of the areas. In the omitted area, the full sample cost weight is replaced by a replicate cost weight. Let the lower case letter a denote one of the 38 basic-level areas included in area = A, and let the lower case letter i denote the intersection of item category = I with one of the 8 major groups. Then, the replicate percent change, for area = a, item subset = i, replicate = r, between months $t-k$ and t, is computed as:

$$PC_S(a,i,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,i,f,t) + CW(a,i,r,t)}{CW(A,I,f,t-k) - CW(a,i,f,t-k) + CW(a,i,r,t-k)} - 1 \right) \times 100$$

for self-representing areas. For non-self-representing areas, the replicate percent change, for area = a, item category = I, replicate = r, between months $t-k$ and t, is computed as:

$$PC_N(a,I,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,I,f,t) + CW(a,I,r,t)}{CW(A,I,f,t-k) - CW(a,I,f,t-k) + CW(a,I,r,t-k)} - 1 \right) \times 100$$

where:

$$CW(A,I,f,t) = \sum_{a \subset A} \sum_{i \subset I} CW(a,i,f,t)$$
$$CW(A,I,f,t) = \sum_{a \subset A} CW(a,I,f,t)$$
$$CW(a,I,f,t) = \sum_{i \subset I} CW(a,i,f,t)$$

and likewise for replicates. The symbol "$a \subset A$" means that the sum is over all basic-level areas within area = A, and the symbol $i \subset I$ means that the sum is over all item categories that are intersections of item category = I with a major group.

Then, the variance is computed with the following Stratified Random Groups Variance Estimation Formula:

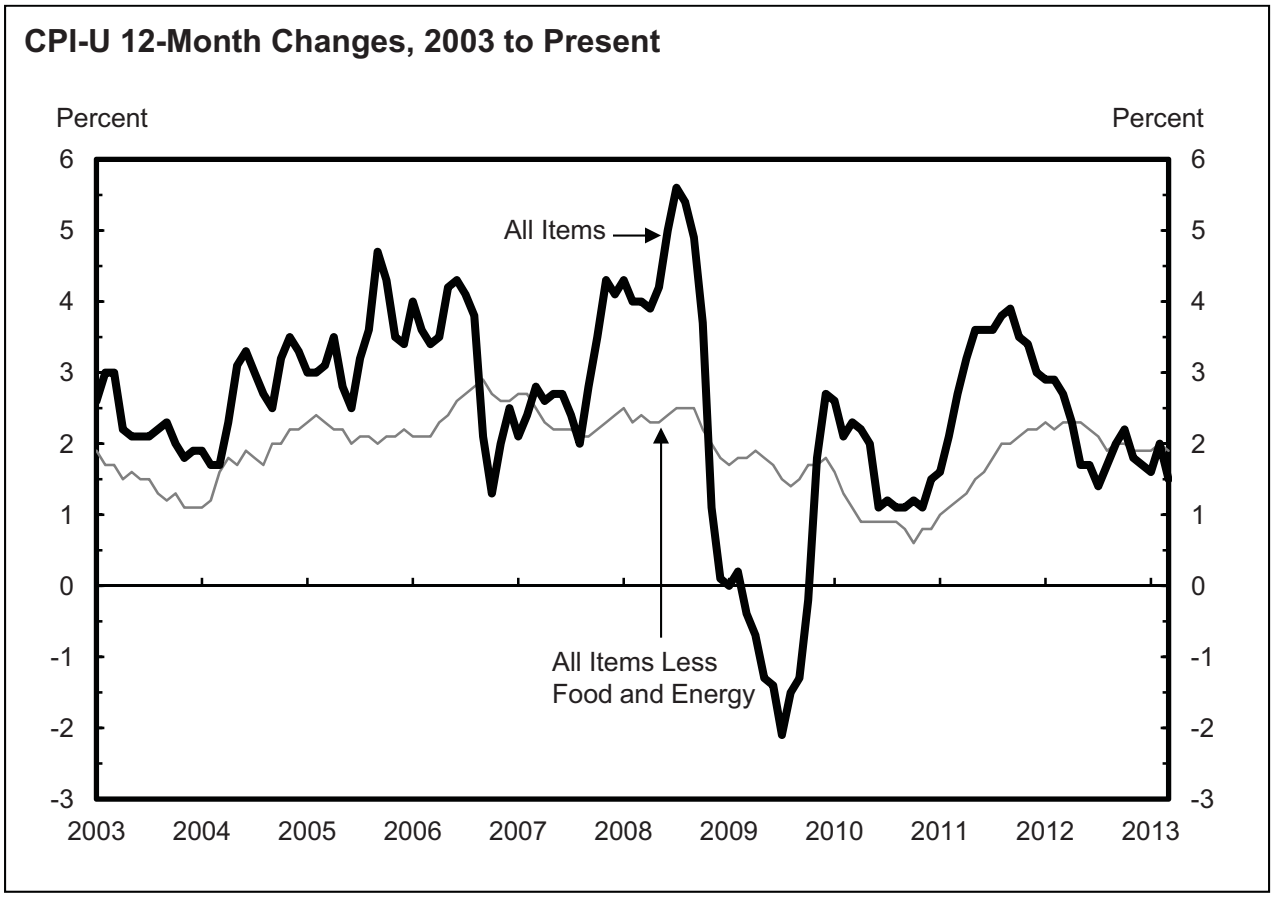
$$V[PC(A,I,f,t,t-k)] = \sum_{i \subset I} \sum_{a \subset A \cap S} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_S(a,i,r,t,t-k) - PC(A,I,t,t-k) \right)^2$$
$$+ \sum_{a \subset A \cap N} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_N(a,I,r,t,t-k) - PC(A,I,t,t-k) \right)^2$$

where S and N are the sets of all self-representing and non-self-representing areas in the CPI's geographic sample, respectively; and A∩S and A∩N are the sets of all self-representing and non-self-representing areas within area = A. The number R_a is the number of replicates in area = a.

Finally, the standard error of the percent change is computed by taking the square root of its variance:

$$SE[\,PC(A, I, f, t, t-k)\,] \;=\; \sqrt{V[PC(A, I, f, t, t-k)]}\;.$$

For more information, write to the CPI Information Office, BLS - Room 3130, 2 Massachusetts Avenue, N.E., Washington, DC 20212, or call Owen Shoemaker at 202-691-6918.


CPI-U 12-Month Changes, 2003 to Present
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Discontinuation of Department Store Inventory Indexes

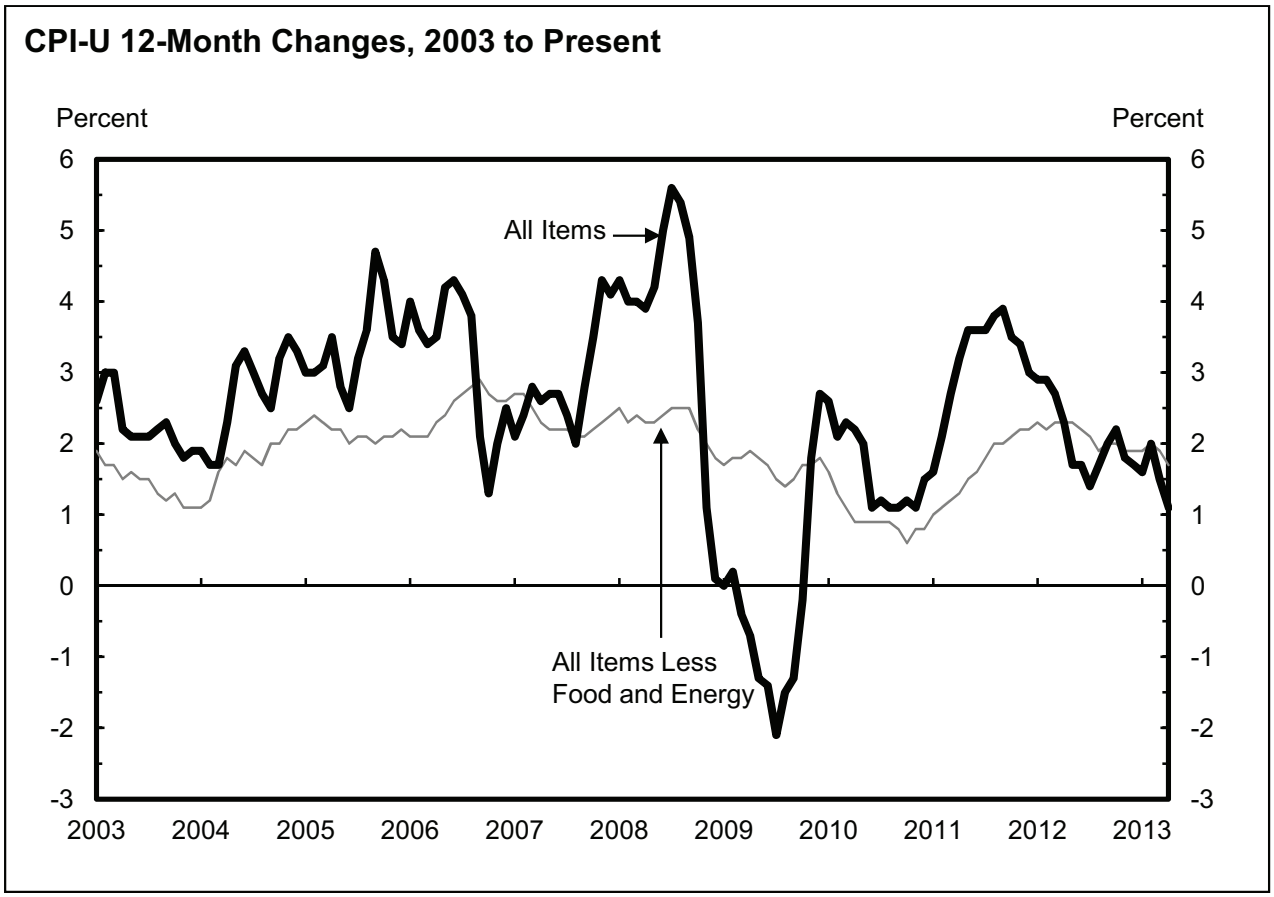
The Bureau of Labor Statistics will discontinue publication of its Department Store Inventory indexes after the release of the December 2013 CPI in mid-January 2014, and these values will no longer be uploaded to the Labstat database. For further information please contact Sharon Gibson at 202-691-6968 or gibson.sharon@bls.gov.

Publication Changes for Average Price Series

The Bureau of Labor Statistics will discontinue publication of three average price series after the release of the June 2013 CPI in mid-July 2013. They are:

- utility (piped) gas, 40 therms;
- utility (piped) gas, 100 therms; and
- electricity, 500 kilowatt hours.

