Aggregation of Dependently Adjusted Seasonally Adjusted Series

The Bureau of Labor Statistics is changing the way aggregation weights for seasonally adjusted Consumer Price Index data are calculated, effective January 2002. At that time, the expenditure weights used to calculate the Consumer Price Index (CPI) will be updated and the seasonally adjusted Consumer Price Indexes for dependently adjusted series will be revised from January 1987 through December 2001. The revised seasonally adjusted series will use the aggregation weights used for the unadjusted series. These aggregation weights are slightly different from the seasonal aggregation weights originally used. The month to month index movement will be the same except for the months in which weight revisions were introduced (December 1986 to January 1987 and December 1997 to January 1998).

Beginning in January 2002, the CPI will use the same aggregation weights for unadjusted and seasonally adjusted data. This will simplify the processing of seasonally adjusted data. In addition, the index level of the seasonally adjusted data will more closely track the level of the unadjusted data.

The revised data will be available through the CPI home page, https://www.bls.gov/cpi/ on Friday, February 15, 2002.

<u>Aggregation Using Standard Aggregation Weights</u>

In January 2002, the formula for calculating dependently seasonally adjusted aggregate series will be changed to

$$SIX_{I,t} = \frac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{aggwt_{I,p}}$$

where

SIX	= seasonally adjusted series
i	= component series
I	= aggregate series
$aggwt$	= standard aggregation weight
t	= current collection period
p	= expenditure base

When standard aggregation weights are used and the weights are revised, the month to month change across the weight revision will include a price change effect and a weight change effect:

$$\frac{SIX_{I,t+1,aggwt}}{SIX_{I,t,aggwt}} = \frac{\dfrac{\sum_{i \in I} (aggwt_{i,p'} * SIX_{i,t+1})}{aggwt_{I,p'}}}{\dfrac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{aggwt_{I,p}}} = \frac{\dfrac{\sum_{i \in I} (aggwt_{i,p'} * SIX_{i,t+1})}{aggwt_{I,p'}}}{\dfrac{\sum_{i \in I} (aggwt_{i,p'} * SIX_{i,t})}{aggwt_{I,p'}}} * \frac{\dfrac{\sum_{i \in I} (aggwt_{i,p'} * SIX_{i,t})}{aggwt_{I,p'}}}{\dfrac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{aggwt_{I,p}}}$$

price change effect *weight change effect*

The expenditure weights used in calculating the Consumer Price Index are updated periodically. Updates occurred in 1940, 1953, 1964, 1978, 1987, and 1998. The next weight update will occur in January 2002; future updates will occur every 2 years, in 2004, 2006, and so on.

In order to provide continuous unadjusted series, the standard aggregation weights in the CPI are set in such a way that the first index for the series calculated using the new weights is equal to the index for the last month calculated using the old weights; this overlap month is called the pivot or link month. The pivot month for the last weight update was December 1997; the new weights were introduced in January 1998.

For seasonally adjusted aggregate series, constructed by aggregating seasonally adjusted component indexes, there are technically two pivot month indexes. One is calculated using the old weighting structure, and one is calculated using the new weights. The difference between these two pivot month indexes, which occurs because of the different weighting applied to the component seasonal factors, is known as the weight effect. When the published pivot month index (old weights) is compared to the following month index (new weights) the resulting change will include both price effects and weight effects.

The purpose of seasonally adjusted data is to highlight the underlying price trend. The inclusion of significant weight effects in seasonally adjusted data can distort the view of the underlying trend. There are several methods that can be used to minimize the weight effect; the CPI currently uses a specially calculated seasonal aggregation weight. With weight updates occurring every 10 or more years, the weight effect was significant. The expenditure weights will be updated frequently in the future; we expect that the weight effect at the time of each update will be negligible.

Based on current data, the median weight effect at the 1998 Revision was 0.04 percent. The largest weight effect for a continuous series was 0.48 percent, reflecting 11 years of change in spending patterns. With biennial weight revisions, we expect the weight effect to be less than 0.1 percent, and significantly less for most series.

<u>Processing</u>

The advantage to using standard aggregation weights is simplification of our procedures for calculating aggregate seasonally adjusted data. Calculation of seasonal aggregation weights is complicated by revisions of seasonally adjusted data. Seasonally adjusted data are subject to revision for 5 years. Seasonal aggregation weights are recalculated each year until the data are declared final. With weight updates occurring every 2 years, the process for calculating and revising seasonal aggregation weights grows in complexity. In addition to calculating seasonal aggregation weights for the current weight structure, revised seasonal aggregation weights would need to be calculated for the 2 previous weight sets.

Elimination of a separate seasonal aggregation weight greatly simplifies processing.

<u>Aggregation Using Seasonal Aggregation Weights</u>

The current formula for calculating dependent seasonally adjusted indexes using a seasonal aggregation weight is

$$SIX_{I,t} = \frac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{saggwt_{I,p}}$$

where *saggwt* is the seasonal aggregation weight.