The Bureau will, however, continue to publish average prices for utility (piped) gas on a per therm basis, and will continue to publish electricity prices on a per kilowatt hour basis. As such, users will be able to convert these data to any consumption amount. CPI Detailed Report table *P1. Average residential prices for utility (piped) gas, electricity, and fuel oil, U.S. city average and selected areas* will no longer be published. Data for fuel oil #2, per gallon (3.785 liters) will continue to be available in the CPI Average Price Data public database.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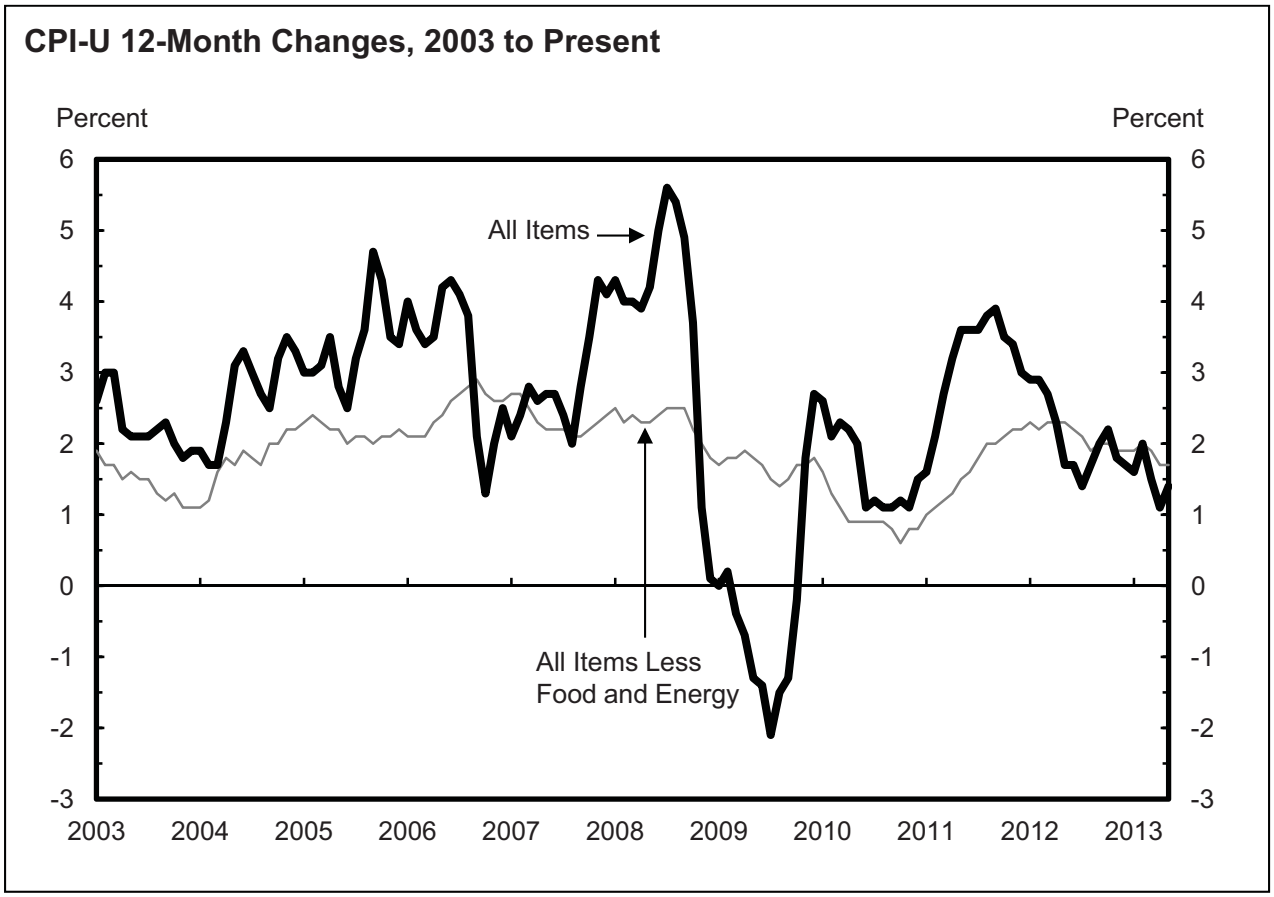
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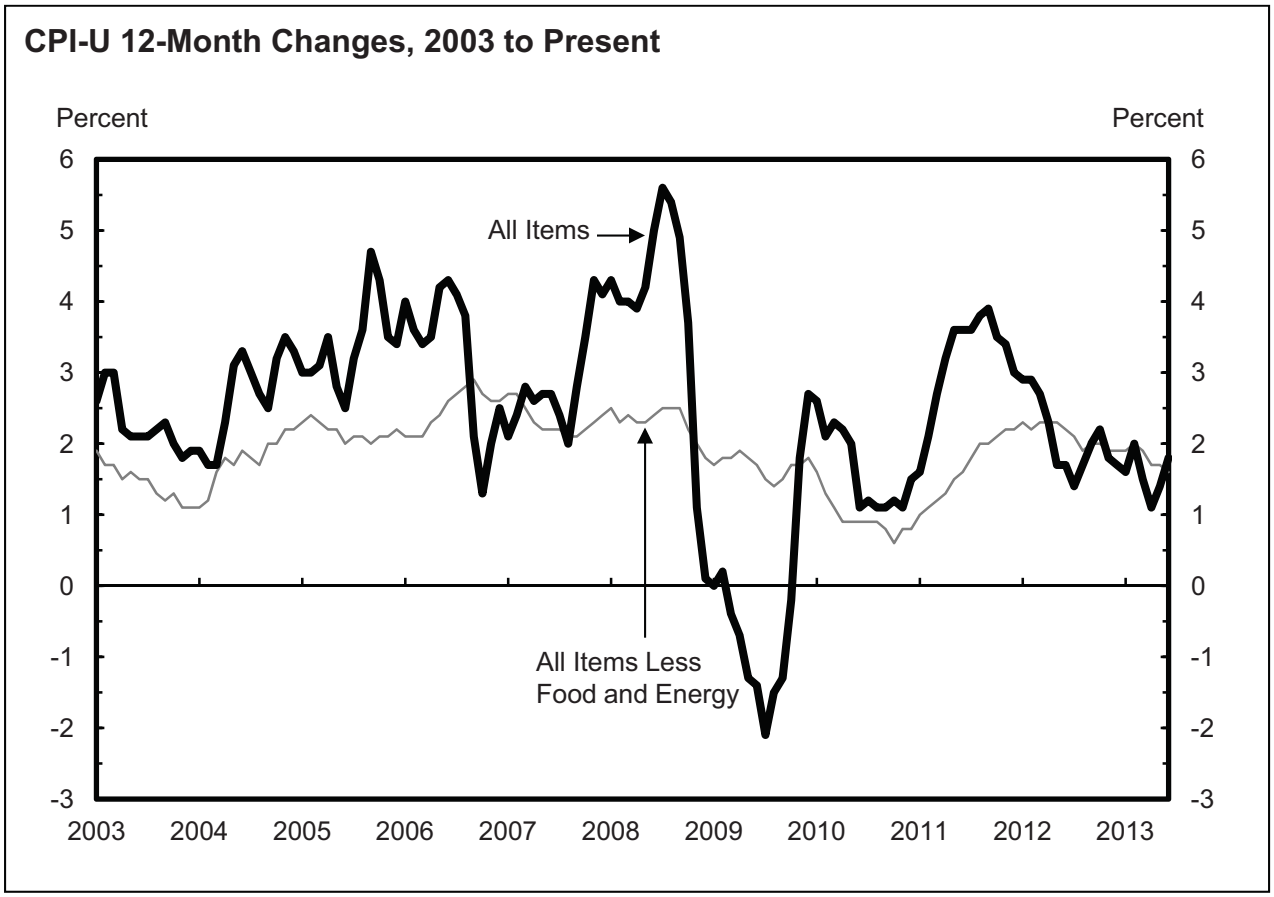
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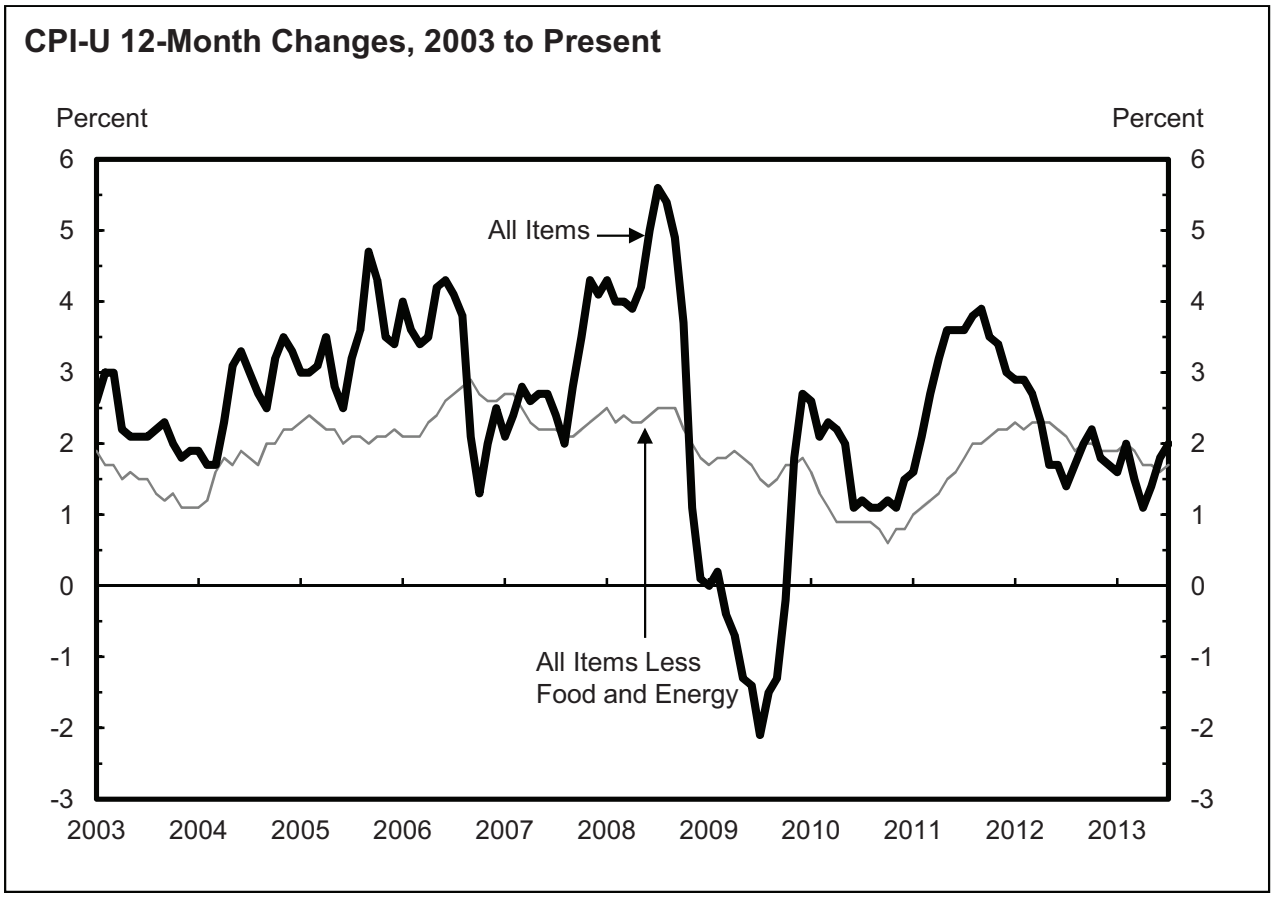
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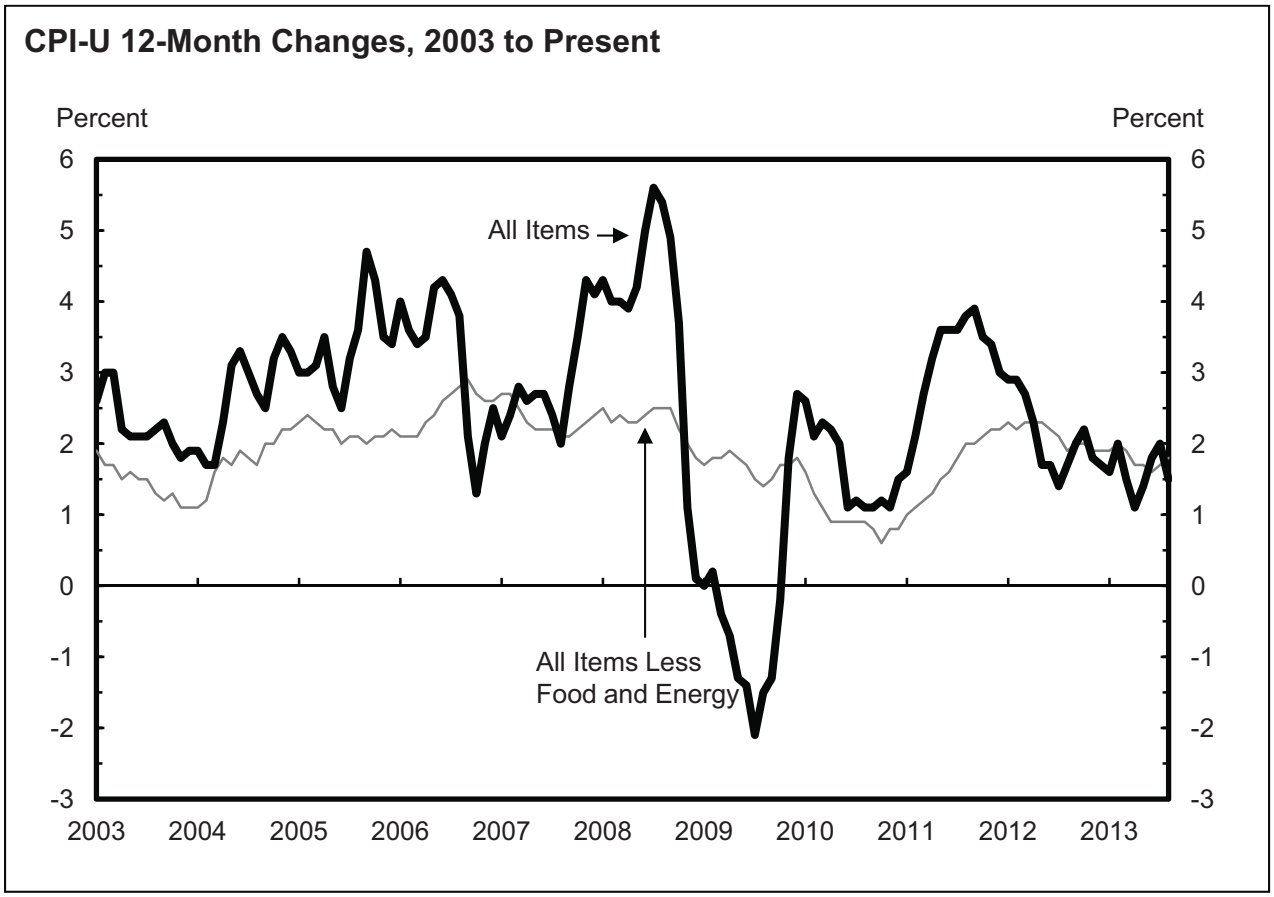
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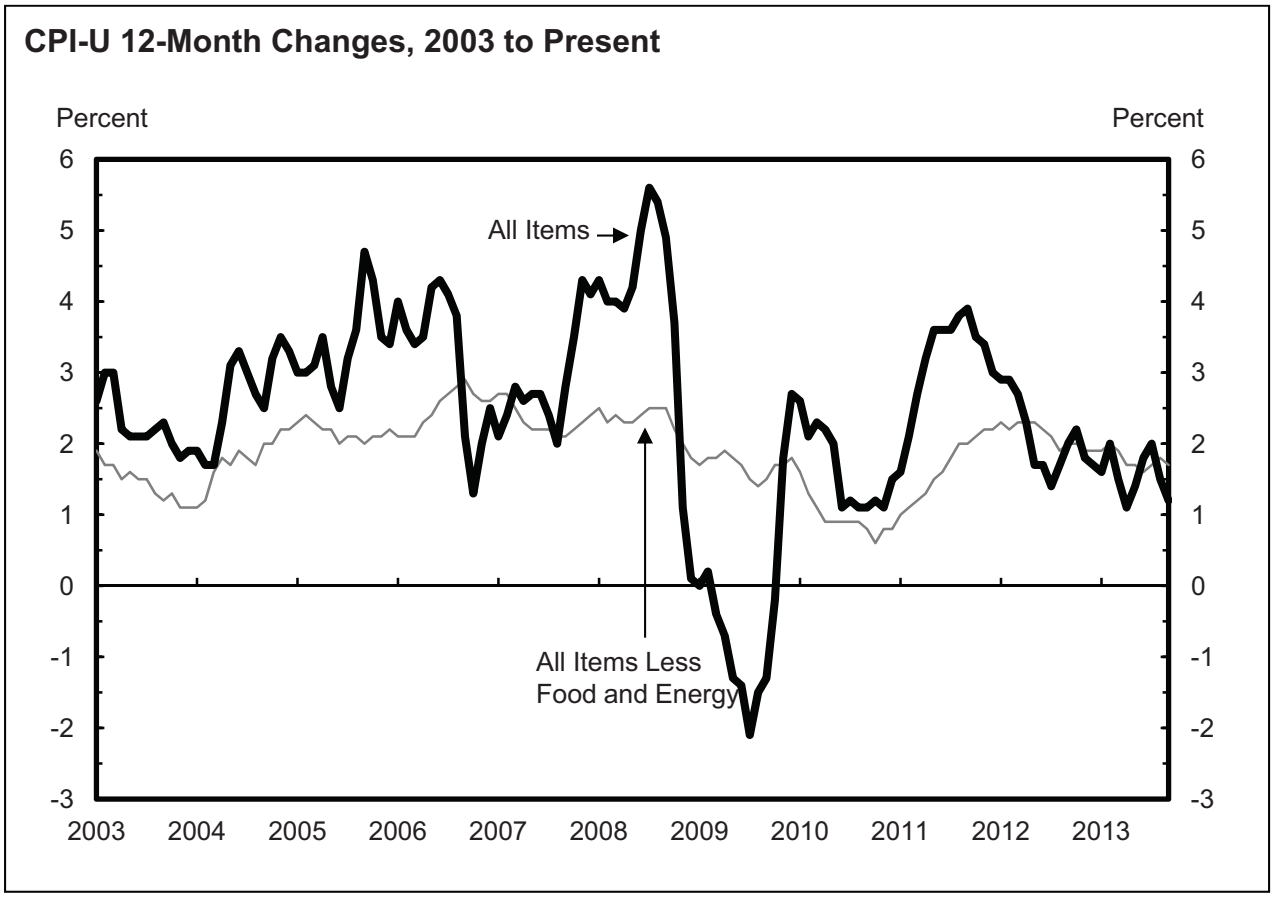
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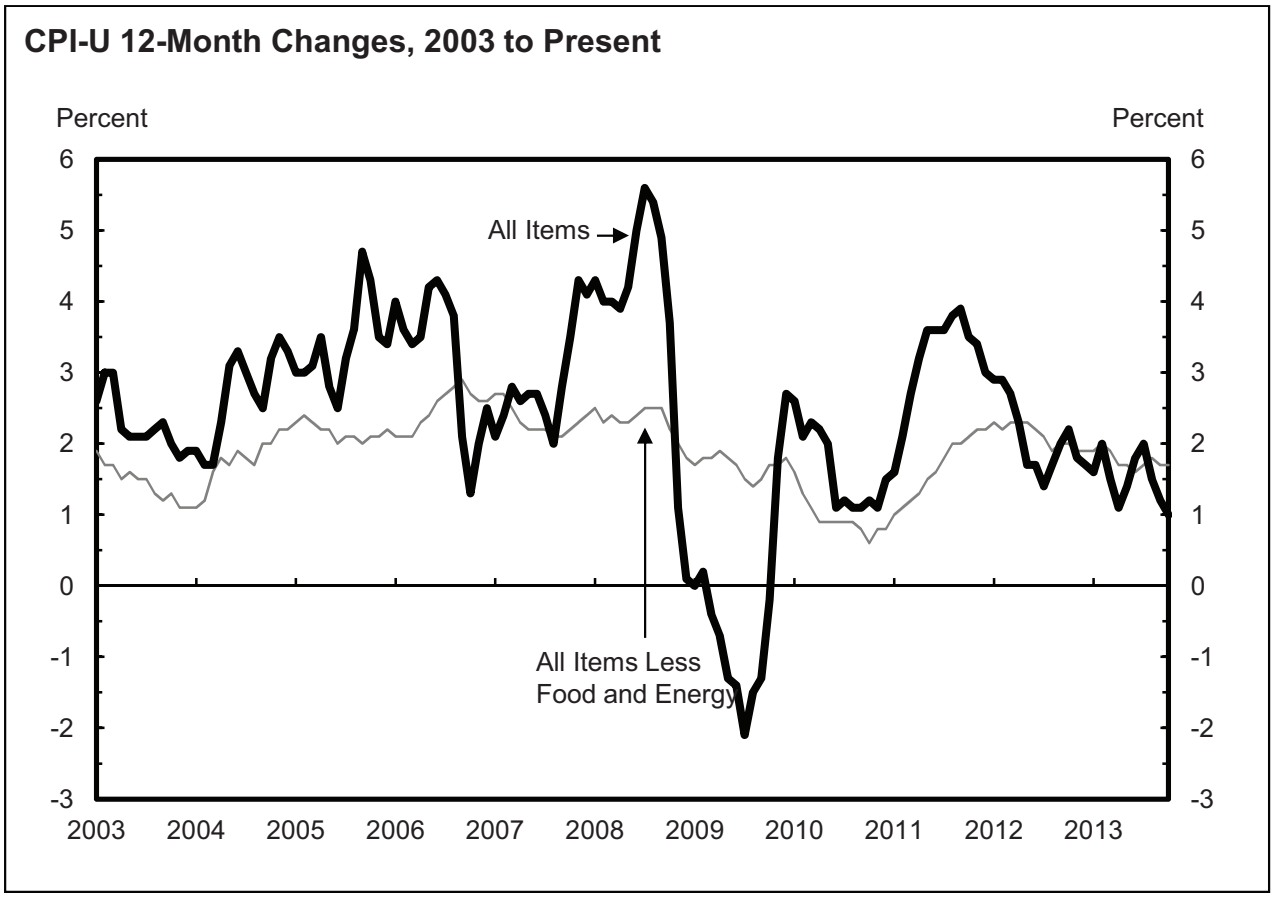
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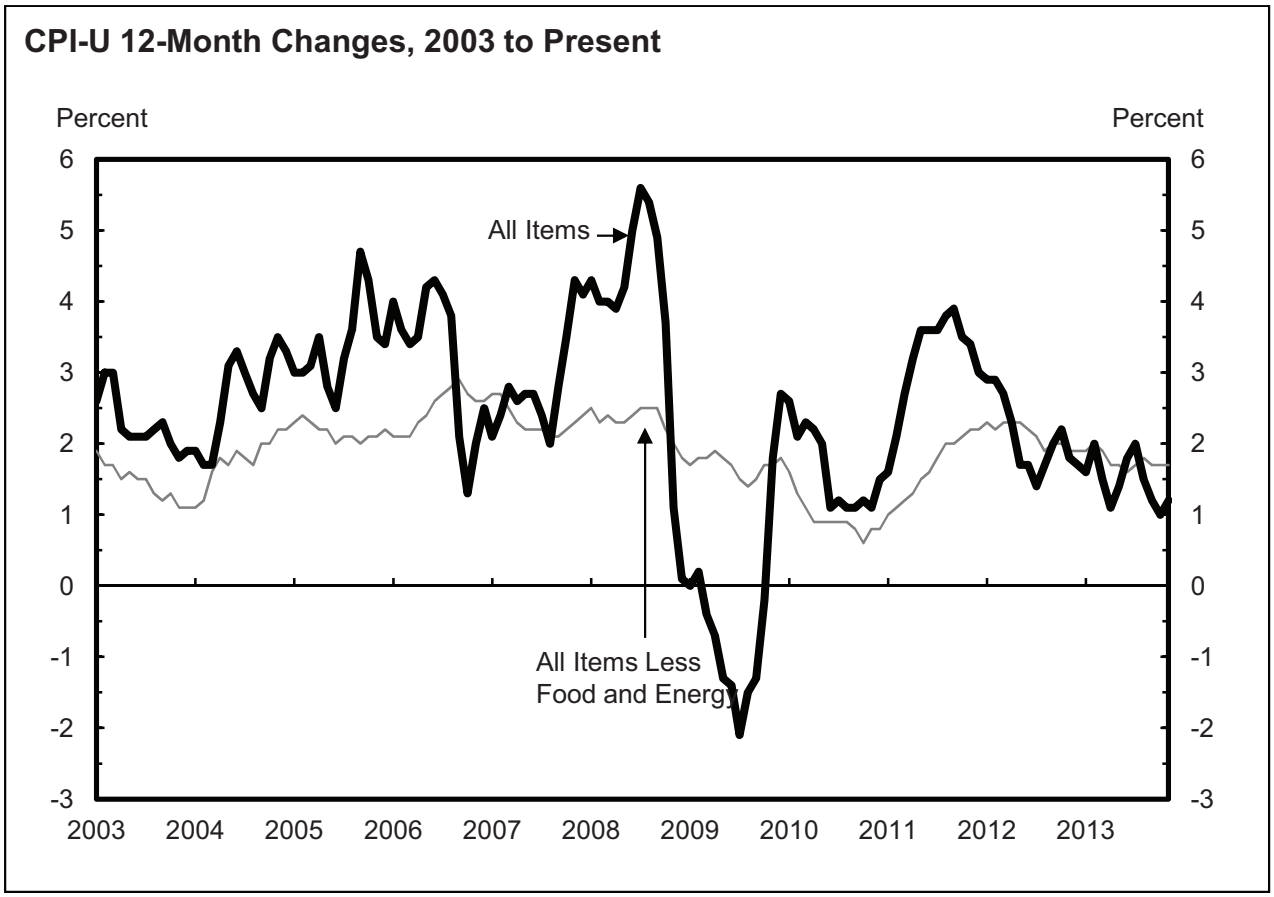
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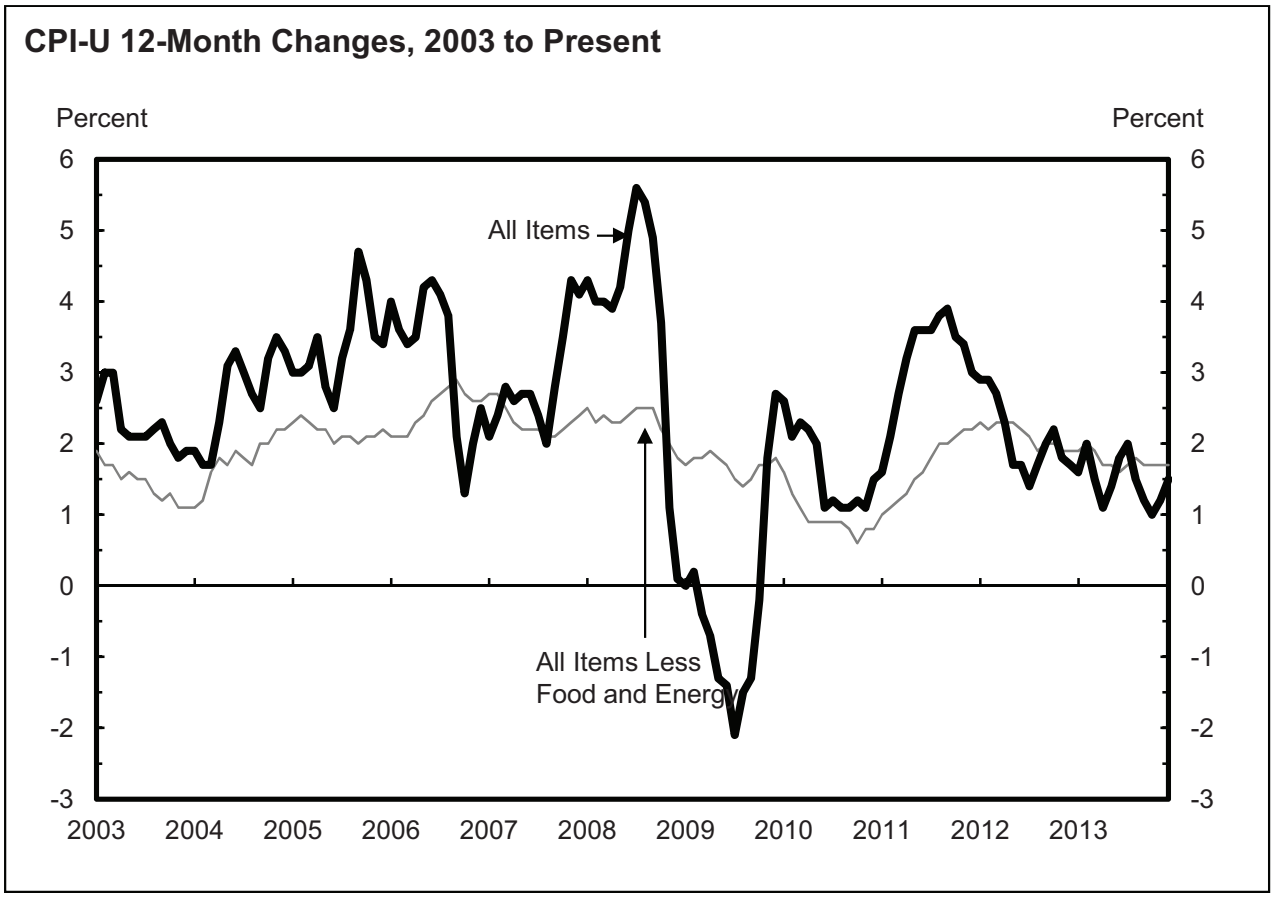
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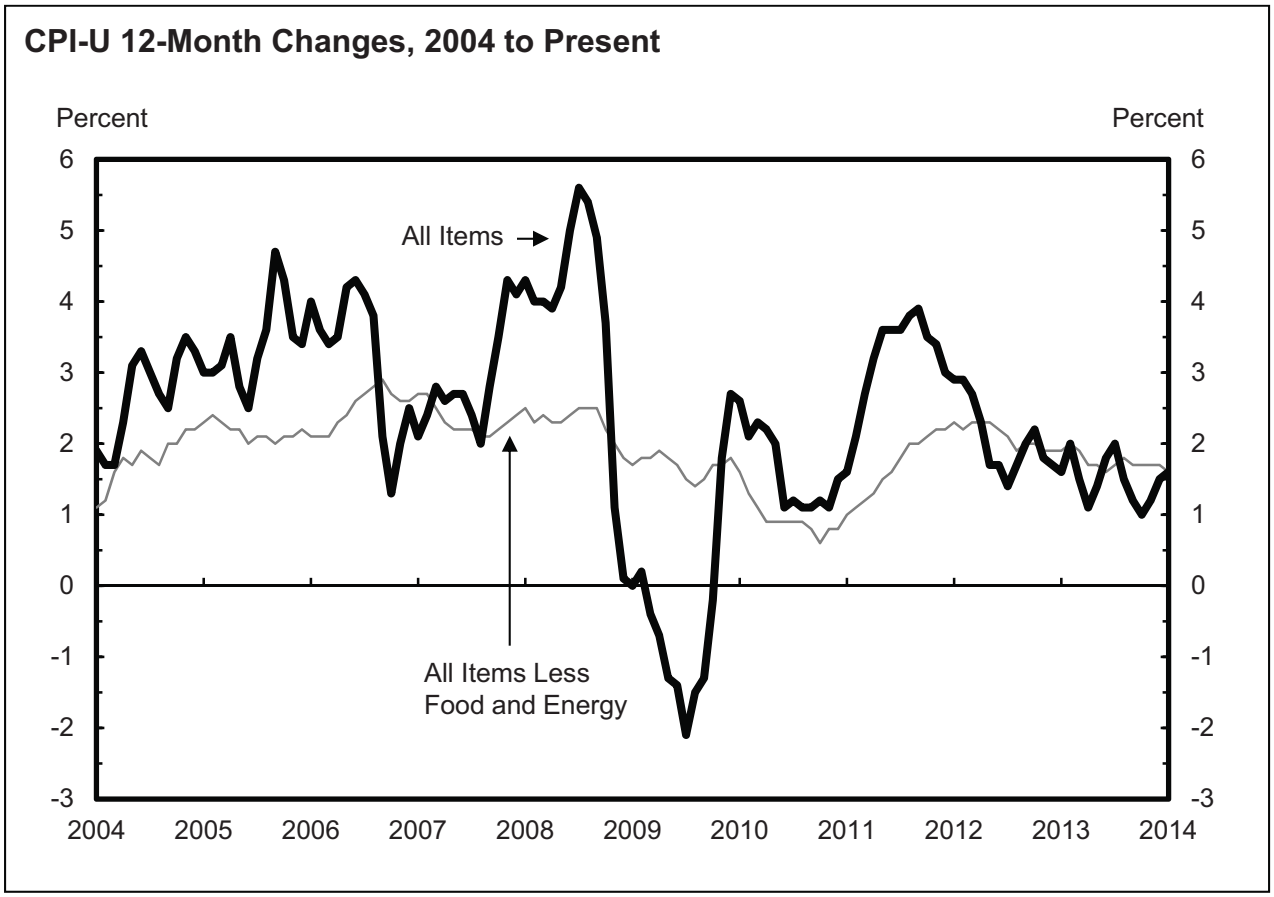
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C-CPI-U Index Revisions