For aggregate series, the saggwt is calculated as follows:

$$saggwt_{I,p} \equiv \frac{\sum_{i\in I} E_{i,v} / sf_{i,v}}{SIX_{I,v}} = \frac{\sum_{i\in I} (aggwt_{i,v} * IX_{i,v}) / sf_{i,v}}{SIX_{I,v}} = \frac{\sum_{i\in I} (aggwt_{i,v} * SIX_{i,v})}{SIX_{I,v}}$$

where $E_{i,v}$ = Expenditures from the Consumer Expenditure Survey
$sf_{i,v}$ = seasonal factor for directly adjusted series
v = pivot month

The seasonally adjusted expenditures for the pivot period are divided by the seasonally adjusted index for the aggregate for the pivot period to get the new seasonal aggregation weight. When seasonal aggregation weights are used, the month to month change across a weight revision will show only the price change effect.

One disadvantage of using the seasonal aggregation weight is that the index levels for the unadjusted and seasonally adjusted series will not always be similar. When a new series is introduced, the pivot month seasonally adjusted index is arbitrarily set equal to 100. If the series is at a low point in its seasonal cycle at the pivot month, the seasonally adjusted series will consistently track at a lower level than the unadjusted series. The opposite is true for a series at a seasonal cycle peak.

<u>Month-to-Month Changes</u>

It can be shown that for any time period when the weights are constant, the month-to-month percent change will be the same whether seasonal aggregation weights or standard aggregation weights are used.

$$\frac{SIX_{I,t+1,saggwt}}{SIX_{I,t,saggwt}} = \frac{\dfrac{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t+1})}{saggwt_{I,p}}}{\dfrac{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t})}{saggwt_{I,p}}} = \frac{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t+1})}{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t})} =$$

$$\frac{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t+1})}{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t})} * \frac{aggwt_{I,p}}{aggwt_{I,p}} = \frac{\dfrac{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t+1})}{aggwt_{I,p}}}{\dfrac{\sum_{i\in I}(aggwt_{i,p} * SIX_{i,t})}{aggwt_{I,p}}} = \frac{SIX_{I,t+1,aggwt}}{SIX_{I,t,aggwt}}$$

Both the standard aggregation weight and the seasonal aggregation weight are constants. The standard aggregation weight is based on expenditure data and is constant once calculated. The seasonal aggregation weight is dependent on the seasonally adjusted index for the pivot month. The seasonal aggregation weight is revised each year until the pivot month index is final. At a given point in time, though, the seasonal aggregation weight is constant, and the same weight is used for all months after the pivot month.

Advantages and Disadvantages

As indicated earlier, elimination of a separate seasonal aggregation weight greatly simplifies processing. In addition, the index level of the seasonally adjusted data will more closely track the level of the unadjusted data. The primary disadvantage of using the standard aggregation weights for aggregation of unadjusted and seasonally adjusted data is that the month-to-month seasonally adjusted index percent change at the revision will have weight effects as well as price effects. With frequent weight updates, this concern is eliminated. In the past, the weight effects at a revision were significant. Weight revisions occurred approximately once a decade. It was felt that minimizing the weight effect would give the best representation of economic movements. The January 2002 revision takes place only 4 years after the last revision, in January 1998. Beginning with the January 2004 revision, the weights will be revised every other year. Thus, the importance of the weight effect is declining. Both methods result in the same relative month-to-month movement when the timeframe does not include a weight revision.

The advantages of the simplified processing afforded by using standard aggregation weights outweigh the disadvantage of showing a negligible weight effect when the expenditure weights are updated. In addition, the index level of the seasonally adjusted data will more closely track the level of the unadjusted data.

In order to provide consistent seasonally adjusted series, historical dependently adjusted series will be revised to the appropriate level by applying level adjustment factors.[1] The level adjustment factors, which will be applied to data for January 1987 through December 1996, are presented in table 1 and table 2. Data for January 1997 through December 2001 will be revised and aggregated using the standard aggregation weights. Because the pivot month (December 1997) indexes are subject to revision, estimates of the level adjustment for January 1997 through December 2001 are not available in advance. The revised data will be available on Friday, February 15, 2002 through the CPI home page: https://www.bls.gov/cpi/

Table 1. Consumer Price Index for All Urban Consumers (CPI-U), U.S. city average: Level adjustment factors for use with seasonally adjusted data for January 1987 through December 1996.