As scheduled, effective with this release of data for January 2014, the Chained Consumer Price Index for All Urban Consumers (C-CPI-U) has undergone its annual revision. Because the current expenditure data required for the calculation of the C-CPI-U are available only with a time lag, the index is issued first in preliminary form, using the latest available expenditure data at the time of publication, and is subject to two subsequent revisions. Therefore, C-CPI-U indexes for the 12 months of 2012 are issued in final form – employing monthly expenditure weights from 2012. Values for the 12 months of 2013 are revised and issued as interim, using expenditure weights from the 2011-2012 period. Calculation of the initial value of the January 2014 C-CPI-U index, and all subsequent months in 2014, will also be based upon 2011-2012 expenditure weights.

Expenditure Weight Update

Effective with this release of the January 2014 CPI, the Bureau of Labor Statistics (BLS) has updated the consumption expenditure weights in the Consumer Price Index for All Urban Consumers (CPI-U) and Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) to the 2011-2012 period. The updated expenditure weights for these indexes replace the 2009-2010 weights that were introduced effective with the January 2012 CPI release.

Chained Consumer Price Index for All Urban Consumers (C-CPI-U) Annual Average Indexes Discontinued

The final revisions of the C-CPI-U indexes for 2012 are available as of February 2014. Annual average indexes for C-CPI-U series will not be published for time periods after 2012. (Monthly C-CPI-U indexes will continue to be published.) In February 2014, the annual average indexes for the final estimates for 2012 C-CPI-U series will be published in the public CPI database. Table 1CA will not be published.

A Note on Seasonally Adjusted and Unadjusted Data

Because price data are used for different purposes by different groups, the Bureau of Labor Statistics publishes seasonally adjusted as well as unadjusted changes each month.

For analyzing general price trends in the economy, seasonally adjusted changes are usually preferred since they eliminate the effect of changes that normally occur at the same time and in about the same magnitude every year--such as price movements resulting from changing climatic conditions, production cycles, model changeovers, holidays, and sales.

The unadjusted data are of primary interest to consumers concerned about the prices they actually pay. Unadjusted data also are used extensively for escalation purposes. Many collective bargaining contract agreements and pension plans, for example, tie compensation changes to the Consumer Price Index before adjustment for seasonal variation.

Seasonal factors used in computing the seasonally adjusted indexes are derived by the X-13ARIMA-SEATS Seasonal Adjustment Method. Seasonally adjusted indexes and seasonal factors are computed annually. Each year, the last five years of seasonally adjusted data are revised. Data from January 2009 through December 2013 were replaced in January 2014. Exceptions to the usual revision schedule were: the updated seasonal data at the end of 1977 replaced data from 1967 through 1977; and, in January 2002, dependently seasonally adjusted series were revised for January 1987-December 2001 as a result of a change in the aggregation weights for dependently adjusted series. For further information, please see "Aggregation of Dependently Adjusted Seasonally Adjusted Series," in the October 2001 issue of the CPI Detailed Report.

Effective with the publication of data from January 2006 through December 2010 in January 2011, the Video and audio series and the Information technology, hardware and services series were changed from independently adjusted to dependently adjusted. This resulted in an increase in the number of seasonal components used in deriving seasonal movement of the All items and 64 other lower level aggregations, from 73 for the publication of January 1998 through December 2005 data to 82 for the publication of seasonally adjusted data for January 2006 and later. Each year the seasonal status of every series is reevaluated based upon certain statistical criteria. If any of the 82 components change their seasonal adjustment status from seasonally adjusted to not seasonally adjusted, not seasonally adjusted data will be used in the aggregation of the dependent series for the last five years, but the seasonally adjusted indexes before that period will not be changed. Note: 35 of the 82 components are not seasonally adjusted for 2014.

Seasonally adjusted data, including the all items index levels, are subject to revision for up to five years after their original release. For this reason, BLS advises against the use of these data in escalation agreements.

Effective with the calculation of the seasonal factors for 1990, the Bureau of Labor Statistics has used an enhanced seasonal adjustment procedure called Intervention Analysis Seasonal Adjustment for some CPI series. Intervention Analysis Seasonal Adjustment allows for better estimates of seasonally adjusted data. Extreme values and/or sharp movements which might distort the seasonal pattern are estimated and removed from the data prior to calculation of seasonal factors. Beginning with the calculation of seasonal factors for 1996, X-12-ARIMA software was used for Intervention Analysis Seasonal Adjustment. In 2014, for the 2009-2013 revisions, the Bureau of Labor Statistics began using X-13ARIMA-SEATS to perform the seasonal adjustment of CPI series, including Intervention Analysis Seasonal Adjustment for certain series.

For the seasonal factors introduced in January 2014, BLS adjusted 31 series using Intervention Analysis Seasonal Adjustment, including selected food and beverage items, motor fuels, electricity and vehicles. For example, this procedure was used for the Motor fuel series to offset the effects of events such as the response in crude oil markets to the worldwide economic downturn in 2008.

For a complete list of Intervention Analysis Seasonal Adjustment series and explanations, please refer to the article "Intervention Analysis Seasonal Adjustment", located on our website at http://www.bls.gov/cpi/cpisapage.htm.

For additional information on seasonal adjustment in the CPI, please write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, Washington, DC 20212 or contact Chris Graci at (202) 691-5826, or by e-mail at graci.christopher@bls.gov, or contact Carlyle Jackson at (202) 691-6984, or by e-mail at jackson.carlyle@bls.gov . If you have general questions about the CPI, please call our information staff at (202) 691-7000.

Revised seasonally adjusted changes

Over-the-month percent changes in the U.S. City Average Consumer Price Index for All Urban Consumers (CPI-U) for All Items and for All Items less food and energy, seasonally adjusted, using former and recalculated seasonal factors for 2013.

All Items

2013	Former	Recalculated	Difference
January	.0	.1	.1
February	.7	.6	-.1
March	-.2	-.2	.0
April	-.4	-.2	.2
May	.1	.2	.1
June	.5	.3	-.2
July	.2	.2	.0
August	.1	.1	.0
September	.2	.1	-.1
October	-.1	.0	.1
November	.0	.1	.1
December	.3	.2	-.1

All Items less food and energy

2013	Former	Recalculated	Difference
January	.3	.2	-.1
February	.2	.2	.0
March	.1	.1	.0
April	.1	.1	.0
May	.2	.1	-.1
June	.2	.2	.0
July	.2	.2	.0
August	.1	.1	.0
September	.1	.1	.0
October	.1	.1	.0
November	.2	.2	.0
December	.1	.1	.0

Articles Appearing in the CPI Detailed Report, 2009-2013

Chained CPI	"C-CPI-U Index Revisions," January & December 2009. "C-CPI-U Index Revisions," January & December 2010. "C-CPI-U Index Revisions," January 2011. "C-CPI-U Index Revisions," January 2012. "C-CPI-U Index Revisions," January 2013.
Expenditure Weight Updates	"Expenditure Weight Update," December 2009. "Expenditure Weight Update," January 2010. "Expenditure Weight Update," December 2011.
General Information	"Consumer prices rose only 0.1 percent in 2008, the smallest change since 1954," March 2009. "Item Structure and Publication Changes for January 2010," January 2010. "Experimental CPI for Americans 62 Years of Age and Older," 1998-2009, March 2010. "Current Price Topics: The Use of CPI in Poverty Measurement," April 2010. "Current Price Topics: The Use of the CPI in Adjusting Federal Income Tax Brackets," July 2010. "Current Price Topics: The Use of the CPI in Social Security Cost-of-Living Adjustments," October 2010. "Redesigning the CPI News Release Tables," September 2011, December 2011, January-April 2012. "Discontinuation of Department Store Inventory Indexes," December 2012, January-December 2013. "Publication Changes for Average Price Series," December 2012, January-July 2013, October 2013. "Chained Consumer Price Index for All Urban Consumers (C-CPI-U) Annual Average Indexes Discontinued," July-September 2013, November-December 2013.
Research Series	"CPI Research Series Using Current Methods, 1978-2008," April 2009. "CPI Research Series Using Current Methods, 1978-2009," April 2010. "CPI Research Series Using Current Methods, 1978-2010," March 2011.
Response Rates	"Response Rates for the CPIs, 2008," January 2009. "Response Rates for the CPIs, 2009," January 2010. "Response Rates for the CPIs, 2010," January 2011. "Response Rates for the CPIs, 2011," January 2012. "Response Rates for the CPIs, 2012," January 2013.
Seasonal Adjustment	"Intervention Analysis in Seasonal Adjustment," January 2009-2010. "A Note on Seasonally Adjusted and Unadjusted Data" January 2009-2013. "Revised Seasonally Adjusted Changes," January 2009-2013. "Changes in Seasonal Adjustment Status for 2009," January 2009. "Seasonal adjustment factors for use with the 2009 All Urban Consumers indexes," January 2009. "Recalculated Seasonally Adjusted Indexes to be Available on February 17, 2010," December 2009. "Recalculated Seasonally Adjusted Indexes to be Available on February 15, 2011," December 2010.
Variance Estimates	"Variance Estimates for Price Changes in the CPI, January 2008-December 2008," February 2009. "Variance Estimates for Price Changes in the CPI, January 2009-December 2009," February 2010. "Variance Estimates for Price Changes in the CPI, January 2010-December 2010," February 2011. "Variance Estimates for Price Changes in the CPI, January 2011-December 2011," February 2012. "Variance Estimates for Price Changes in the CPI, January 2012-December 2012," February 2013.
Vehicle Quality Changes	"Report on Quality Changes for 2010 Model Vehicles," December 2009. "Report on Quality Changes for 2011 Model Vehicles," December 2010. "Report on Quality Changes for 2013 Model Vehicles," December 2012.

REPORT ON QUALITY CHANGE FOR 2014 MODEL VEHICLES

In accordance with usual practice, most new-model-year passenger cars and light motor trucks were introduced into the Producer Price Index (PPI) with the release of data for October 2013.

Passenger Cars

The value of quality changes for a sample of 2014 model year domestically produced passenger cars included in the PPI for October averaged $85.65, according to estimates by the U.S. Bureau of Labor Statistics (BLS). This change represents 103.8 percent of the average $82.54 increase in manufacturers' invoice prices for this year's models as compared with last year's models.

The retail equivalent value of these quality changes averaged $90.18, representing 116.2 percent of the average $77.60 over-the-year increase in manufacturers' suggested list prices.

Light Trucks

The value of quality changes for a sample of 2014 model year domestically produced light trucks included in the PPI for October averaged $22.69. This change represents 2.8 percent of the average $815.48 increase in manufacturers' invoice prices for this year's models as compared with last year's models.

The retail equivalent value of quality changes averaged $24.38, representing 2.8 percent of the average $860.96 over-the-year increase in manufacturers' suggested list prices.

For technical information regarding quality changes for 2014 model year motor vehicles, contact Thaddious Foster at Foster.Thaddious@bls.gov or (202) 691-6443. For general PPI information, contact the PPI Section of Index Analysis and Public Information, at ppi-info@bls.gov or (202) 691-7705.

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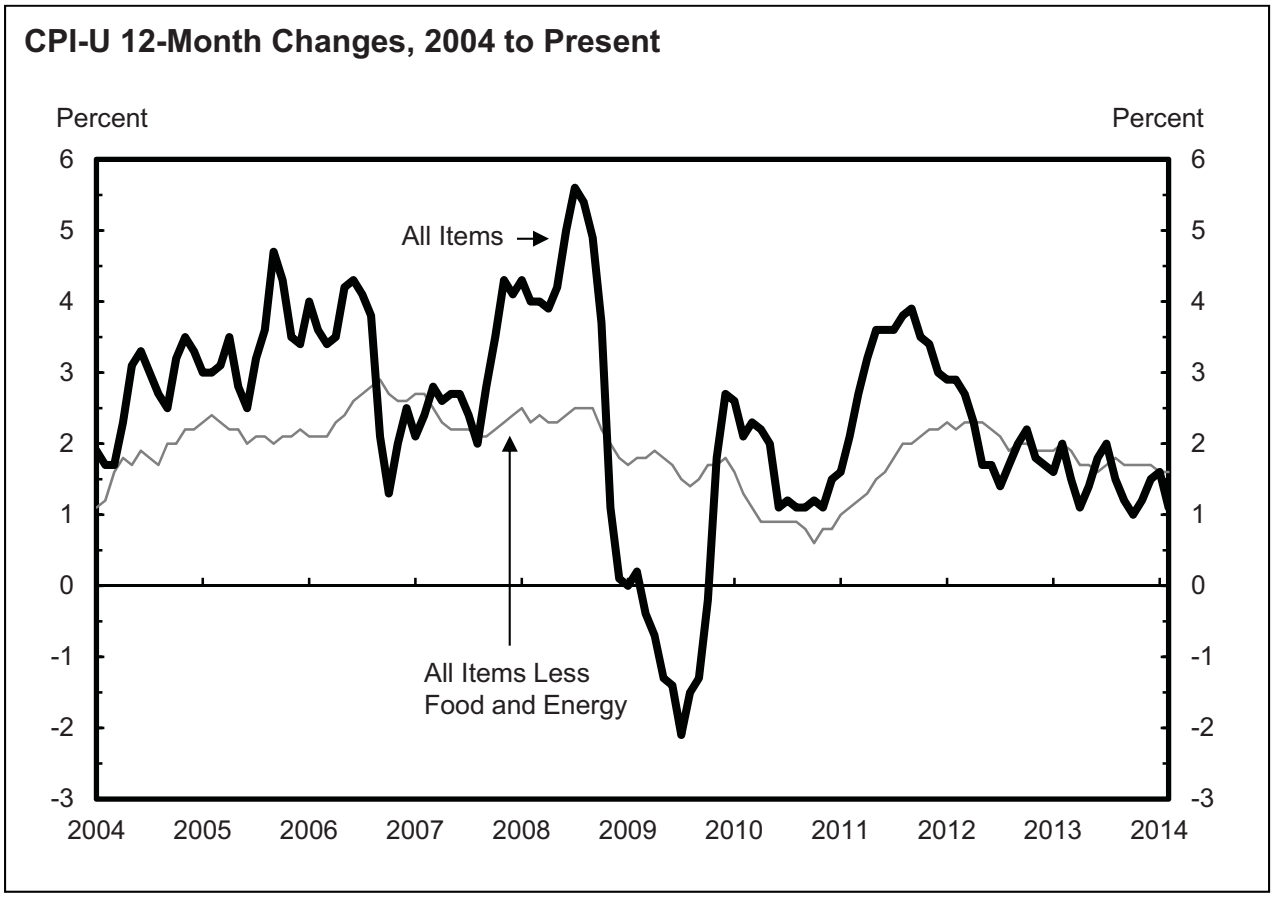
Estimates of the value of quality change are based on a review by the BLS of data supplied by producers for similarly equipped 2013 and 2014 domestically produced models priced for the PPI. Most of the estimates of quality changes in this notice are derived from information supplied for the PPI for October. These data also form the basis of the new vehicle quality adjustment for the Consumer Price Index (CPI). However, it should be noted that, effective with the release of data for January 1999, changes made solely for the purpose of meeting air pollution standards are no longer considered quality improvements for CPI calculation purposes.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Variance Estimates for Price Changes in the Consumer Price Index January–December 2013

Owen J. Shoemaker

This article presents variance estimates for 1-month, 2-month, 6-month, and 12-month percent changes in the Consumer Price Index for All Urban Consumers (CPI-U). Variance is a measure of the uncertainty caused by the use of a sample of retail prices, instead of the complete universe of retail prices. The estimates cover the period January 2013 through December 2013. Each month the U.S. Bureau of Labor Statistics collects prices from a sample of approximately 81,600 commodities and services (C&S) quotes in approximately 24,400 outlets[1] around the United States for the Consumer Price Index (CPI).

The most commonly used measure of sampling variability is the *standard error* of the estimate – the square root of the variance. The standard error of the CPI's change can be used to construct confidence intervals to determine whether the change for a particular CPI series is significantly different from zero. This information should help users determine which index changes are significant.

Presentation of findings

The percent changes in the CPI along with their standard errors were estimated for the 12 months from January through December 2013. In summary, tables 1V through 5V show the median values of those percent changes, as well as the median values of the standard errors. Table 1V shows this information for U.S. city average, and tables 2V through 5V show the same information for the Northeast, Midwest, South, and West regions of the country.

For example, from January through December 2013, the 1-month changes in the U.S. city average all items index had a median value of 0.12 percent. The standard errors of those 12 estimates had a median value of 0.03 percent. Margins of error are usually expressed as a statistic's point estimate plus or minus two standard errors, so the margin of error on the CPI's 1-month change is approximately 0.12 percent plus or minus 0.06 percent. Therefore, in a typical 1-month period in 2013, the true change in the CPI was probably somewhere between 0.06 percent and 0.18 percent. The tables also show median percent changes and standard errors for 2- and 6-month intervals and for the full year 2013. Margins of error can be calculated for these intervals in the same way as for a 1-month period.

Analysis of findings

Analyzing the data reveals three significant observations. First, standard errors increase as one moves from the U.S. city average to individual regions of the country and from *all items* to individual item categories. Second, standard errors differ between item categories. Third, the standard errors decrease on a relative basis (standard error divided by price change), as the price change interval gets longer.

The primary reason standard errors increase as one moves from the U.S. city average to individual regions of the country is that sample sizes differ. In general, smaller sample sizes lead to larger standard errors. For example, the U.S. city average all items index is computed each month from approximately 87,700 prices (including Rent and REQ quotes) throughout the United States, and its median standard

[1] In addition, BLS collects approximately 6,100 rents each month, used for both Rent and Rental Equivalence (REQ), each month.

error for 1-month changes is 0.03 percent. By contrast, the Northeast region all items index is computed from approximately 19,000 prices, and its median standard error is 0.07 percent. Regional indexes have larger standard errors because their sample sizes are smaller.

One can observe this same effect moving from the all items index to individual item categories. Again, the U.S. city average all items index is computed each month from approximately 87,700 prices, and its median 1-month standard error is 0.03 percent. By contrast, the U.S. city average recreation index is computed from approximately 5,600 prices, and its median 1-month standard error is 0.14 percent, over four times as large. Again, smaller sample sizes typically lead to larger standard errors.

The second significant observation is that standard errors differ between item categories. There are two reasons for this. First, item categories differ in sample size. For example, the U.S. city average food and beverages index is computed from approximately 34,900 prices each month, while the U.S. city average recreation index is computed from approximately 5,600 prices. Therefore, it is not surprising that the recreation index has larger standard errors. Second, there are real differences in item category price behaviors caused by different selling practices, seasonal influences, and consumer demand. This is especially true for the apparel category, in which it is common for the prices of individual items to fluctuate by 50 percent or more each month. As a result, standard errors for apparel indexes are large.

The third observation is that standard errors generally tend to decrease, on a relative basis (standard error divided by price change), as the price change interval gets longer. For the U.S. city average all items index, the median standard error divided by the median percent change is 0.03/0.12 = 0.25 for 1-month changes, 0.04/0.16 = 0.25 for 2-month changes, 0.07/0.59 = 0.12 for 6-month changes, and 0.08/1.49 = 0.05 for 12-month changes. This shows that the relative accuracy of percent changes in the CPI generally improves as the price change interval gets longer. On an absolute basis, standard errors tend to increase, but at a decreasing rate.

Findings presented here indicate that users should exercise caution when using CPI estimates to make inferences about index changes for relatively short time periods, for individual goods and services, or for local areas. The standard errors of those estimates may be on the same order of magnitude as the estimates themselves; and, thus, few inferences about them are reliable.

Sources of error

One way of analyzing the error in a survey estimate is to divide the total error into two sources: *sampling error* and *non-sampling error*. Sampling error is the uncertainty in the CPI caused by the fact that a sample of retail prices is used to compute the CPI, instead of using the complete universe of retail prices. Non-sampling error is the rest of the error. Non-sampling error includes things such as incorrect information given by survey respondents, data processing errors, and so forth. Non-sampling error arises regardless of whether data are collected from a sample of retail prices or from the complete universe.

Another way of analyzing error is to divide it into *variance* and *bias*. The variance of the CPI is a measure of how close different estimates of the CPI would be to each other if it were possible to repeat the survey over and over using different samples. Of course, it is not feasible to repeat the survey multiple times, but statistical theory allows the CPI's variance to be estimated anyway. A small variance, for example, indicates that multiple independent samples would produce values that are consistently very close to each other. *Bias* is the difference between the CPI's *expected* value and its *true* value. A statistic may have a small variance but a large bias, or it may have a large variance but a small bias. For an index to be considered accurate, both its variance and bias need to be small.

The Bureau of Labor Statistics (BLS) is constantly trying to reduce the error in the CPI. Variance and sampling error are reduced by using a sample of retail prices that is as large as possible, given resource constraints. BLS has developed a model that optimizes the allocation of resources by indicating the number of prices that should be observed in each geographic area and each item category, in order to minimize the variance of the U.S. city average all items index. BLS reduces non-sampling error through a series of computerized and professional data reviews, as well as through continuous survey process improvements and theoretical research.

Replication and variance estimation

An important advantage of using sampling is that the CPI's variance can be estimated directly from the sample data. Starting in 1978, the CPI's sample design has accommodated variance estimation by using two or more independent samples of items and outlets in each geographic area. This allows two or more statistically independent estimates of the index to be made. The independent samples are called *replicates*, and the set of all observed prices is called the *full sample*.

BLS collects CPI data in 38 geographic areas across the United States. These areas consist of 31 *self-representing* areas and 7 *non-self-representing* areas. Self-representing areas are large metropolitan areas, such as the Boston, St. Louis, and San Francisco metropolitan areas. Non-self-representing areas are collections of smaller metropolitan areas. For example, one non-self-representing area is a collection of 32 small metropolitan areas in the Northeast region (Buffalo, Hartford, Providence, Bangor, and others), of which 8 were randomly selected to represent the entire set. Within each of the 38 areas, price data are collected for 211 item categories called *item strata*. Together the 211 item strata cover all consumer purchases. Examples of item strata are bananas, women's dresses, and electricity.

Multiplying the number of areas by the number of item strata gives 8,018 (= 38 × 211) different area and item combinations for which price indexes need to be calculated. Separate price indexes are calculated for each one of these 8,018 area and item combinations. After all 8,018 of these *basic-level* indexes are calculated, they are aggregated to form *higher-level* indexes, using expenditure estimates from the Consumer Expenditure Survey as their weights. Examples of higher-level geographic areas are the four regions (Northeast, Midwest, South, and West); and examples of higher-level item categories are the eight major groups (food & beverages, housing, apparel, transportation, medical care, education and communication, recreation, and other goods and services). The highest level of geographic aggregation is the U.S. city average, and the highest level of item aggregation is all items.

Variances are computed with a Stratified Random Groups Method, in which variances are computed separately for certain subsets of areas and items and are then combined to produce the variance of the entire area and item combination. Subsets of items are formed by the intersection of the item category with each of the eight major groups.