Item Code	Item Title	Level Adjustment Factor
SA0	All items	0.99932659526447
SA0E	Energy	1.00350571809222
SA0L1	All items less food	1.00032069654291
SA0L12	All items less food and shelter	1.00062005796949
SA0L12E	All items less food, shelter, and energy	0.99890160108245
SA0L12E4	All items less food, shelter, energy, and used cars and trucks	0.99969338109949
SA0L1E	All items less food and energy	0.99862946847454
SA0L2	All items less shelter	0.99975903320569
SA0L5	All items less medical care	1.00083330902630
SA0LE	All items less energy	0.99879094018791
SA311	Apparel less footwear	1.00132214674933
SAA	Apparel	0.99995324550230
SAA2	Women’s and girls’ apparel	1.00043267902463
SAC	Commodities	0.99981421715880
SACE	Energy commodities	1.00099461925798
SACL1	Commodities less food	0.99867857080338
SACL11	Commodities less food and beverages	0.99963937523226
SACL1E	Commodities less food and energy commodities	0.99988575763120
SACL1E4	Commodities less food, energy, and used cars and trucks	1.00119169627147
SAF	Food and beverages	0.99972034675630
SAF1	Food	0.99868585267151
SAF11	Food at home	0.99990526538189
SAF112	Meats, poultry, fish, and eggs	1.00017927084735
SAF1121	Meats, poultry, and fish	0.99968580695353
SAF11211	Meats	1.00029150982754
SAF113	Fruits and vegetables	0.99989404268686
SAF1131	Fresh fruits and vegetables	1.00286856973450
SAF115	Other food at home	1.00045455985688
SAG	Other goods and services	0.99645615635526
SAH	Housing	1.00072227985618
SAH1	Shelter	1.00163859180900
SAH2	Fuels and utilities	1.00017196702959
SAH21	Fuels	1.00717345558590
SAH3	Household furnishings and operations	1.00054457710847
SAM	Medical care	0.99898550137250
SAS	Services	0.99967847389687
SAS367	Other services	0.99708969720805
SAS4	Transportation services	1.00033267531316
SASLE	Services less energy services	0.99949903212504
SAT	Transportation	0.99948728584425
SAT1	Private transportation	0.99856994633031
SEAC	Women’s apparel	1.00013481541914
SEFK	Fresh fruits	0.99856411046612
SEHF	Gas (piped) and electricity	1.00599001717135

Table 2. Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), U.S. city average: Level adjustment factors for use with seasonally adjusted data for January 1987 through December 1996.

Item Code	Item Title	Level Adjustment Factor
SA0	All items	0.99986976295709
SA0E	Energy	1.00239424663013
SA0L1	All items less food	1.00132140627495
SA0L1E	All items less food and energy	0.99855667920074
SA0L2	All items less shelter	0.99987406497296
SA0L5	All items less medical care	1.00043259245613
SA0LE	All items less energy	0.99918541082466
SA311	Apparel less footwear	1.00082806932476
SAA	Apparel	1.00046429995875
SAA2	Women's and girls' apparel	0.99830926603719
SAC	Commodities	0.99971844608330
SACE	Energy commodities	1.00049021139203
SACL1	Commodities less food	0.99896306607373
SACL11	Commodities less food and beverages	1.00065887489629
SACL1E	Commodities less food and energy commodities	0.99950036434787
SAF	Food and beverages	0.99896327975145
SAF1	Food	0.99914464838781
SAF11	Food at home	0.99957910152453
SAF112	Meats, poultry, fish, and eggs	1.00032954489545
SAF1121	Meats, poultry, and fish	1.00024319048413
SAF11211	Meats	1.00070449887252
SAF113	Fruits and vegetables	0.99765340605007
SAF1131	Fresh fruits and vegetables	0.99232814442297
SAF115	Other food at home	1.00065445411741
SAG	Other goods and services	0.99812850299715
SAH	Housing	1.00112851501844
SAH1	Shelter	1.00072786448314
SAH2	Fuels and utilities	1.00106064678852
SAH21	Fuels	1.00825918692716
SAH3	Household furnishings and operations	1.00066000976400
SAM	Medical care	0.99950521056747
SAS	Services	1.00002220193720
SAS367	Other services	0.99759052510255
SAS4	Transportation services	1.00003146958059
SASLE	Services less energy services	0.99855912477519
SAT	Transportation	1.00006820851772
SAT1	Private transportation	0.99955073963680
SEAC	Women's apparel	0.99824205799826
SEFK	Fresh fruits	1.00096742067240
SEHF	Gas (piped) and electricity	1.00660608543668

[i] Both the aggregation weight (aggwt) and the seasonal aggregation weight (saggwt) are constants. Aggwt is based on expenditure data and is constant once calculated; saggwt is dependent on the pivot month

seasonally adjusted index, and is constant once that index has been declared final. (December 1986 seasonally adjusted indexes were final in February 1991.)

$$SIX_{I,t,saggwt} = \frac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{saggwt_{I,p}}$$

$$SIX_{I,t,aggwt} = \frac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{aggwt_{I,p}}$$

$$\frac{SIX_{I,t,aggwt}}{SIX_{I,t,saggwt}} = \frac{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})}{aggwt_{I,p}} * \frac{saggwt_{I,p}}{\sum_{i \in I} (aggwt_{i,p} * SIX_{i,t})} = \frac{saggwt_{I,p}}{aggwt_{I,p}}$$

$$SIX_{I,t,aggwt} = SIX_{I,t,saggwt} * \frac{saggwt_{I,p}}{aggwt_{I,p}}$$