Let $CPI(A,I,f,t)$ denote the index value where A = area, I = item category, f indicates that it is the full-sample value, and t = month; and let $CPI(A,I,f,t-k)$ denote the value of the same index in month = $t-k$. In general, the upper-case letter A denotes a *set* of areas, such as the Northeast or Midwest region of the country; and the upper-case letter I denotes a higher-level item category, such as all items or all items less food and energy. Also let $CPI(A,I,r,t)$ and $CPI(A,I,r,t-k)$ be the corresponding index values for replicate = r. Most areas have two replicates, but some have more. Then, the full-sample k-month percent change between months $t-k$ and t is computed by dividing $CPI(A,I,f,t)$ by $CPI(A,I,f,t-k)$, subtracting 1, and multiplying by 100:

$$PC(A,I,f,t,t-k) = \left(\frac{CPI(A,I,f,t)}{CPI(A,I,f,t-k)} - 1 \right) \times 100$$

Every index has a weight *W(A,I,f)* or *W(A,I,r)* associated with it, which is used to combine the index with other indexes to produce indexes for larger geographic areas and larger item categories. For example, the weights are used to combine all 8,018 basic-level indexes into higher-level indexes such as the U.S. city average all items index. The product of an index and its weight is called a *cost weight*, $CW(A,I,r,t) = CPI(A,I,r,t) \times W(A,I,r)$, and is an estimate of the total cost in area = A for consumption of item category = I in month = t.

For the Stratified Random Groups method used here, replicate percent changes are defined as follows: full sample cost weights are used for every geographic area within area = A except for one of the areas. In the omitted area, the full sample cost weight is replaced by a replicate cost weight. Let the lower case letter a denote one of the 38 basic-level areas included in area = A, and let the lower case letter i denote the intersection of item category = I with one of the 8 major groups. Then, the replicate percent change, for area = a, item subset = i, replicate = r, between months $t-k$ and t, is computed as:

$$PC_S(a,i,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,i,f,t) + CW(a,i,r,t)}{CW(A,I,f,t-k) - CW(a,i,f,t-k) + CW(a,i,r,t-k)} - 1 \right) \times 100$$

for self-representing areas. For non-self-representing areas, the replicate percent change, for area = a, item category = I, replicate = r, between months $t-k$ and t, is computed as:

$$PC_N(a,I,r,t,t-k) = \left(\frac{CW(A,I,f,t) - CW(a,I,f,t) + CW(a,I,r,t)}{CW(A,I,f,t-k) - CW(a,I,f,t-k) + CW(a,I,r,t-k)} - 1 \right) \times 100$$

where:

$$CW(A,I,f,t) = \sum_{a \subset A} \sum_{i \subset I} CW(a,i,f,t)$$
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$$CW(a,I,f,t) = \sum_{i \subset I} CW(a,i,f,t)$$

and likewise for replicates. The symbol "$a \subset A$" means that the sum is over all basic-level areas within area = A, and the symbol $i \subset I$ means that the sum is over all item categories that are intersections of item category = I with a major group.

Then, the variance is computed with the following Stratified Random Groups Variance Estimation Formula:

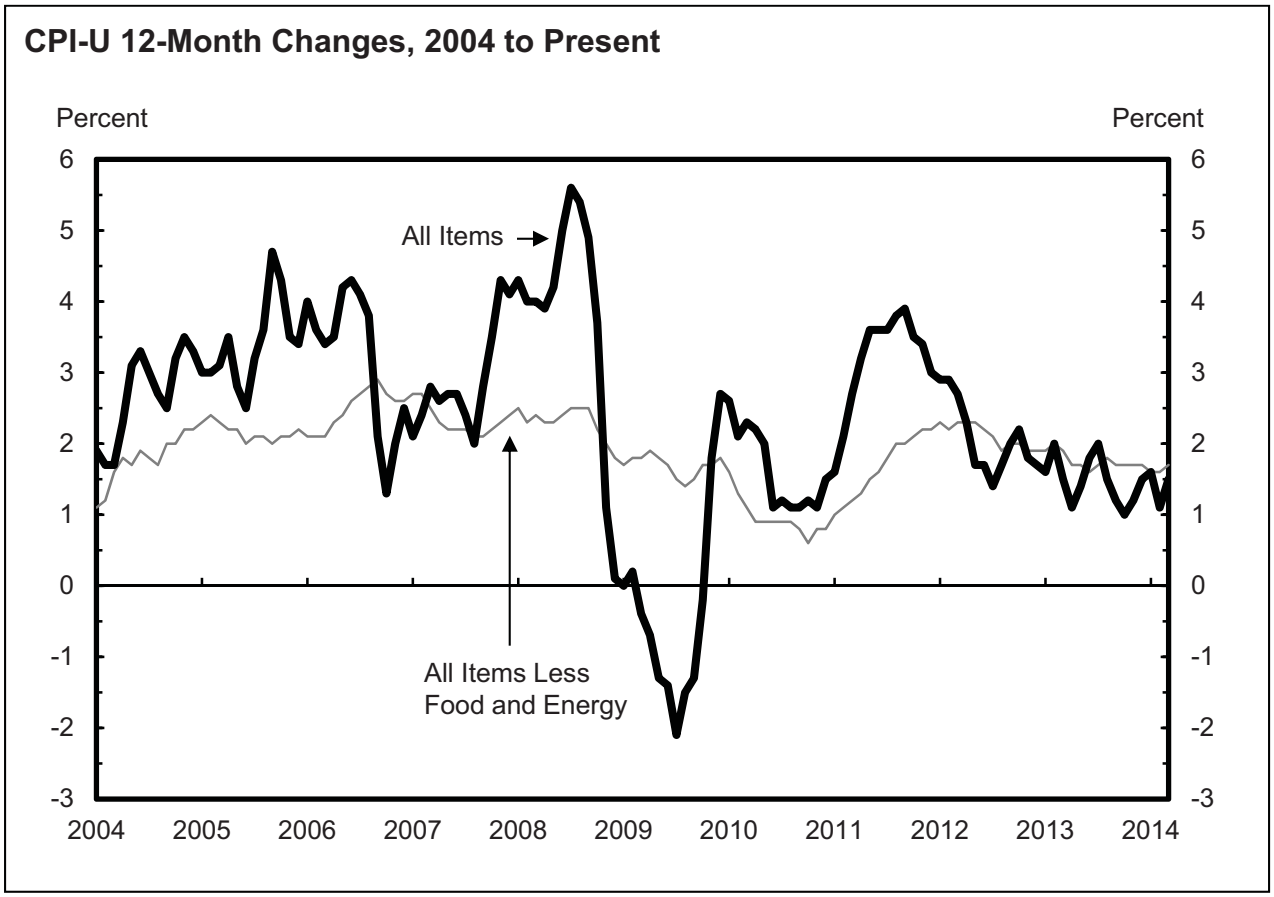
$$\begin{aligned} V[PC(A,I,f,t,t-k)] &= \sum_{i \subset I} \sum_{a \subset A \cap S} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_S(a,i,r,t,t-k) - PC(A,I,t,t-k) \right)^2 \\ &+ \sum_{a \subset A \cap N} \frac{1}{R_a(R_a-1)} \sum_{r=1}^{R_a} \left(PC_N(a,I,r,t,t-k) - PC(A,I,t,t-k) \right)^2 \end{aligned}$$

where S and N are the sets of all self-representing and non-self-representing areas in the CPI's geographic sample, respectively; and A∩S and A∩N are the sets of all self-representing and non-self-representing areas within area = A. The number R_a is the number of replicates in area = a.

Finally, the standard error of the percent change is computed by taking the square root of its variance:

$$SE[\,PC(A, I, f, t, t-k)] \;=\; \sqrt{V[PC(A, I, f, t, t-k)]}\;.$$

For more information, write to the CPI Information Office, BLS - Room 3130, 2 Massachusetts Avenue, N.E., Washington, DC 20212, or call Owen Shoemaker at 202-691-6918.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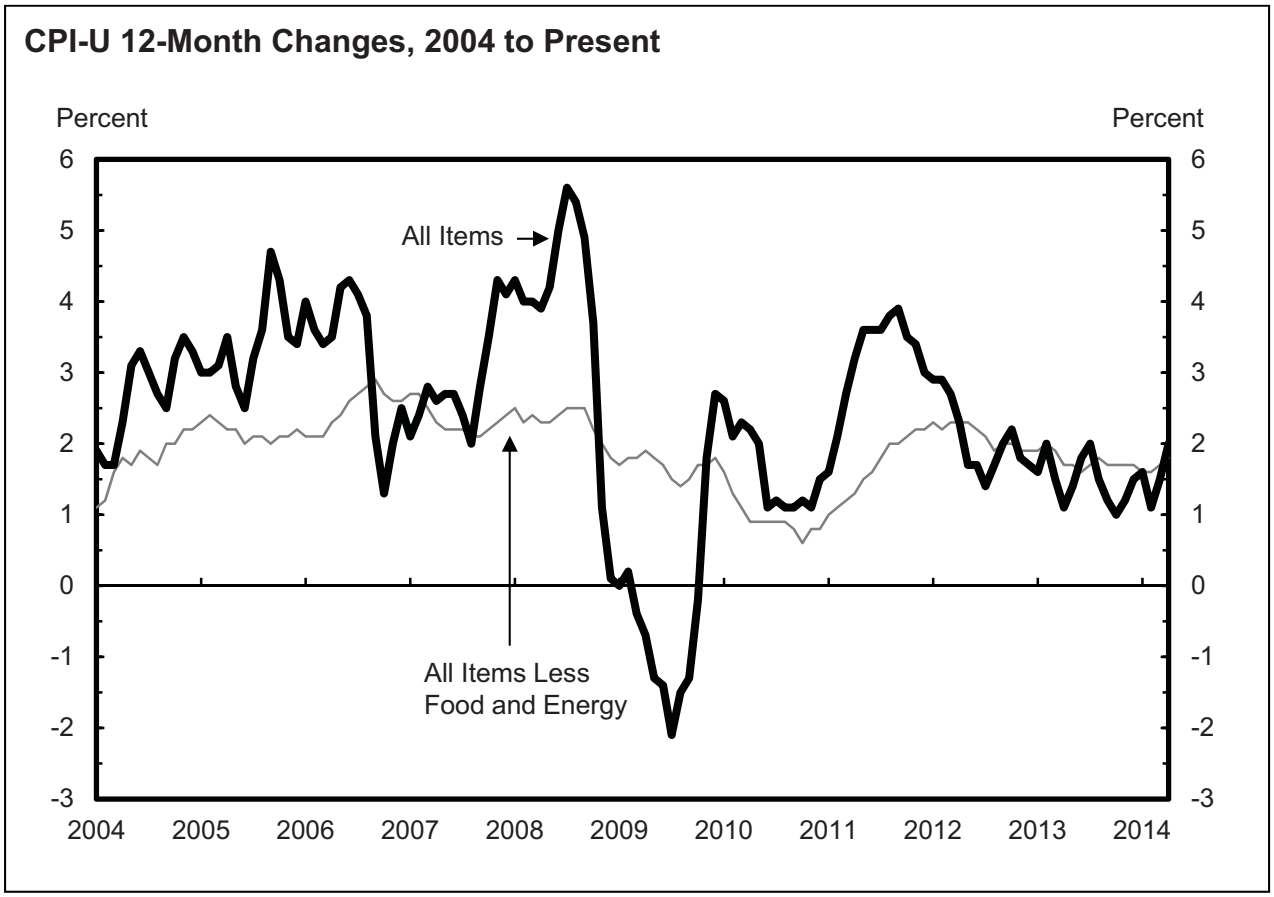
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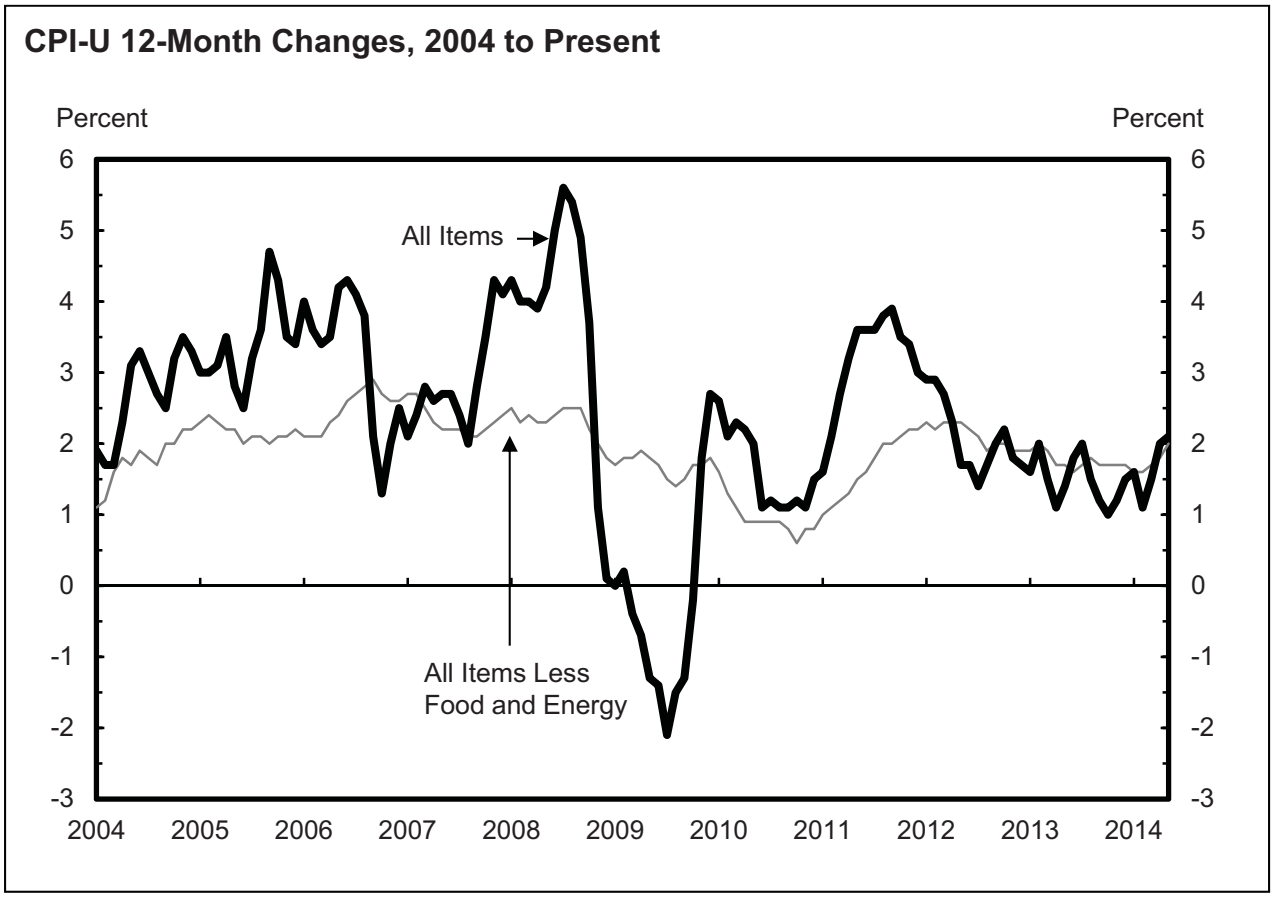
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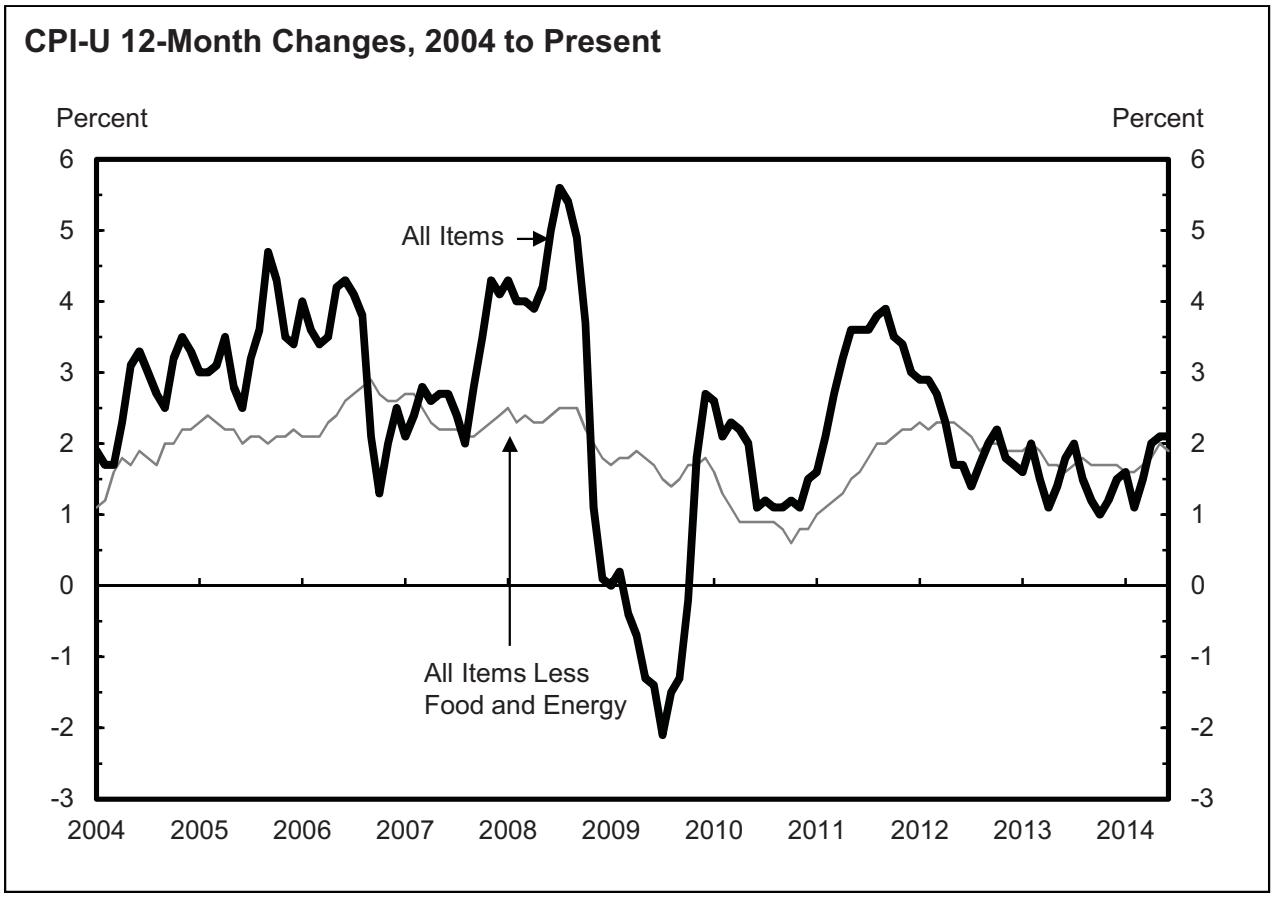
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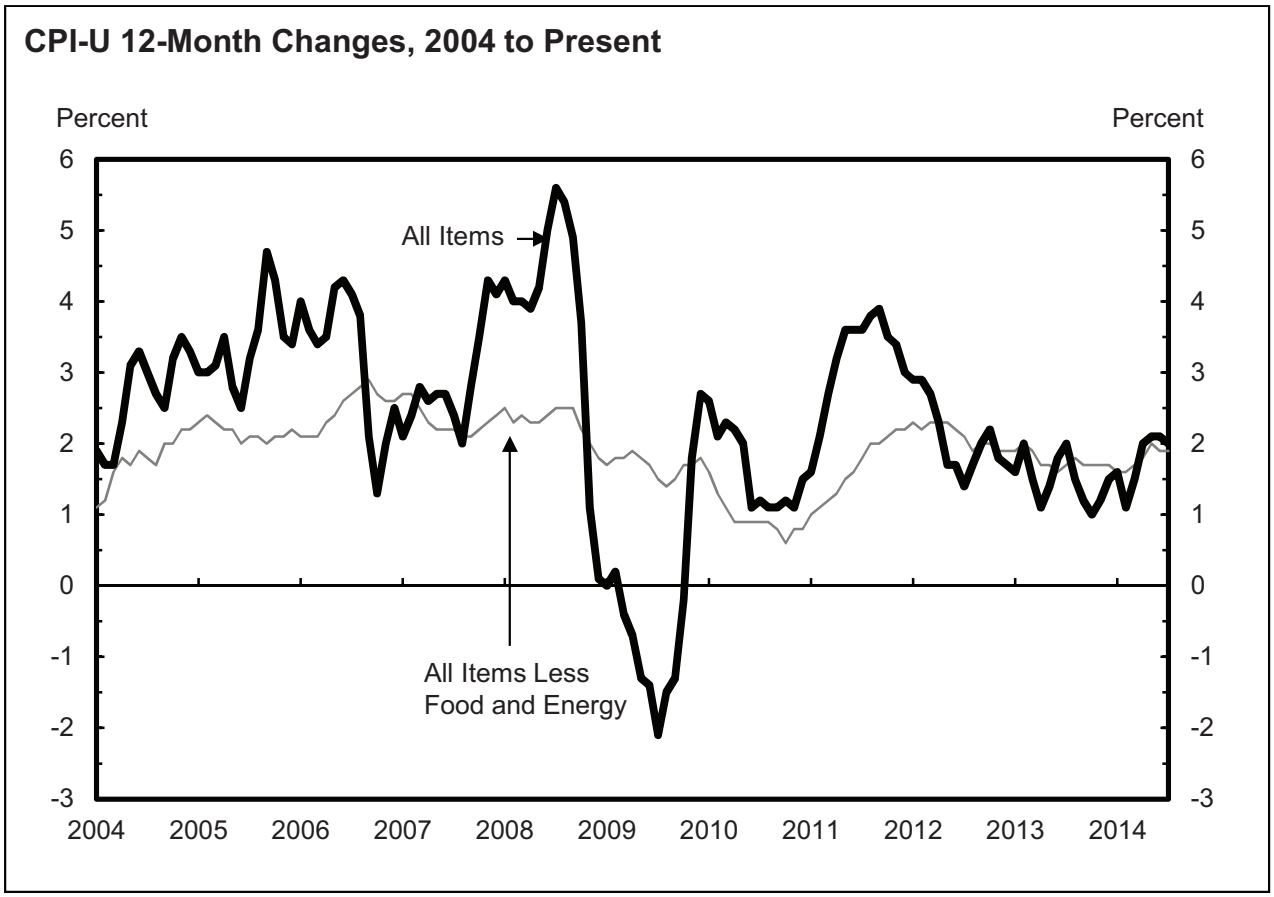
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